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# Adaptive Markets Hypothesis: A Systematic Review of Its Testing and Application in Financial Market Efficiensy Studies

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***Abstract:*** *This study is a Systematic Literature Review (SLR) that aims to examine how the Adaptive Markets Hypothesis (AMH) has been tested and applied in studies on financial market efficiency. Through a systematic selection process, 30 scientific articles from reputable Scopus journals (Q1 and Q2) have been analyzed to answer five main research questions, including the AMH testing approach, the methodology used, the type of market or instrument studied, the results of empirical studies, and the limitations and directions of further research. The review results show that most studies provide support for the AMH, with the finding that market efficiency is dynamic (time-varying) and can change depending on crises, economic conditions, and investor behavior. The AMH has been tested on various markets such as stocks, foreign exchange, commodities, and crypto, both in developed and developing countries. The methodological approaches used are also diverse, ranging from rolling window analysis, variance ratio test, Hurst exponent, to machine learning-based methods and Bayesian inference. This SLR concludes that the AMH offers a more realistic framework than the Efficient Market Hypothesis (EMH), especially in understanding the efficiency of modern complex and adaptive markets. This study makes theoretical and practical contributions, and recommends that further research develop the AMH approach in under-researched market contexts and with more innovative analytical methods.*
***Keywords:*** *Adaptive Markets Hypothesis, Market Efficiency, Financial Market, Stock Market, Cryptocurrency, Empirical Evidence, Systematis Literature Review*

## 1. Introduction

In recent decades, rapid developments in finance have encouraged various theoretical approaches to understanding market behavior (Palagan, 2016). One of the central issues that continues to be of concern in the financial literature is the extent to which financial markets can be considered efficient in reflecting available information (Dyckman, Thomas, R. and, 1986).

Research on market efficiency has become one of the main pillars in the financial literature for the past few decades (Zen, 2022). The Efficient Market Hypothesis (EMH) dominates this paradigm with the assumption that financial asset prices fully reflect all available information (Mirza, 2016). Empirical developments show anomalies and inconsistencies that cannot always be explained by the EMH. In response to these limitations, Lo (2004) introduced

the Adaptive Markets Hypothesis (AMH) as an alternative approach that combines the principles of economic rationality with evolutionary and behavioral elements.

Studies on the Adaptive Markets Hypothesis are still scattered in various individual studies without any systematic mapping. This makes it difficult for researchers and practitioners to obtain a comprehensive picture of how this theory has been used and to what extent it contributes to explaining the dynamics of market efficiency (Gumanti & Utami, 2014). This is where the role of a systematic review becomes important, because it can summarize, compare, and evaluate existing findings in a structured manner (Gabriela, 2015).

Based on this background, this study is structured in the form of a Systematic Literature Review (SLR) which aims to systematically examine and synthesize various empirical studies that test and apply AMH in the context of financial market efficiency. Through this SLR approach, the article is expected to provide a deeper understanding of the development of AMH, identify trends and gaps in the literature, and provide direction for further research in this field.

The Systematic Literature Review (SLR) approach begins with the formulation of research questions, which serve as a guide in determining the theme, focus, and scope of the study (Snyder, 2019). Therefore, the first step in implementing SLR is to formulate the core questions that will be answered in this study. The main questions that form the basis of this study are as follows:
RQ1: How has the Adaptive Markets Hypothesis (AMH) been empirically tested in the context of financial market efficiency?
RQ2: What are the methodological approaches used in AMH testing studies?
RQ3: In what types of markets or financial instruments has AMH been applied or tested?
RQ4: What are the results of empirical studies of AMH?
RQ5: What are the limitations in the existing literature, and what are the directions for future AMH research?

## 2. Research Methods

This study uses the Systematic Literature Review (SLR) approach to systematically review various empirical studies related to the testing and application of the Adaptive Market Hypothesis (AMH) in financial market efficiency studies. SLR was chosen because it is able to identify, evaluate, and synthesize literature in a structured and transparent manner.

The review process follows the PRISMA (Preferred Reporting Items For Systematic Reviews and Meta-Analyses) guidelines which consist of four main stages: identification, screening, eligibility, and inclusiveness. PRISMA was chosen because it provides clear steps in literature selection and increases the validity and consistency of the study results.

In its implementation, this study follows five SLR stages, namely: (1) formulating research questions, (2) conducting a systematic literature search, (3) determining inclusion and exclusion criteria, (4) assessing the quality of the literature, and (5) compiling and discussing the findings. These stages are the basis for compiling a systematic review of AMH in the context of financial market efficiency.

**Application of Criteria**

In this study, the application of selection criteria is focused on the selection of literature relevant to the testing and application of the Adaptive Markets Hypothesis (AMH) in the study of financial market efficiency. The selection process is carried out systematically to ensure that only sources that meet certain criteria are analyzed further.

The inclusion criteria used include: (1) Literature published in the period 2011 to 2025, (2) Scientific publications such as reputable journal articles in Scopus (Q1 and Q2), (3) English-language literature, (4) Viewing abstracts of relevant literature, and (5) literature that can be accessed in full (full-text), The application of these criteria aims to ensure that the focus of the study remains in accordance with the main objectives of the study.

**Literature Search**

The process of selecting literature for the review is carried out through a careful selection procedure, which includes identifying appropriate databases and making effective search queries to produce relevant results. In this study, Scopus was chosen as the main database to ensure the quality and dependability of the findings. As a leading database, Scopus offers a variety of scientific articles, covering more than 20,000 peer-reviewed journals across various disciplines, making it easy to search for comprehensive literature (Nofel et al., 202

**Research design**

This study uses the Systematic Literature Review research method or systematic literature review with a qualitative approach. A systematic literature review is a type of review where empirical findings according to certain eligibility criteria are collected to answer research questions. The author finds, critically evaluates, and synthesizes the results of various studies that raise the same and relevant topics. In this research method, there are three stages: planning, implementation, and

**Quality Assessment**

In the initial stage, existing literature was collected from the Watase database. The process of identifying and selecting articles in this study followed the PRISMA 2020 guidelines to ensure transparency and traceability in

literature searches. This study identified 274 articles through a search on the Scopus database using a number of relevant keywords such as Adaptive Markets Hypothesis, Market Efficiency, Financial Market, Stock Market, Cryptocurrency, Empirical Evidence. Furthermore, an initial screening process was carried out by eliminating 47 duplicate articles, 63 articles that were automatically marked as ineligible (based on the publication year range 2011–2025), and 49 articles that were excluded based on journal classification (Tier Q1 and Q2). No articles were removed because they did not have an abstract. Thus, 115 articles passed to the further screening stage.

In the screening stage, a review of the abstract and initial content was carried out to assess the suitability of the topic, which resulted in 76 articles being excluded because they did not meet the inclusion criteria. A total of 39 articles were then identified for full-text review, but 9 of them were not successfully accessed, so only 30 articles could be assessed at the eligibility stage. After a comprehensive eligibility assessment, all 30 articles were declared to meet the criteria and were included in this systematic literature review.

## 3. Research Results

This section presents a systematic discussion based on the five research questions (RQ) that have been formulated in this study. As a basis for analysis, 30 articles that meet the inclusion criteria have been evaluated and analyzed thoroughly. The articles consist of various market contexts, methodological approaches, and test results for the Adaptive Markets Hypothesis (AMH).

To provide an overview of the scope and characteristics of the research analyzed, Table 1 below presents a summary of each article based on the author's name, study object, main findings, and journal ranking according to the Scopus/SJR tier. The following is a discussion of each research question (RQ) in stages.

### How the Adaptive Markets Hypothesis (AMH) Has Been Empirically Tested in the Context of Financial Market Efficiency (RQ1)

Based on the results of a review of 30 articles studied, most empirical research on the Adaptive Markets Hypothesis (AMH) focuses on tests of market efficiency that are dynamic or change over time (time-varying efficiency). In almost all studies, AMH is used as an alternative approach to explain why return predictability and market anomalies are not always consistent, and can differ depending on economic conditions or market volatility.

Studies in developed markets also emphasize the adaptivity of efficiency. (Noda, 2016) tested the TOPIX and TSE2 in Japan using a time-varying AR model, and found that the secondary market (TSE2) tends to be less efficient than TOPIX, but both experience clear changes in efficiency after major economic events. (Popović et al., 2013) in Montenegro applied a rolling window

to the autocorrelation test and runs test, and reported a marked variation in efficiency over the period 2004–2011.

**What are the Methodological Approaches Used in AMH Testing Studies (RQ2)**

The methodological approach in AMH testing is generally dynamic and adjusted to market complexity and data availability. Some of the dominant and frequently used methods in the findings of the reviewed articles include:

1. Rolling Window Analysis and Time-Varying Tests
   This is the most common method, used to observe changes in market efficiency over time. Studies such as Charles et al., (2017), and Khuntia & Pattanayak (2018), and Bassiouny et al. (2023). Similar approaches are also used by Popović et al. (2013), Mirzaee Ghazani & Khalili Araghi (2014), Noda (2016), and Rönkkö et al. (2024) rely on this technique to measure the dynamics of efficiency over time. use this technique to show when the market becomes efficient and when it becomes inefficient. This technique is also effective in capturing the impact of crises or other major events.
2. Variance Ratio Test and Martingale Difference Hypothesis (MDH)
   Used to detect the presence of random walk in market returns. Studies by Urquhart & McGroarty (2016) and Charles et al. (2017) and Akbar et al. (2024) applied this method to assess whether the market is weakly efficient. If the test results show a violation of random walk, then it is an indication of return predictability, which supports AMH.
3. Hurst Exponent and Detrended Fluctuation Analysis (DFA)
   Used to measure long memory and return persistence. Asif & Frömmel (2022) and Hiremath & Narayan (2016) and Varghese & Madhavan (2020) used the Hurst exponent to see the presence of long-term memory in the Indian currency and stock markets. The fluctuating Hurst value indicates that market efficiency is inconsistent and follows time dynamics.
4. Generalized Spectral (GS) Test and Dominguez-Lobato (DL)
   Used in studies on crypto markets such as Gyamfi (2017) and Khursheed et al. (2020) to capture non-linear and adaptive properties in digital market efficiency. These methods are able to detect forms of efficiency that are not visible in traditional linear approaches.
5. Sharpe Ratio, LPM, Logistic Regression, and Behavioral Metrics
   Used by Noreen et al. (2022) adds a behavioral dimension to the AMH test, by combining the risk-return ratio and measures such as myopic loss aversion. This suggests that shifts between investor rationality and irrationality contribute to fluctuations in market efficiency.
6. Momentum, Contrarian, and Calendar Anomaly Strategies
   Used by Lekhal & El Oubani (2020), Munir et al. (2022), and Xiong et al. (2019) used this strategy to observe whether seasonal patterns and anomaly-

based strategies remain consistent or change. The inconsistency of the results indicates the non-stationary nature of the market, one of the main foundations of AMH.

7. Bayesian Model Averaging (BMA)
   Used by Chalamandaris (2020) to examine the relevance of financial statement information in derivative instrument (CDS) trading. This approach is unique because it evaluates changes in the way market participants respond to information, reflecting the basic principle of AMH that investment strategies change over time.
8. Multi-Methodology and Comparative Approach
   Several studies such as Ghazani & Jafari (2021) and Cruz-Hernández & Mora-Valencia (2024) use a combination of several methods to comprehensively test cross-market or cross-instrument efficiency. This reflects the flexibility of the AMH approach which is not limited to just one method.

From all studies, it can be seen that the methods used in AMH testing generally have an adaptive and contextual character, very different from EMH testing which is more static. The approach in the AMH study actually encourages the use of statistical techniques that are able to capture inconsistencies in market efficiency and changes in investor behavior.

**In What Types of Markets or Financial Instruments Has the AMH Been Applied or Tested (RQ3)**

Based on the articles analyzed, the Adaptive Markets Hypothesis (AMH) has been widely applied to various types of markets and financial instruments, both conventional and unconventional markets, as well as traditional instruments and digital assets. This shows that the AMH has a high degree of flexibility and is able to explain market efficiency in various different financial contexts.

1. Stock Market

Most studies test the AMH on the stock market, both global, regional, and sectoral stock indices. Findings:

a. Akbar et al. (2024) and Charles et al. (2017) studied Islamic and conventional stock indices, including sectoral indices such as consumer goods, financials, and technology.
b. Akhter & Yong (2019) studied the Bangladesh stock market (DSE), while Cruz-Hernández & Mora-Valencia (2024) focused on the Latin American stock market.
c. Hiremath & Narayan (2016) evaluated the Indian stock market, while (Ghazani & Araghi, 2014) examined the Iranian stock market (TEPIX index).

d. Munir et al. (2022) analyzed the South Asian stock market, while Noda (2016) applied the time-varying AR model to the Japanese stock market.
e. Noreen et al. (2022) researched the US stock market and Okorie & Lin (2021) researched the US, Brazilian, Indian and Russian stock markets.
f. Gyamfi (2017) analyzed the Ghanaian stock market with the GSEALSH and GSEFSII indices.
g. Popović et al. (2013) examine the Montenegrin stock market, while Rönkkö et al. (2024) examine the small stock market in Finland (OMXH25).
h. Urquhart & McGroarty (2014) tested the DJIA on the US stock market, while Urquhart & McGroarty (2016) tested it on global indices.
i. Xiong et al. (2019) tested the calendar effect on the Chinese stock market.

The results of these studies show that stock market efficiency is not constant and varies with market conditions and economic policies, supporting the adaptive market hypothesis.

2. Foreign Exchange Market

A study by Asif & Frömmel (2022) tested the efficiency of 28 currencies against the USD, both from developed and developing countries. They used the Hurst exponent approach and rolling-window DFA to capture long memory in exchange rate data. The results show that the foreign exchange market experiences episodes of efficiency and inefficiency depending on periods of crisis and central bank intervention.

3. Oil and Energy Markets

A study by Ghazani & Ebrahimi, (2019) tested three crude oil benchmarks (Brent, WTI, OPEC) and showed that oil market efficiency changes depending on the type of oil and time period. A similar study by Varghese & Madhavan, (2020) found that the efficiency of WTI, Brent, and Dubai crude oil markets varies over time, with WTI being the most efficient, based on rolling Hurst exponent and nonparametric tests. This study confirms that even global commodity markets are subject to adaptive mechanisms as described by the AMH and shows that energy market efficiency is dynamic and influenced by market conditions and the characteristics of each type of oil.

4. Cryptocurrency Market

The crypto market has become an area of considerable research in the context of the AMH due to its high volatility and dynamics. Findings:

a. Chu et al. (2019) studied the Bitcoin and Ethereum markets with high-frequency data.
b. Khuntia & Pattanayak (2018) and Khursheed et al. (2020) analyzed several coins such as Bitcoin, Monero, Litecoin, and Stellar.

c. Ghazani & Jafari (2021) compared the efficiency of the crypto market with the gold and oil markets.

Almost all of these studies concluded that the efficiency of the crypto market is unstable and highly responsive to news, policies, and speculator behavior, making it very suitable to be tested with the AMH approach.

5. Derivative Instruments (Credit Default Swaps)

Research by Chalamandaris, (2020) tested the relevance of financial statement information to Credit Default Swaps (CDS) trading. This study is unique in that it highlights how market participants adaptively adjust their investment strategies depending on economic conditions and major events such as the 2008 financial crisis.

6. Precious Metals Market

A study by Shahid et al., (2019) examined the precious metals market on the NYSE, including instruments such as gold, silver, and possibly other metals, showing cycles of efficiency and inefficiency that change over time, supporting the AMH assumption that market efficiency is dynamic and adaptive to market conditions, volatility, and investor sentiment.

**How are the Empirical Study Results of AMH (RQ4)**

Based on the results of the review of 30 articles analyzed in this study, it can generally be concluded that the majority of empirical study results provide support for the Adaptive Markets Hypothesis (AMH). These results indicate that market efficiency is not static as assumed in the Efficient Market Hypothesis (EMH), but is dynamic and changes over time, depending on external factors such as the financial crisis, monetary policy, and global market conditions.

Most studies show that in stable market conditions, efficiency tends to increase, but when there are shocks such as the 2008 crisis or the COVID-19 pandemic, market efficiency decreases and provides room for predictability of returns. This is observed in studies such as Bassiouny et al. (2023) and Chu et al. (2019), where the emergence of anomalies or increased market volatility is evidence that the market is evolving and adapting to environmental changes.

The study by Okorie & Lin, (2021) shows that market efficiency changes significantly during the crisis period. Munir et al. (2022) also supports the argument that the market is adaptive to external pressures. Varghese & Madhavan (2020) show that price efficiency fluctuates over time. The study by Shahid et al. (2019) also found similar dynamics of efficiency and inefficiency appearing alternately depending on the period. This finding is reinforced by Rönkkö et al. (2024) found that efficiency increased after liberalization, with volatility and returns dynamically influencing each other.

Based on findings from various studies, there is no research that explicitly rejects the validity of the Adaptive Market Hypothesis (AMH). On the contrary, almost all research results actually strengthen the view that market efficiency is contextual and develops dynamically along with changes in market conditions, so that the AMH concept is more representative of describing modern financial market conditions than the assumption of fixed efficiency. For example, Kyei et al., (2023) found that the relationship between commodity prices and financial system stability is asymmetric, depending on market conditions. Although this study does not test the efficiency of market instruments directly, it still broadens the scope of the application of AMH in explaining the dynamics of complex financial behavior.

**What are the Limitations in the Existing Literature, and What is the Direction of Future AMH Research (RQ5)**

In this review, several research gaps can be identified from the articles analyzed, thus opening up opportunities for further research directions.

1. There are still limited studies that test AMH in emerging markets, especially in Southeast Asia, Africa, and the Middle East. Future research can explore Islamic stock markets, local commodity markets, or secondary exchanges in these countries.
2. The approaches used are generally still classical statistics such as variance ratio, Hurst exponent, or rolling window. With the development of data technology and artificial intelligence, there is a great opportunity to use machine learning and big data analytics to measure market efficiency adaptively and in real-time.
3. Most studies only focus on weak-form efficiency. There are still few that examine semi-strong or strong-form efficiency within the AMH framework, for example by looking at market reactions to the release of fundamental information or macroeconomic news.
4. There is potential to study the integration of AMH theory with behavioral finance, because both emphasize the importance of context and changing investor behavior. This approach can help explain more deeply about how market adaptation occurs psychologically and socially.

   Thus, the direction of further research can be focused on:

   a. Expanding the market context (geographic and asset type),
   b. Developing modern quantitative methods,
   c. Applying a cross-theory approach (AMH + behavioral finance),
   d. and testing other forms of efficiency.

## 4. Conclusion

This study is a Systematic Literature Review (SLR) of 30 articles that examine the application of the Adaptive Markets Hypothesis (AMH) in financial market efficiency. The results show that AMH is widely supported as a framework that explains dynamic market efficiency that is influenced by external factors. Various methods such as rolling-window, variance ratio, and Bayesian analysis are used in various market contexts, including emerging and Islamic markets. AMH is considered relevant as an alternative to EMH, both theoretically and practically. However, the study is still limited to weak-form efficiency, without quantitative meta-analysis, and has not explored many other forms of efficiency. Future research needs to expand the geographical context, integrate AI approaches, and combine AMH with behavioral finance theory. Overall, AMH is proven to be relevant to understanding modern complex and adaptive financial markets.

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