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A Comprehensive Review Of Asset Pricing Models In Finance

Ramsundar G*[1], Radha D[2]
[1*]Department of Computer Science & Engineering, Amrita School of Computing, Bengaluru, Amrita Vishwa Vidyapeetham, India.
[2]Department of Computer Science & Engineering, Amrita School of Computing, Bengaluru, Amrita Vishwa Vidyapeetham, India

ABSTRACT

This paper critically reviews some popular asset pricing models in finance with an emphasis on the Capital Asset Pricing Model (CAPM) and multi-factor models, including the Fama-French (FF) models. Asset pricing models represent a significant issue in financial research that deals with explaining the expected excess returns of a stock using various market variables. Being one of the early models, CAPM focuses on the relationship between risk and return; therefore, it has provided useful insights into how the market prices systematic risks. However, because of its assumptions and limitations-such as reliance on a single risk factor-sophisticated multifactor models are being developed. While CAPM was important in the development of asset pricing theory, FF models introduce other factors that include size, value, and profitability. The focus is to better capture stock returns variability and bring more power to the theories of asset pricing. This critical study is needed to highlight flaws and strengths, validity, and applicability in today's financial markets. The review will present a balanced view of the performances of such models under different market conditions and also would help investors and researchers to understand more realistically their implications for asset pricing as well as investment decisions.

Keywords: *Asset Pricing Models, CAPM, Fama-French Models, Stock Returns, Market Variables, Financial Modelling, Multi-Factor Models*

1.INTRODUCTION

Extensive and very comprehensive work has been done in the field of asset pricing and its implications (Kuehn *et al*., 2017) [48]. Asset pricing refers to the revaluation of stock price (for stocks) or the value of future assets under certain conditions (Fama & French, 1988) [22]. Asset pricing is the core element of modern finance and asset pricing has always been one of the hotspots of financial research (Edmans, 2011) [18]. As part of the modern Investment Research industry, asset valuation plays a very critical role in the Merger & Acquisition, Reorganization, and listing process (Dutta, 2019) [17].

The traditional and the most popular asset pricing models such as CAPM and FF have analyzed and incorporated variables that affect the stock price which include simple/multiple Linear regression [7] [40] [47] (Iqbal *et al*., 2017; Belo *et al*., 2017; Kothari & Shanken, 1997), Given the volume, velocity, and variety of data which has much more noise than signals, traditional asset pricing models are ineffective for analyzing the complex, high-dimensional, and noisy financial market data series (Hassan & Javed, 2011; Mayers, 1972; Basu, 1983) [33][6] [54].

Asset pricing is one of the central concepts in modern finance and forms the backbone of investment decisions, market valuations, and financial research (Khan *et al*., 2022) [44]. Asset pricing either involves the revaluation of stock prices or is an evaluation of the future value the asset would take for given conditions [42] (Jegadeesh & Titman, 1993). As will be described later, asset pricing cuts across many financial activities, such as mergers and acquisitions, corporate reorganizations, and public listings where accurate valuation is paramount in making decisions (Jagannathan & Wang, 1998) [41]. Many studies have been conducted over the years in this area and several models have been developed aimed at explaining and predicting asset prices. Such models include the constant correlation model among others (Crook *et al*., 2011) [15]. The main purpose of pricing asset models is, therefore, the quantification of expected returns of assets by integrating various risk factors into consideration to enable investors to make informed choices regarding their respective portfolios. According to Markowitz (1952) [52], below is a critical review that gives an overview of the traditional and modern asset pricing model, with specific attention to the CAPM and multi-factor FF models, which have monopolized finance research and practice since the work of Fama and Schwert (1977) [27].

Probably the most recognized and implemented model is CAPM, which was developed by William Sharpe back in 1991. The CAPM changed within this field when it introduced a systematic way of measuring risk and its relation to expected returns (Maiti & Vuković, 2020) [51]. It has become the cornerstone of modern asset pricing theory (Huynh, 2018) [39]. CAPM postulates that the expected return of an asset is determined through its sensitivity to market risk, depicted by one factor: the premium on the market (Bontis, 2003) [9]. The model assumes a linear relationship in which an asset's return and its risk are positively related. Mainly, the model is considering that investors are compensated only for the bearing of systematic, non-diversifiable risks (Campbell, 1996) [10]. Whereas the simplicity of CAPM has been an advantage in its wide application, it is equally its limitation (Charles *et al*., 2016). The framework is straightforward and thus easy to understand, but it depends on one risk factor, which itself cannot capture the full complexity of real-world financial markets, where often multiple risk factors influence asset returns (Frazzini & Pedersen, 2014) [31].

Limitations of the CAPM promoted the development of more sophisticated multifactor models, the most important among these have been FF models (Nugraha et al., 2022). An extended version of the CAPM, a three-factor model developed in 1993 by Eugene Fama and Kenneth French, known as the Fama-French three-factor model, called FF3M, included two new risk factors besides size and value in addition to the market risk factor from the CAPM (Iqbal *et al*., 2017) [40]. These factors capture the for small-cap stocks to outperform large-cap stocks and value stocks-those with high book-to-market ratios-outperform growth stocks. As noted by (Bhandari 1988) [8], given these factors in the specification allowed for a more articulate view of asset returns reflecting the empirical evidence that other variables beyond market risk significantly affect returns (Kim *et al*., 2011) [45]. In 2015, Fama and French [25] extended their model to the five-factor model, now called the FF5M, and included additional factors of profitability and investment (Huynh, 2018) [39]. These additional factors capture the performance variation of firms due to their profitability and asset growth rates, thereby making a more complete framework in asset pricing. These FF factor models have been fundamental in developing knowledge about cross-sectional variation in the returns of assets and providing more reliable measures with which investors and researchers could better assess risk and make decisions on their investments (Fama & MacBeth, 1973) [20].

Despite various developments, traditional asset pricing models, like CAPM and the FF models, have considerable limitations when applied to today's complex and high-dimensional financial markets (Horváth & Wang, 2021) [34]. The introduction of big data-particularly in aspects of volume, velocity, and a variety of new complexities for which traditional models are not well suited. Financial data are becoming noisier, as there are many more signals to decipher and much more data to process than ever before (Kothari & Shanken, 1997) [47]. Linear models, such as those followed by CAPM and the FF models, often cannot explain the intricacies of financial markets of today, in which, more often than not, the relationships between variables are nonlinear and may be affected by many different factors (Fama & French 2016) [21]. Besides, the incapability of these models to incorporate market anomalies and behavioral factors may substantially affect asset prices. Due to this limitation, their effectiveness in real scenarios concerning the exact return prediction is small (Khan *et al*., 2022) [44].

While financial markets continue to evolve, the demand for advanced asset pricing models intensifies, including requirements for complexity handling: high-frequency data, market anomalies, and dynamic risk factors (Belo *et al*., 2017) [7]. Traditional model limitations in these areas open promising avenues with new approaches related to machine learning (ML) and artificial intelligence (AI) (Asness *et al*., 2013) [59]. These technologies allow for the analysis of large data sets, the identification of patterns within noisy data, and an improvement in the accuracy of predictions. The researchers and practitioners utilize advanced computational techniques to develop superior models depicting the financial markets and, therefore, the multidimensional nature of asset pricing (Ali, 2022) [60]. The current review makes an effort to capture the latest state of the asset pricing models by critically looking into their strengths, limitations, and applicability; it is also important to note that unrelenting innovation should occur in this area since it is quite vital in the field of finance. This paper will present significant insight into the development of asset pricing models and the role they are playing in shaping financial decision-making using a detailed study of traditional and modern approaches.

2.RESEARCH QUESTION AND SEARCH STRATEGY

2.1Research Question(s)

The following research questions are investigated and addressed:

1. What are the variables used in the studies?
2. What are the types of Asset Pricing Models and their findings covered in the studies?
3. Where were the studies conducted geographically?
4. What are the research gaps and directions for future research that can be identified through a systematic literature review?

2.2Search Strategy

The search strategy for this comprehensive review in finance focuses deep into the Scopus database as the basis of a wide-ranging review. Being one of the most highly indexed databases for high-quality research articles, journals, and conference proceedings in finance, the selection of Scopus has been prompted by the comprehensiveness of its coverage, hence ensuring that the dataset concerning asset pricing models is broad and relevant. The search was conducted using a strategic combination of keywords and phrases to capture all relevant research. Key search terms included "Asset Pricing Models," "Capital Asset Pricing Model (CAPM)," "Fama-French Model," "Multi-Factor Asset Pricing," and "Stock Returns." Boolean operators (AND, OR) were used to refine the search results, ensuring that the literature covered a range of topics from traditional models like CAPM to more advanced multi-factor models.

2.3Inclusion and Exclusion Criteria

This systematic literature review (SLR) on asset pricing models was conducted in a very critical manner to ensure that studies that fulfill the inclusion criteria by being published within the periods of 1952 to 2022, on CAPM and multi-factor models, and in English were to be included. Undetailed, incomplete, non-peer-reviewed, and redundant articles would not be included according to the Prisma Guidelines. A comprehensive explanation of these criteria may be found in Table 1.

Table 1: Inclusion and Exclusion Criteria

Criteria	**Description**
Inclusion Criteria	
The focus of the Study	Includes research examining the validity, performance, and applicability of asset pricing models, specifically CAPM, FF models, and other multi-factor models.
Scope of Analysis	Studies that provide empirical testing, evaluation, or comparison of asset pricing models under different market conditions
Valuable Insights	Provide insights into the performance and relevance of these models in diverse financial markets, including emerging markets.
Relevance to Financial Markets	Papers that discuss the impact of these models on investment decisions, stock returns, and market behavior.
Publication Language	Published in English.
Publication Time Frame	Studies published between 1952 to 2022.
Type of Publications	Only studies indexed in the Scopus database, including peer-reviewed journal articles, conference

	proceedings, and high-quality academic studies related to asset pricing models.
Geographic Relevance	Research covering major financial markets, including developed and emerging markets.
Exclusion Criteria	
Irrelevant Focus	Excluding studies that do not exclusively deal with asset pricing models or focus on unrelated financial theories.
Broad Financial Studies	Excludes studies that relate to general financial markets, but do not focus on asset pricing.
Insufficient Methodological Detail	Poor data, low-quality studies, or studies where comprehensive model analysis is missing.
Language Limitation	Non-English publications.
Non-Peer-Reviewed Sources	Excludes non-academic reports, panel discussions, and unverified presentations.
Duplicate Findings	Excludes redundant studies where similar findings are already comprehensively covered.
Specific Exclusions	Excludes studies that do not test models in financial markets or lack empirical evidence.

2.4Selection of Articles:

The Scopus database includes targeted keywords and different search terms are combined. These include "Asset Pricing," "Single Factor Asset Pricing", and "Multi-Factor Asset Pricing, Research studies published until 2022 were only reviewed and evaluated, and after that duplicate publications were excluded, followed by the elimination of studies based on non-relevant titles and abstracts. Figure 1 depicts the screening process of the research papers.

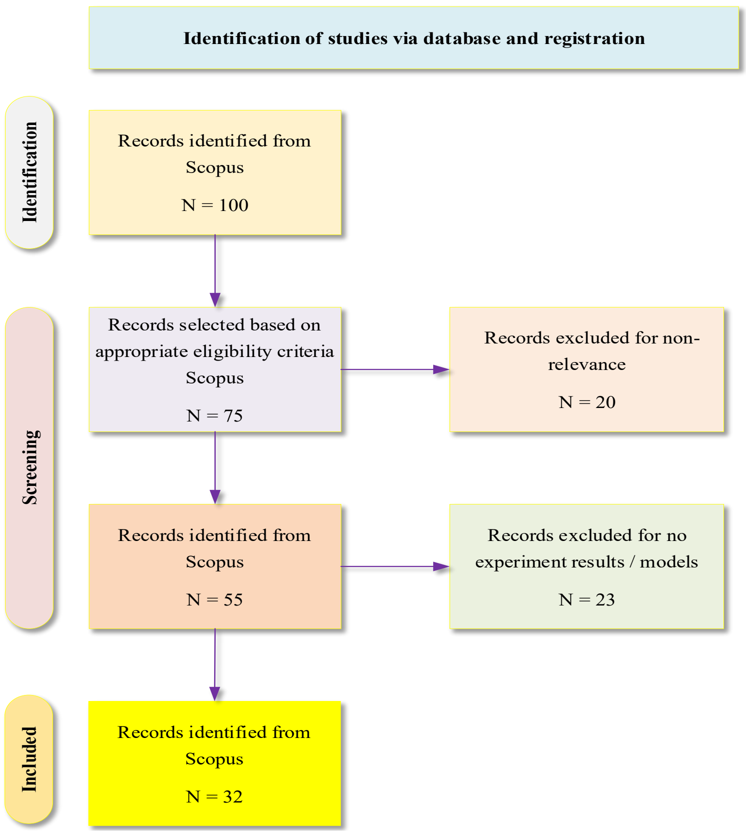

Figure 1: Flowchart of Study Selection and Screening Process

2.5Quality assessment

This systematic literature review adheres to the PRISMA guidelines to evaluate the effectiveness and relevance of asset pricing models in finance, with a focus on the CAPM and multi-factor models. Out of 100 initially identified records from Scopus, 75 were selected based on eligibility criteria. Further screening revealed 55 relevant records, from which only 32 finally met the inclusion criteria for the final analysis. The quality of these studies, regarding the research design, relevance of methodology, and topical relevance, is assessed in the following Table 2.

Table 2: Data quality analysis

Data quality	Methodology quality	Methodology relevance	Topic relevance
Excellent	Comprehensive research design with robust data and results.	The methodology is perfectly aligned with the research topic and goals.	The study fully aligns with the topic, providing strong evidence for future research.
Good	Clear research design with meaningful outcomes.	The research question is well-defined and matches the study's outcome.	The study is relevant and offers valuable insights for the review.
Satisfactory	Adequate research design, though limited	The research question is unclear but still aligns with the study's outcome	The study partially matches the topic but provides useful insights.
Inadequate	Flawed research design or insufficient data.	The methodology lacks relevance to the research topic.	The study does not align with the topic and offers limited value.

3.RESEARCH FINDINGS

The following section collects and compares the analysis for year-wise published articles from 1952 to 2022. Even the trend in publications during this period brings substantial insight into the focus developed on asset pricing models in finance. The upward trend in the publications shows the interest of more in seeking to understand the financial markets and developing models to seize better risks and returns of assets. Over time, these have evolved from basic theories of [52] Markowitz's portfolio selection, 1952, and Sharpe's CAPM, 1965, to more advanced multifactor models, such as the FF models in 1993 and 2015. It would, therefore, imply that with time, there is a refinement of asset pricing theories that move from basic to comprehensive models that explain market anomalies. the methodologies vary from empirical tests to case studies and theoretical modeling. This also the varying contribution of different regions within this emergent body of literature, with substantial research output emanating from developed and emerging markets, which reflects the variety in market structure and factors affecting asset pricing. These trends in perspective the improvement in the understanding of how the asset pricing models evolved and are applied both academically and in practice.

Table 3 reflects the publication trends of articles between 1952 and 2022. There was only one published article for the early years of 1952, 1965, 1966, and then a few subsequent years. The publications started rising reasonably in 1977, with three articles published that year. Until the early 1990s, these publications again became erratic, with publications of just one or two in particular years. However, from four articles in 2011, this has risen rapidly since 2015, reaching its height of eight articles on asset pricing models in the year 2022, to show that there has been a greater interest in more recent years.

This sets a pattern that although the foundational theories in asset pricing models were set in the mid-20th century, the actual research and development occurred post-2010. This evidence increased work published as a result of increased complexity in financial markets and the requirement for advanced models to understand market behavior. The tendency also underlines the evolutionary nature of the field in the sense that more recent models attempted to make up for the drawbacks of the earlier frameworks like the CAPM. **Table 3.** gives a bright reflection of how dynamic shifting occurred in research output for seven decades.

Table 3. provides a detailed breakdown of the year-wise publication trends from 1952 to 2022.

Year	No. of Articles
1952	1
1965	1
1966	1
1970	1
1972	1
1973	1
1977	3
1981	1
1983	1
1985	1
1988	2
1991	1
1992	1
1993	2
1996	1
1997	1
1998	1
2003	1
2010	1
2011	4
2013	1
2014	1
2015	2
2016	3
2017	7
2018	3
2019	3
2020	3
2021	2
2022	8

3.1Overview of this research

3.1.1Traditional Asset Pricing Models

The traditional asset pricing models, such as the CAPM, are set up to associate risk and return, anchored on a single market risk factor to explain asset returns. Simple, it gave an elementary understanding of risk. However, CAPM is mostly criticized because of its inability to allow for the presence of more than one risk factor that can influence the prices of assets.

3.1.1.1Capital Asset Pricing Model (CAPM)

In 1991, William Sharpe developed the CAPM, which is one of the cornerstones of finance and asset pricing. It reflects a great breakthrough in understanding the relationship between risk and return of assets. CAPM postulates that the return of a risky asset can be related to its sensitivity to the overall market represented by a single risk factor called the market premium. The core formula of the model is expressed in equation (1).

$$Rit-Rft=\alpha+bi(MKTt)+ei \quad (1)$$

where Rit represents the excess return of the asset, Rft is the risk-free rate, bi is the asset's sensitivity to the market (beta), $MKTt$is the market premium, and ei is the error term. CAPM assumes a linear relationship between an asset's risk and return, suggesting that investors are compensated only for bearing systematic, non-diversifiable risk. This model became the cornerstone of modern finance by providing a systematic approach to linking risk and expected return, which had profound implications for investment decisions.

The early research on CAPM was done by Sharpe (1991) [58], Lintner (1965), [50] and Mossin (1966), [56] which readily got accepted by investors due to its simple but robust layout for the analysis of risk-return trade-off. Thus, investors started using it in most of the financial decisions such as portfolio management, asset pricing, and capital budgeting. Initially popular, over time, CAPM received serious criticisms. Researchers such as Basu (1977) [5], Ross (1976), Banz (1981) [4], and Acaravci and Karaomer (2017) [1] accordingly expressed some doubts about the model's efficiency and its validity in correctly representing the complexities of financial markets. Fama (1970) [19] was one of the early critics who pointed out the inherent limitations of CAPM, particularly its inability to quantify expected returns adequately using only the market risk factor. Fama demonstrated that the model's predictive power was limited because it could not account for other factors influencing returns, such as company size, book-to-market ratios, or market anomalies. This shortcoming highlighted CAPM's failure to capture the full spectrum of risks affecting asset prices, which led to the development of alternative models that incorporated additional risk factors.

Follow-up studies, such as Ross (1976), for instance, did Arbitrage Pricing Theory (APT). The latter attempts to relax these limitations by providing a model framework that allows multiple risk factors. Under APT, it was possible to have several economic variables, such as GDP growth, inflation, and dividend yield, which were significant in explaining asset returns. With these developments, however, the assumptions of simplicity that CAPM made have proved to be a strength as much as a weakness. If its transparent, intuitively appealing structure made it widely usable, that very transparency also rendered the model vulnerable to criticism for inadequate consideration of the diversity and dynamism of risk in financial markets. Basu (1977) [5] and Rosenberg et al. (1985) further questioned CAPM’s assumptions, arguing that its reliance on a single beta factor is insufficient to explain the variability in stock returns. They suggested that other factors, such as earnings yield, price-to-book ratios, and momentum, could significantly impact asset pricing beyond what CAPM could capture. They also found that there was indeed a positive association between book-to-market ratios and stock returns, which had not been captured by the CAPM. Meanwhile, DeBondt and Thaler (1985) did report such an association. Banz (1981) [4] stated the "size effect": the fact that smaller firms have higher risk-adjusted returns compared with larger firms. Both findings were damaging to the validity of CAPM.

3.1.1.2 Arbitrage Pricing Theory (APT)

APT was independently developed by Stephen Ross in 1976 as a theoretical alternative to CAPM. Unlike the CAPM, relying on the single factor of market risk, APT can be considered a multifactor model explaining asset returns. It follows that the approach represents an adaptable framework behind the complexities of asset pricing. The fundamental equation of APT is given in equation (2).

$$E(ri) = Rf + \beta 1 * Rp1 + \beta 2 * Rp2 + \cdots + (\beta n * Rpn)) \quad (2)$$

where E(ri) is the expected return of the asset, Rf is the risk-free rate, and β represents the sensitivity of the asset to each risk factor Rp. APT does not specify the exact factors but allows them to be determined empirically, offering flexibility in capturing a range of economic variables influencing returns.

Ross, (1976) stated that asset returns depend on variants of macroeconomic attributes like GDP growth, inflation, and dividend yield. Further, these have been questioned and even decried by, among other researchers, Florensia & Susanti 2020 [29], who have shown that most of these risk factors are neither always reliable nor observable in all markets. Rosenberg et al. (1985) supported the need for models like APT, arguing that CAPM’s reliance on a single market risk factor was insufficient for explaining the variation in stock returns. They concluded that a multi-factor approach, such as APT, was necessary to capture the diverse influences on asset pricing, reflecting the complex realities of financial markets. APT’s emphasis on multiple factors provided a significant advancement, addressing the limitations of traditional single-factor models like CAPM and offering a broader perspective on the determinants of asset returns.

3.1.2 Development of Multi-Factor Models

This development of multi-factor models, an extension of the traditional asset pricing frameworks, was pushed forward by the inclusion of other risk factors, such as size, value, profitability, and the so-called FF factors. These models were intended to provide broader explanations of asset returns that are usually not possible through single-factor models, such as CAPM, to capture market complexities.

3.1.2.1 Fama-French Three-Factor Model (FF3M)

Perhaps the most important extension of the traditional CAPM in the asset pricing literature has been the FF3M, named after its developers Eugene Fama and Kenneth French in 1993. The model adds two additional factors to the market factor (small-minus-big, SMB) and value (high-minus-low, HML)-in an attempt to capture some nuances in stock returns. In this regard, the core equation of the FF3M is presented in equation (3).

$$Rit-Rft=\alpha+bi(MKTt)+si(SMBt)+hi(HMLt)+eit \quad (3)$$

where Rit is the excess return of the asset, Rft is the risk-free rate, $MKTt$ represents the market premium, $SMBt$ accounts for the size premium, $HMLt$ captures the value premium, and eite_{it}eit is the error term. This model addresses CAPM's limitations by adding size and value factors, which account for the empirical observation that small-cap stocks often outperform large-cap stocks and that value stocks (those with high book-to-market ratios) tend to outperform growth stocks.

Fama and French (1993) [24] have demonstrated that adding the size and value factors represents an improvement of CAPM in explaining stock returns, hence making FF3M one of the accepted models in empirical finance. However, further studies such as Carhart (1997) [11] have recognized limitations in FF3M and argued that the model still could not explain variations in expected stock returns fully. Carhart extended the FF3M including a momentum factor, reflecting the tendency of high-return stocks in the past to continue performing well over a short period. This extension brought out that with even three factors, some dynamics of asset returns were not fully represented and hinted at the evolving character of the asset pricing models.

Other empirical performance evaluations of the FF3M have also pointed out some relative strengths and weaknesses in different capital markets. The study by Martinsa and Eid (2015) [53] addressed the performance of both FF3M and the Fama-French Five-Factor Model in the pricing of the Brazilian stock market. Their findings showed that the FF5M outperformed FF3M, therefore suggesting that the factors of profitability and investment increased the explanatory power of the model. Martinsa and Eid documented that while the market premium (MKT), size premium (SMB), and value premium (HML) in FF3M were significant in explaining variations in excess returns, the profitability (RMW) and investment (CMA) factors introduced in FF5M captured more dimensions of asset pricing that FF3M missed.

Chiah et al. (2016) [13] also compared the performance of FF3M and FF5M in the Australian market, showing that profitability and investment factors positively and significantly influenced stock returns. The results of their study verified that FF5M outperforms FF3M in describing the variation of asset returns, thus supporting the fact that the two additional factors provide a more robust model framework for explaining stock performance. Although FF5M improved matters, FF3M has remained one of the foundational models in finance due to the ease with which it shows, and the important insight it offers in return with relation to the size and value effects.

3.1.2.2 Fama-French Five-Factor Model (FF5M)

The FF5M, by Eugene Fama and Kenneth French (2015) [25], was an extension of their Three-Factor Model, FF3M, through the introduction of two additional factors: profitability, robust-minus-weak, RMW, and investment, conservative-minus-aggressive, CMA. The inclusion of these factors aims to pick up other dimensions of asset pricing, hence further overcoming some shortcomings of the FF3M. The formula for FF5M is given in equation (4).

$$Rit-Rft=\alpha+bi(MKTt)+si(SMBt)+hi(HMLt)+ri(RMWt)+ci(CMAt)+eit \quad (4)$$

where Rit represents the excess return of portfolio i for the month t, Rft is the risk-free rate, $MKTt$ is the market premium, $SMBt$ is the size factor (small-minus-big), $HMLt$ is the value factor (high-minus-low), $RMWt$ is the profitability factor, $CMAt$ is the investment factor, and eit is the error term. The profitability factor captures the performance of stocks with high operating profitability compared to those with lower profitability, while the investment factor distinguishes between companies that invest conservatively versus those that are more aggressive in their asset growth.

Fama and French, (2015) [25] included the two additional factors in consideration of empirical evidence pointing to the fact that conventional factors could not explain the variation of return on stocks. This is demonstrated by their tests in developed markets. FF5M outperformed FF3M while describing asset returns since the new factors especially capture the effects of profitability and investment decisions on the performance of stocks. This ability of the FF5M to incorporate these new factors generated an even broader perspective on the market that had become instrumental for investors focused on drivers of stock returns other than the market, size, and value factors.

Using the Australian market, Chiah *et al.* (2016) [13] tested the FF5M against the FF3M and found that both the added factors of profitability and investment have positive significant impacts on stock returns. The authors concluded that the FF5M outperforms the FF3M in describing variation in asset returns, emphasizing the importance of added risk factors to model larger market-wide movements. Nevertheless, the efficiency of FF5M is not without criticism. Huynh (2018) [39] conducted the GRS test on FF3M and FF5M; the results obtained for the FF models were unsatisfactory, hence the ongoing need to find better asset pricing models. This supports the argument that, whereas FF5M had improved on previously developed models, it still grapples to incorporate all the anomalies existing in financial markets.

Dutta (2019) [17] also identified some shortcomings of the FF5M, including that it failed to identify long-term anomalies. The study showed that while the model performs better than FF3M in many aspects, it still lags when it comes to wide anomalies that affect asset return over a longer time. The inability to fully accommodate these anomalies implies that additional factors or alternative modeling approaches may be necessary to enhance the predictive power of asset pricing models.

Despite these critiques, the FF5M remains one remarkable step forward in asset pricing studies, offering a more detailed framework that includes factors representative of the quality of firms' operations and their investment policy. The inclusion of profitability and investment factors widens the perspective on the risk-return relationship and makes the approach to asset valuation more subtle, taking into consideration some different components driving stocks. In such a continuously developing financial environment, the FF5M is the first real step toward better models that better reflect the rich complexity of financial markets and challenge academics and practitioners alike with constant updates in their asset-pricing theories.

3.2 Contemporary Extensions and Alternative Models

3.2.1 Fama-French Six-Factor Model and Other Extensions

Fama and French (2018) [26] developed two new models, namely the FF6OP and the FF6CP, each being an extension of their five-factor model to take into account further dimensions in asset pricing. These two six-factor models introduced some new factors that would further trigger an improvement in predictive power in the variations of operating profitability and cash profitability, respectively. The performances of the FF6 models were then evaluated based on the maximum squared Sharpe ratio, which is a measure of return performance relative to risk. Their findings indicated that the other new six-factor model, FF6CP, in particular, was the best performer among the models considered and had successfully picked up some sophisticated aspects of asset pricing that the other models had failed to capture. Chai et al. (2019) [12] conducted empirical tests of both the FF5FM and the FF6CP for the United States and Australian markets. Their study confirmed that the alternative six-factor model was better fitted for both the United States and Australian markets in explaining variations in asset returns not fully explained by its five-factor. This supported the notion that operating and cash profitability factors added much to the explanatory power of the model. This made the FF6CP robust and versatile in stock performance analysis across various financial environments. These developments reflect the ongoing search for an asset pricing model that properly captures the increasing complications of today's markets.

3.2.2The Q-Factor Model and Other Alternatives

Hou et al. (2017) [35] presented the q-factor model as an extension of the Fama-French Three-Factor Model (FF3FM) by including one factor to capture those anomalies that the traditional models of factors had failed to explain. The q-factor model also consists of market, size, investment, and profitability variables to cover the gaps in previous models. Hou et al. found that the q-factor model was successful in accommodating some market anomalies, particularly those related to investment and profitability, which were often overlooked by other models like FF3FM. The q-factor's inclusion of these additional factors provided a more comprehensive approach to understanding variations in stock returns, especially in complex market conditions. Further, Stambaugh and Yuan 2017 evaluated the performance of the q-factor model against FF3FM, FF5FM, and some other well-known models in a rather special environment of horse racing-related anomalies. Indeed, their results demonstrated that the q-factor model performs much better than all others and is more precise and powerful in capturing the return associated with particular market anomalies.

This study emphasized the flexibility and robustness of the q-factor model as a competitive alternative to traditional FF models, especially in those situations where traditional factors could not explain dynamics in asset pricing. In another related work, Hou *et al*. (2019) [37] evaluated various models, including the q-factor model, the mispricing model by Stambaugh and Yuan (2017), and the Fama-French five- and six-factor models developed between 2015 and 2018, in the U.S. market. Their findings confirmed that the q-factor model was more effective than competing models, particularly in terms of the subsuming factor, which measures the model's ability to incorporate and explain additional variations in returns. This effectiveness underscores the q-factor model's capacity to provide a more nuanced and detailed understanding of asset returns compared to more traditional multi-factor models, thereby establishing its relevance in contemporary asset pricing research. The consistent performance of the q-factor model across different contexts and comparisons reinforces its significance as an advanced tool for addressing the complexities of modern financial markets.

Taking all these points together, one can see that the applicability of the five-factor model appears to be limited and continues to be challenged on a wide basis. One must question the notion at this point that the five-factor model constitutes a robust and fully reliable improvement to the currently available multi-factor asset-pricing models. **Table 4.** shows the structural empirical review of Asset Pricing Models

Table 4: Structural Empirical Review of Asset Pricing Models

Reference	Research Question	Model	Market	Estimation Techniques	Conclusion
Sharpe (1991) [58]	Can a stock's excess return be explained by a single Market Risk factor?	CAPM	U. S	OLS Regression	Findings suggest that there is a positive relationship between a stock's excess return and the market risk factor
Sharpe (1991), [58], [50] Lintner (1965) & Mossin, (1966) [56]	Does a single factor (Market Risk) explain the stock's returns?	CAPM	U. S	OLS Regression	Results show that the variability of the stock returns can be explained by the market risk factor alone.

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Fama, (1970) [19]	How does CAPM perform?	CAPM	U. S	OLS Regression	Findings confirm that CAPM's drawback is not able to quantify expected returns about a single risk factor
Ross, (1976)	How does APT perform?	APT	U. S	OLS Regression	Results show that some unknown factors affect the stock returns. But, it is silent on those factors
Basu, (1977) [5]	How does CAPM perform?	CAPM	U. S	OLS Regression	price-earnings ratios should be considered in an asset-pricing mode
Banz, (1981) [4]	How does CAPM perform?	CAPM	U. S	OLS Regression	Results show that CAPM ignored the size effect as it failed to explain the higher risk-adjusted returns for small stocks
Rosenberg *et al.* (1985)	How CAPM performs?	CAPM	U. S	OLS Regression	Single variables like market risk are inadequate to explain the stock's return variation
Debondt & Thaler, (1985)	what is the relationship between Book to Market ratio with stock return?	CAPM + Book to-market ratio	U. S	OLS Regression	Results show that positive relationship between book-to-market ratio and stock return
Fama & French, (1992) [23]	what is the relation of size and book-to-market equity with stock returns?	CAPM + size, leverage, price-to-earnings (P-E) ratio and book-to-market ratio	U. S	OLS Regression	Size and book-to-market equity capture the cross-sectional variation in average stock returns associated with size, E/P, book-to-market equity, and leverage.
Fama & French, (1993) [24]	What are the relevant factors that affect a stock's return?	CAPM model with two prominent factors (Size and Value)	U. S	OLS Regression	value stocks tend to outperform growth stocks, and that small-cap stocks outperform large-cap stocks.
Carhart (1997) [11]	Does the impact of the Momentum factor explain the deviation of the returns	FF3FM +Momentum	U. S	OLS Regression	Additional factor Momentum does not add significant explanatory power to the analysis.

	produced by FF3FM?				
Fama & French, (2015) [25]	How do profitability and Investment factors based on FF3FM perform?	FF5FM	U. S	OLS Regression	stocks with high operating profitability perform better) and investment (stocks of companies with high total asset growth have below-average returns)
Martinsa & Eid, (2015) [53]	How do FF3FM and FF5FM perform?	FF3FM and FF5FM	Brazilian	OLS Regression	Findings conclude that the FF5FM outperforms the FF3FM
Chiah *et al.* (2016) [13]	Which model is better to estimate the expected returns?	FF3FM and FF5FM	Australian	OLS Regression	FF5FM outperforms the FF3FM for capturing the variation in asset returns.
Acaravci & Karaomer, (2017) [1]	How does CAPM perform?	CAPM	U. S	OLS Regression	Evidence indicates that a single factor can't explain the market returns
Chowdhury (2017) [14]	How FF3FM performs?	FF3FM	Bangladesh	OLS Regression	FF3FM is less explanatory for explaining stock returns in the Bangladesh stock market
Jiao & Lilti, (2017) [43]	Which model is better to estimate the expected returns?	FF3FM and FF5FM	Chinese	OLS Regression	Two factors added in FF5FM (RMW (profitability) and CMA (investment premium)) do not capture more variation than the FF3FM in asset returns
Fama & French, (2018) [26]	what is model relation model equity with performance metrics?	Alternative six-factor model	U. S	OLS Regression	Alternative six-factor model in the US market and found that the model performs well under all performance metrics
Fama & French, (2018) [26]	Does the impact of the Momentum factor explain the deviation of the returns	FF5FM +Momentum	U. S	OLS Regression	Additional factor Momentum does not add significant explanatory power to the analysis.

	produced by Fama French five factor model?				
Fletcher (2018) [28]	Which model is better to estimate the expected returns?	FF5FM and FF6FM.	U. K	OLS Regression	FF6FM is the foremost model for explaining variation in expected stock return
Chai *et al.* (2019) [12]	Which model is better to estimate the expected returns?	FF5FM and FF6CP (alternative six-factor model)	U.S & Australia	OLS Regression	FF5FM and FF6CP (alternative six-factor model) in US and Australian markets. This study found that the alternative six-factor model is suitable for both markets.
Sadhwani *et al.* (2019)	Does the FF5FM model perform better than FF3FM model?	FF3FM and FF5FM	Pakistan	OLS Regression	Research demonstrated that the FF5FM outperforms the FF3FM and better explains the variability
Florensia & Susanti, (2020) [29]	How CAPM performs?	CAPM	U. S	OLS Regression	Findings suggest that it is very difficult to determine the factors that impact the stock returns
Haqqani and Aleem (2020)	what is that relation factor equity with performed efficiently?	Augmented liquidity six-factor model	Pakistan	OLS Regression	The authors documented that the six-factor model performed efficiently
Paliienko *et al.* (2020)	Does the FF5FM model perform better than FF3FM model?	FF3FM and FF5FM	U. S	OLS Regression	FF5FM better explained the variation in excess portfolio return compared to other asset pricing models
Foye & Valentinci, (2020) [30]	Does the FF5FM model perform better than the FF3FM model?	FF5FM, FF3FM	Indonesia	OLS Regression	FF5FM more significantly captured variability in stock return than FF3FM
Mosoeu & Kodongo, (2020) [55]	How FF5FM performs?	FF5FM	Emerging markets	OLS Regression	It is concluded that profitability is one of the most useful factors in emerging equity.

Ali *et al.* (2021) [3]	Which model is better to estimate the expected returns?	CAPM, FF3FM, FF5FM and FF6FM (including the momentum factor)	Pakistan	OLS Regression	FF5FM significantly explained more variation in excess portfolio returns than alternative asset pricing models
Li and Duan (2021) [49]	Which model is better to estimate the expected returns?	FF3FM and FF5FM	U. S	OLS Regression	FF5FM displayed a substantial increase and showed greater efficiency during the epidemic
Kostin *et al.* (2022) [46]	Does the FF5FM model perform better than the FF3FM model?	FF3FM, FF5FM	Developed markets	OLS Regression	FF5FM does not outperform in developed markets
Hua (2022) [38]	Which model is better to estimate the expected returns?	FF3FM, C4FM, Novy–Marx 4FM, FF5FM and Hou–Xue–Zhang 4F-model	Chinese Market	OLS Regression	FF5FM was insufficient for explaining better variation in asset return for the SME board
Akhtar *et al.* (2022) [2]	Does the FF5FM model perform better than the FF3FM model?	FF3FM, FF5FM	Indian Market	OLS Regression	FF3FM has more favorable characteristics for explaining variation in asset return

4.IDENTIFIED RESEARCH GAP

Based on a comprehensive analysis of articles, the most critical research gaps should be addressed in future studies. **Table 5.** Shows the research gaps

Table 5. Identified research gaps.

Perspective	Identified Gaps	Suggestions for Future Research
Spatial Interconnections	No mechanisms are employed to capture the spatial interconnections among similar assets.	Future studies should utilize Graphical Neural Networks to model the intricate relationship between similar assets
Sample types	Small and micro-cap securities are not included in the samples	Sample types should be expanded to include more small and micro-cap companies.
Type of Data	No factors are constructed based on text or other types of instructed data	A multimodal data set should be included
Researched technologies	Lack of adoption of advanced technologies	It is recommended that researchers apply AI Augmented models for factor selection and handling high dimensional variables.
Research Markets	Insufficient research from developing economies and emerging markets	It was suggested that research be conducted context of developing and emerging economies

5.LIMITATION

The database search was performed until the end of Q3 2022. Therefore, articles that were indexed after this date may not be included in our review. As the scope of this review is limited to Scopus and Web of Science, which index publications of sufficient quality, this review was unable to include articles not indexed by these databases. Some articles may have been accidentally omitted due to human error; however, we are sure that the vast majority of relevant articles have been covered.

6.FUTURE DIRECTION

In recent years, the impact of ML on finance has been most prominently recognized in its role in price prediction and portfolio optimization. Notably, ML has made significant strides in the development of advanced techniques and processes for asset pricing. These innovations not only enhance the accuracy of predictions but also simplify the application of traditional models.

The fusion of alternate data streams—text, images, and speech—with traditional financial information is revolutionizing asset pricing. This surge in popularity is significantly driven by the advancements in transformers and LLMs. By harnessing the power of Computer Vision (CV) and Natural Language Processing (NLP), this multimodal approach augments traditional financial analyses, providing a richer, more nuanced view of market dynamics. The result is the creation of pricing models that are not only more accurate but also significantly more sophisticated.

7.CONCLUSION

This comprehensive review of the models of asset pricing highlighted how developments have been evolving from traditional models like the CAPM into advanced multifactor frameworks, namely, the FF models. While the CAPM does focus on market risk, it provides the very basics for understanding the relationship between risk and return. Often criticized because of its simplicity, it arguably cannot capture the full, multifaceted nature of asset returns. The added factors of size, value, profitability, and investment were thus brought into the FF models to complement these lacunae and enhance the explanatory power of asset returns in variable market conditions. Even these advanced models are found wanting in today's complex financial environment replete with high-dimensional data and market anomalies. Integration of ML and AI in asset pricing is a promising frontier as financial markets continue their evolution, offering more accurate and dynamic models. Asset pricing has to keep pace, whereby continuous innovation and adaptation are important. The reason is simple: researchers keep refining these models so that they are closer to market realities, enabling better and more informed investment decisions. This review emphasized how asset pricing theories need to be advanced further to accommodate the ever-increasingly complex nature of modern-day financial markets.

References

1. Acaravci, S. K., & Karaomer, Y. (2017). Fama-French five factor model: evidence from Turkey. International Journal of Economics and Financial Issues, 7(6), 130-137.
2. Akhtar, S., Ahmad Ansari, V., Ahmad Ansari, S., & Ahmad, A. (2022). Fama–French Three-Factor Versus Daniel-Titman Characteristics Model: A Comparative Study of Asset Pricing Models from India. Complexity, 2022(1), 6768434.
3. Ali, F., Khurram, M. U., & Jiang, Y. (2021). The five-factor asset pricing model tests and profitability and investment premiums: evidence from Pakistan. Emerging Markets Finance and Trade, 57(9), 2651-2673.
4. Banz, R. W. (1981). The relationship between return and market value of common stocks. Journal of financial economics, 9(1), 3-18.
5. Basu, S. (1977). Investment performance of common stocks in relation to their price-earnings ratios: A test of the efficient market hypothesis. The journal of Finance, 32(3), 663-682.
6. Basu, S. (1983). The relationship between earnings' yield, market value and return for NYSE common stocks: Further evidence. Journal of financial economics, 12(1), 129-156.
7. Belo, F., Li, J., Lin, X., & Zhao, X. (2017). Labor-force heterogeneity and asset prices: The importance of skilled labor. The Review of Financial Studies, 30(10), 3669-3709.
8. Bhandari, L. C. (1988). Debt/equity ratio and expected common stock returns: Empirical evidence. The journal of finance, 43(2), 507-528.
9. Bontis, N. (2003). Intellectual capital disclosure in Canadian corporations. Journal of human resource costing & accounting, 7(1), 9-20.

10. Campbell, J. Y. (1996). Understanding risk and return. Journal of Political economy, 104(2), 298-345.
11. Carhart, M. M. (1997). On persistence in mutual fund performance. The Journal of finance, 52(1), 57-82.
12. Chai, D., Chiah, M., & Zhong, A. (2019). Choosing factors: Australian evidence. Pacific-Basin Finance Journal, 58, 101223.
13. Chiah, M., Chai, D., Zhong, A., & Li, S. (2016). A Better Model? An empirical investigation of the Fama–French five-factor model in Australia. International Review of Finance, 16(4), 595-638.
14. Chowdhury, E. K. (2017). Functioning of Fama-French three-factor model in emerging stock markets: an empirical study on chittagong stock exchange, Bangladesh. Journal of Financial Risk Management, 6(04), 352.
15. Crook, T. R., Todd, S. Y., Combs, J. G., Woehr, D. J., & Ketchen Jr, D. J. (2011). Does human capital matter? A meta-analysis of the relationship between human capital and firm performance. Journal of applied psychology, 96(3), 443.
16. De Bondt, W. F., & Thaler, R. (1985). Does the stock market overreact?. The Journal of finance, 40(3), 793-805.
17. Dutta, A. (2019). Does the Five-Factor Asset Pricing Model Have Sufficient Power?. Global Business Review, 20(3), 684-691.
18. Edmans, A. (2011). Does the stock market fully value intangibles? Employee satisfaction and equity prices. Journal of Financial economics, 101(3), 621-640.
19. Fama, E. F. (1970). Efficient capital markets. Journal of finance, 25(2), 383-417.
20. Fama, E. F., & MacBeth, J. D. (1973). Risk, return, and equilibrium: Empirical tests. Journal of political economy, 81(3), 607-636.
21. Fama, E. F., & French, K. R. (2016). Commodity futures prices: Some evidence on forecast power, premiums, and the theory of storage. In The World Scientific Handbook of Futures Markets (pp. 79-102).
22. Fama, E. F., & French, K. R. (1988). Permanent and temporary components of stock prices. Journal of political Economy, 96(2), 246-273.
23. Fama, E. F., & French, K. R. (1992). The cross-section of expected stock returns. the Journal of Finance, 47(2), 427-465.
24. Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. Journal of financial economics, 33(1), 3-56.
25. Fama, E. F., & French, K. R. (2015). A five-factor asset pricing model. Journal of financial economics, 116(1), 1-22.
26. Fama, E. F., & French, K. R. (2018). Choosing factors. Journal of Financial Economics 128: 234–52.
27. Fama, E. F., & Schwert, G. W. (1977). Human capital and capital market equilibrium. Journal of Financial Economics, 4(1), 95-125
28. Fletcher, J. (2018). Bayesian tests of global factor models. Journal of Empirical Finance, 48, 279-289.
29. Florensia, C., & Susanti, N. (2020). How does the six-factor model do in explaining the relationship between return and risk on the Indonesia stock exchange?. International Journal of Research in Business and Social Science (2147-4478), 9(7), 93-107.
30. Foye & Valentinčič, A. (2020). Testing factor models in Indonesia. Emerging Markets Review, 42, 100628.
31. Frazzini, A., & Pedersen, L. H. (2014). Betting against beta. Journal of financial economics, 111(1), 1-25.
32. Hair, Joseph F., William C. Black, Barry J. Babin, and Rolph E. Anderson. (2010). Multivariate Data Analysis, 7th ed. New York: Pearson. Haqqani, Kanwal, and Muhammad Aleem. 2020. Testing liquidity augmented Fama-French five-factor model in Pakistan stock exchange. Global Economics Review V: 255–65
33. Hassan, A., & Javed, M. T. (2011). Size and value premium in Pakistani equity market. African Journal of Business Management, 5(16), 6747.
34. Horváth, D., & Wang, Y. L. (2021). The examination of Fama-French model during the COVID-19. Finance Research Letters, 41, 101848.
35. Hou, K., Mo, H., Xue, C., & Zhang, L. (2017). The economics of value investing (No. w23563). National Bureau of Economic Research.
36. A Comparison of New Factor Models. Fisher College of Business Working Paper 2015-03-05. HKUST Finance Symposium (2016): Active Investing and Arbitrage Capital, Charles A. Dice Center Working Paper No. 2015-05. Available online: https://ssrn.com/abstract=2520929 (accessed on 6 February 2023)
37. Hou, K., Mo, H., Xue, C., & Zhang, L. (2019). Which factors?. Review of Finance, 23(1), 1-35.
38. Hua, Z. (2022). A Comparative Analysis of the Fama-French Five-Factor Model: Based on the Data of China's SME Board. Frontiers in Business, Economics and Management, 4(2), 34-42.

39. Huynh, T. D. (2018). Explaining anomalies in Australia with a five-factor asset pricing model. International Review of Finance, 18(1), 123-135.
40. Iqbal, A., Ali, A., & D'Abreo, P. X. (2017). Fama And French Three Factor Model Application In The Pakistan Stock Exchange (Pse). IBT Journal of Business Studies (JBS), 1(1).
41. Jagannathan, R., & Wang, Z. (1998). An asymptotic theory for estimating beta-pricing models using cross-sectional regression. The Journal of Finance, 53(4), 1285-1309.
42. Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. The Journal of finance, 48(1), 65-91.
43. Jiao, W., & Lilti, J. J. (2017). Whether profitability and investment factors have additional explanatory power comparing with Fama-French Three-Factor Model: empirical evidence on Chinese A-share stock market. China Finance and Economic Review, 5, 1-19.
44. Khan, N., Zada, H., & Yousaf, I. (2022). Does premium exist in the stock market for labor income growth rate? A six-factor-asset-pricing model: Evidence from Pakistan. Annals of Financial Economics, 17(03), 2250017.
45. Kim, D., Kim, T. S., & Min, B. K. (2011). Future labor income growth and the cross-section of equity returns. Journal of Banking & Finance, 35(1), 67-81.
46. Kostin, K. B., Runge, P., & Charifzadeh, M. (2022). An analysis and comparison of multi-factor asset pricing model performance during pandemic situations in developed and emerging markets. Mathematics, 10(1), 142.
47. Kothari, S. P., & Shanken, J. (1997). Book-to-market, dividend yield, and expected market returns: A time-series analysis. Journal of Financial economics, 44(2), 169-203.
48. Kuehn, L. A., Simutin, M., & Wang, J. J. (2017). A labor capital asset pricing model. The Journal of Finance, 72(5), 2131-2178.
49. Li, K., & Duan, Y. (2021, April). Research on the application of Fama and French three-factor and five-factor models in American industry. In Journal of Physics: Conference Series (Vol. 1865, No. 4, p. 042105). IOP Publishing.
50. Lintner, J. (1965). Security prices, risk, and maximal gains from diversification. The journal of finance, 20(4), 587-615.
51. Maiti, M., & Vuković, D. (2020). Role of human assets in measuring firm performance and its implication for firm valuation. Journal of Economic Structures, 9(1), 47.
52. Markowitz, Harry. (1952). Portfolio selection. The Journal of Finance 7: 77–91.
53. Martinsa, C. C., & Eid Jr, W. (2015). Pricing assets with Fama and French 5–Factor Model: a Brazilian market novelty. XV Encontro Brasileiro de Finanças, 23-25.
54. Mayers, David. (1972). Nonmarketable assets and capital market equilibrium under uncertainty. In Studies in the Theory of Capital Markets. NewYork: Praeger Publishers, pp. 223–48.
55. Mosoeu, S., & Kodongo, O. (2022). The Fama-French five-factor model and emerging market equity returns. The Quarterly Review of Economics and Finance, 85, 55-76.
56. Mossin, J. (1966). Equilibrium in a capital asset market. Econometrica: Journal of the econometric society, 768-783.
57. Nugraha, F., Nurmatias, N., & Wahyudi, W. (2022). Analisis Fama French 5 Factors Model Dalam Mempengaruhi Excess Return Saham Pada Lq45. Ikraith-Ekonomika, 5(1), 89-102.
58. Sharpe, W. F. (1991). Capital asset prices with and without negative holdings. the Journal of Finance, 46(2), 489-509.
59. Asness, Clifford, and Andrea Frazzini. (2013). The Devil in HML's Details. The Journal of Portfolio Management 39: 49–68.
60. Ali, F. (2022). Testing mispricing-augmented factor models in an emerging market: A quest for parsimony. Borsa Istanbul Review, 22(2), 272-284.