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FAMA MEETS MAMA: REVISITING MARKET EFFICIENCY THROUGH ADAPTIVE MOVING AVERAGES

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Abstract: *This paper examines the recent performance of the MESA adaptive moving average (MAMA) and following adaptive moving average (FAMA) in the Saudi MSCI Tadawul 30 (MT30) from 2011 to 2025, relative to the buy-and-hold benchmark. Using Sharpe and Sortino ratios, maximum drawdown, Ulcer index, payoff and tail ratios, we assess strategy outcomes across four distinct subperiods reflecting stability, the oil price collapse, reform-driven consolidation and the pandemic era. Results show that buy-and-hold dominates in tranquil and reform-led markets, while MAMA–FAMA provides superior risk-adjusted performance and tail resilience during systemic stress. These findings support the* adaptive market hypothesis *by demonstrating that efficiency is regime-dependent and evolves with market conditions, underscoring the importance of adaptive strategies in emerging markets.*

Keywords: *Market efficiency, technical analysis, adaptive moving averages, emerging market*

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Introduction

The efficient market hypothesis (EMH) asserts that asset prices reflect all available information, implying that no trading rule can consistently generate abnormal returns (Fama, 1970). Yet a long history of anomalies, behavioural effects and cyclical inefficiencies has challenged this view (De Bondt & Thaler, 1985; Jegadeesh & Titman, 1993). In response, Lo (2004, 2017) proposed the adaptive market hypothesis (AMH), which argues that efficiency is not static but evolves with market ecosystem, investor learning and competition.

Alongside this line of discussion, technical analysis has moved from a practice viewed with scepticism to a subject of serious academic inquiry. Advances in artificial intelligence, financial modelling, econometrics and technical indicators, as well as computing power, have provided technical rules with greater rigour. Among these innovations, Ehlers (2001) dynamically adapt his moving average indicators to market cycles through maximum entropy spectral analysis (MESA) by introducing two indicators: MESA adaptive moving average (MAMA) and the following adaptive moving average (FAMA). The design of these indicators offers a mean to test whether adaptive trading rules can extract predictive content from historical price data.

Emerging markets provide a particularly relevant context for this investigation. These markets are often characterized by structural inefficiencies, lower liquidity and higher volatility, conditions under which adaptive rules may be more effective (Urquhart & McGroarty, 2016; Lim & Brooks, 2018). The Saudi stock market provides a rich setting for examining adaptive efficiency with MAMA–FAMA rules. As the largest and most liquid market in the Gulf, it has undergone profound structural changes, including foreign investor access, MSCI Emerging Market inclusion and the landmark Aramco IPO, all of which reshape price discovery and trading dynamics. Studying this market offers an opportunity to assess time-varying efficiency in a major oil-dependent economy and the practical relevance of advanced technical analysis.

Literature Review

Empirical research on market efficiency has gradually shifted from the binary acceptance or rejection of EMH toward the recognition of time-varying efficiency. Studies applying rolling and nonlinear models show that efficiency fluctuates with crises, institutional changes and behavioural dynamics (Noda, 2016; Urquhart & McGroarty, 2016). This aligns with the AMH, which frames efficiency as contingent rather than absolute (Lo, 2017).

Technical analysis has played an important role in this evolution. Brock, Lakonishok and LeBaron (1992) first demonstrated the statistical significance of simple moving averages, prompting a reassessment of technical rules within academic finance. Nor and Wickremasinghe (2017) demonstrates that market efficiency evolves over time. More recent work highlights the potential of nonlinear moving averages and adaptive rules to capture regime shifts and volatility clustering (Zhu, Li, & Wang, 2020; Todea, Ulici, & Silaghi, 2022). Nor et al. (2023) shows that a hybrid framework of fractal with trend or contrarian indicators can provide investors better investment performance. Within this trajectory, MAMA and FAMA remain underexplored in peer-reviewed studies despite their wide use among practitioners.

By situating MAMA and FAMA within the market efficiency debate, this paper contributes by introducing adaptive spectral filters as rigorous instruments for efficiency testing. In addition, we explore this adaptive-based technical analysis in the context of an emerging market. The findings will clarify whether adaptive moving averages reveal exploitable inefficiencies in different market phases.

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Research Method

We examine the profitability of technical strategies across the MT30 constituents over the period 1 July 2011 to 30 June 2025. To capture potential shifts in market dynamics, the full sample is further partitioned into four distinct, non-overlapping subperiods, outlined as follows:

- 2011:Q3 to 2014:Q2 (pre-oil-crash stability)
- 2014:Q3 to 2016:Q4 (oil-price collapse and direct Qualified Foreign Investor access)
- 2017:Q1 to 2019:Q4 (consolidation reforms and pre-COVID)
- 2020:Q1 to 2025:Q2 (COVID, Russia-Ukraine war and VAT shock)

The first indicator, MAMA, represents a non-linear, adaptive filter that adjusts its smoothing constant dynamically in response to changes in dominant market cycles. Unlike fixed-length moving averages, which impose constant lag regardless of prevailing volatility or cycle structure, MAMA adapts in real time using phase and amplitude information derived from Hilbert Transform. This spectral approach allows the filter to minimize lag in trending regimes while avoiding excessive whipsaw in sideways markets. Accordingly, MAMA is defined as a recursive weighted average of current price and its prior value:

$$MAMA_t = \alpha_t P_t + (1 - \alpha_t) MAMA_{t-1}$$

where P_t is the input price series (commonly the median price is used: $(High_t + Low_t)/2$) and α_t is a time-varying smoothing constant, bounded by predefined limits, which makes it different to a standard exponential moving average. The adaptive smoothing constant α_t is a function of the phase rate of change as measured by Hilbert Transform homodyne discriminator.

To complement MAMA, Ehlers (2001) proposed FAMA, a slower-moving confirmation line derived by reapplying the adaptive filter with a reduced sensitivity. FAMA acts as a stabilizing benchmark against which MAMA crossovers generate trading signals. FAMA is computed recursively as:

$$FAMA_t = \beta_t \times MAMA_t + (1 - \beta_t) FAMA_{t-1}$$

where the adaptation coefficient $\beta_t = \alpha_t \times 0.5$, ensuring that FAMA lags behind MAMA. By construction, MAMA reacts more rapidly to shifts in cycle phase than FAMA. The MAMA–FAMA crossover rule provides a natural signal mechanism: buy (sell) signal is generated when $MAMA_t$ crosses above (below) $FAMA_t$, while sell signal occurs when $MAMA_t$ crosses below $FAMA_t$. For robustness, we explore several performance measures, such as Sharpe ratio, Sortino ratio and maximum drawdown to gauge risk and returns as compared to the benchmark buy-and-hold (B&H) policy.

Results and Discussion

The results in Table 1 reveal a clear shift in the relative effectiveness of adaptive and passive strategies across the pre-oil-crash and crisis regimes. During the stable period of 2011:Q3–2014:Q2, B&H produced superior risk-adjusted performance, reflected in higher Sharpe and payoff ratios, while MAMA–FAMA offered stronger downside protection with a higher Sortino ratio, smaller drawdowns and a lower Ulcer Index. This balance shifted decisively during the oil price collapse of 2014:Q3–2016:Q4, when adaptive trading rules substantially outperformed passive exposure across nearly all measures, achieving higher Sharpe and Sortino ratios, materially reducing drawdowns and improving tail risk characteristics.

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Table 1: Performance of MAMA–FAMA and B&H (Pre-Oil Crash and Crisis)

	Panel A: Pre-oil-crash stability period		Panel B: Oil price collapse and market stress period	
	MAMA–FAMA	B&H	MAMA–FAMA	B&H
Sharpe Ratio	1.32	1.60	0.31	0.03
Sortino Ratio	3.64	2.62	0.02	-0.21
Maximum Drawdown %	-7.83	-14.53	-11.81	-41.86
Ulcer Index	2.98	5.88	9.77	23.00
Payoff Ratio	3.98	7.40	2.64	1.65
Tail Ratio	1.19	1.23	1.42	0.88

Source: Analysed by the Authors. Panel A: 2011:Q3 to 2014:Q2. Panel B: 2014:Q3 to 2016:Q4.

These findings indicate that MAMA–FAMA strategies can capture cyclical inefficiencies and mitigate downside risk in periods of heightened market stress, while passive exposure remains advantageous when conditions are stable and informational efficiency is higher. In Table 2, we provide further evidence of the regime-dependent nature of strategy performance during the reform-driven and post-pandemic phases.

Table 2: Performance of MAMA–FAMA and B&H (Reform and Post-Pandemic)

	Panel A: Reform-driven and MSCI inclusion period		Panel B: Post-pandemic period	
	MAMA–FAMA	B&H	MAMA–FAMA	B&H
Sharpe Ratio	-0.10	1.05	0.62	0.53
Sortino Ratio	-0.22	1.55	1.15	1.12
Maximum Drawdown %	-18.75	-15.23	-13.35	-29.20
Ulcer Index	7.04	5.25	8.18	12.79
Payoff Ratio	2.39	3.53	2.71	4.56
Tail Ratio	0.91	1.14	1.04	1.01

Source: Analysed by the Authors. Panel A: 2017:Q1 to 2019:Q4. Panel B: 2020:Q1 to 2025:Q2.

Between 2017:Q1 and 2019:Q4, passive investing dominated as market reforms, foreign investor participation and MSCI inclusion enhanced informational efficiency, allowing B&H to deliver higher risk-adjusted returns, superior payoff and better downside management. However, the dynamic shifted once again during the 2020:Q1–2025:Q2 period, where heightened volatility from the pandemic, oil price shocks and global monetary tightening improved the relative performance of MAMA–FAMA. The adaptive strategy achieved stronger Sharpe and Sortino ratios, significantly reduced drawdowns and improved tail resilience, although B&H continued to capture greater upside potential. These results support the central tenet of the AMH: the effectiveness of trading strategies evolves with market conditions, with adaptive approaches excelling under turbulence and passive strategies prevailing in more efficient environments.

Figure 1 complements this evidence by illustrating the drawdown patterns of adaptive technical trading. Specifically, it provides a visual perspective of how such risk varied over time.

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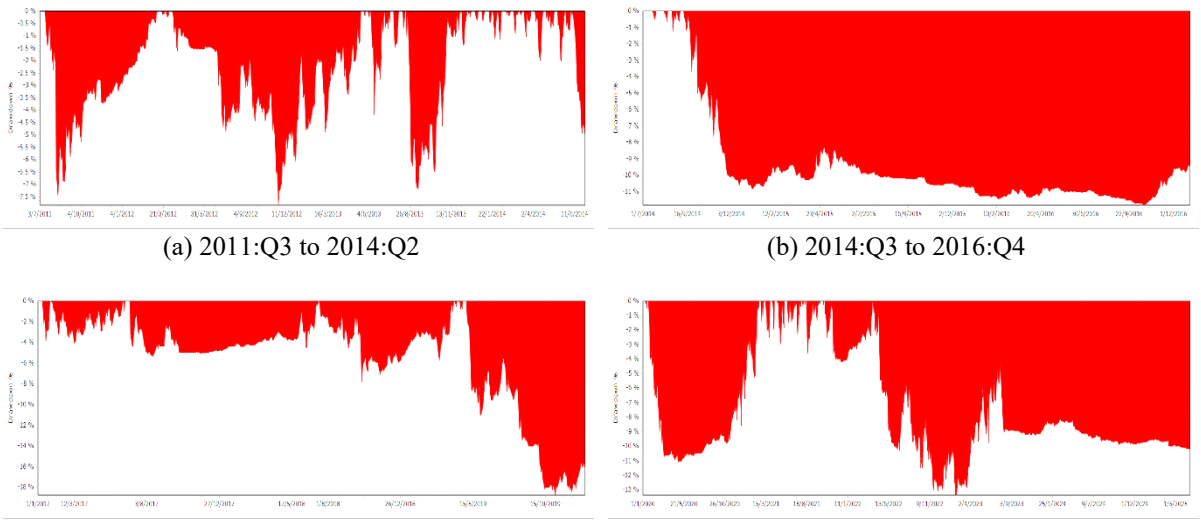

(a) 2011:Q3 to 2014:Q2 (b) 2014:Q3 to 2016:Q4

(c) 2017:Q1 to 2019:Q4 (d) 2020:Q1 to 2025:Q2

Figure 1: MAMA–FAMA Drawdowns

Source: Analysed by the Authors.

Overall, the evidence underscores that the profitability of adaptive rules is not constant but regime dependent. MAMA–FAMA strategies excel when volatility and systemic stress undermine market resilience, while B&H dominates in stable or reform-driven phases where informational efficiency improves. This cyclical interplay provides strong empirical support for the AMH.

Conclusion and Implications

This study evaluates the MAMA–FAMA adaptive trading rule against the B&H benchmark in the MSCI Tadawul 30 using recent data (from 2011 to 2025). The results show that performance is regime-dependent: passive investing dominates in stable and reform-driven periods, while adaptive strategies deliver higher Sharpe ratios, stronger drawdown control and better tail protection during systemic stress such as the 2014–2016 oil collapse and post-2020 volatility. These findings support the adaptive market hypothesis, illustrating that efficiency evolves with structural changes and external shocks. For investors, this underscores the importance of regime-sensitive strategies in emerging markets, where passive exposure suits stable phases and adaptive rules offer greater resilience in turbulent conditions. Future research could build on recent technical approaches (e.g., Nor et al., 2023; Ospina-Holguín & Padilla-Ospina, 2025; Shi, 2025) to deepen understanding of AMH dynamics.

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