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TESTING THE ADAPTIVE MARKET HYPOTHESIS (AMH) AS AN EVOLUTIONARY PERSPECTIVE ON MARKET EFFICIENCY BY SIMPLE MOVING AVERAGE (SMA) METHOD

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ABSTRACT

In the realm of financial markets, experts have extensively employed technical analysis. Especially, certain academic investigations have underscored the capacity of these tools to yield favorable returns in comparison to a straightforward buy-and-hold approach. Our study examined BSE Sensex, Brazilian Index, Financial Times Stock Exchange Group (FTSE), German DAX, Hang Seng Index, Standard and Poor's (S&P 500), and Nikkei 225. During the timeframe spanning from 1998 to 2023, a practical implication derived from the Adaptive Market Hypothesis (AMH) is that profit opportunities materialize intermittently, depending upon the level of market efficiency and the prevailing market circumstances. To probe into this implication, we systematically monitor the evolving efficacy of simple moving average trading strategies, along with the correlation between this efficacy and both the degree of market efficiency and specific market conditions. The major findings reveal that investing at maxima and minima of simple moving average result in more favorable outcomes than a passive buy and hold strategy. Consequently, investors possess the opportunity to leverage market inefficiencies and particular market conditions through trading strategies such as directional trading. In aggregate, our

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findings and results align with the framework of the Adaptive Market Hypothesis (AMH), which has been validated as a superior explanatory model for the dynamics of emerging markets in comparison to the Efficient Market Hypothesis (EMH).

Keywords: **Simple Moving Average (SMA), Efficient Market Hypothesis (EMH), Adaptive Market Hypothesis (AMH)**
JEL Classification: G1, G4.

1. INTRODUCTION

The efficient market hypothesis (EMH), which holds that stock market prices represent fundamental values and replicate all relevant and existing information, has been extensively studied in the fields of economics and finance Fama (1965). When new information is received in such an efficient market, security prices react fast, take into account all information available at any given interval, and find a new symmetry. Additionally, gathering knowledge is expensive and will not yield additional profits in a market with efficient information flow. A straightforward approach of purchasing and keeping diversified assets cannot outperform fundamental or technical research. In other words, any active portfolio management never raise better return than buy and hold strategy by the EMH (Fama,1970).
Grossman, S.J., Stiglitz, (1980) give a theoretically convincing justification for why it is impossible for a market to be entirely efficient because, if prices accurately reflected all available information, traders would have no reason to invest in expensive information. Assuming that complete efficiency is impossible. Yet, numerous significant investigations have demonstrated that stock returns do not adhere to random walks (Brock, W., Lakonishok, J., & LeBaron, 1992; Cheung & Coutts, 2010; Fama, E. F., & French, 1988; Jegadeesh & Titman, 1993). The validity of EMH has, however, been contested in a number of studies due to competing arguments that have been put up in the literature and the stochastic nature of asset values. In light of this, several researchers started to create models by including illogical human behaviors like overreaction and overconfidence, which subsequently led to the formation of behavioral finance by (Kim et al., 2011; Shiller, 2021).
Lo, (2004) offers a fresh paradigm known as the AMH, which may be able to explain the variance in market efficiency across time. The evolutionary principle and the idea of constrained rationality are combined to create the AMH. An investor who exhibits gratifying rather than ideal behavior is said to be bounded rational. Market players that have limited information access or information processing skills are just concerned with getting a good result because optimization might be expensive (Lo, 2004; Simon, 1955) claims that achieving a desirable result does not need analytical thinking, but rather a transformative procedure that involves trial and error and natural assortment. Natural selection influences the quantity and make-up of market players as well as trading techniques, ensuring that only the fittest will survive. Heuristics are used by market players to make investment decisions while also adapting to the environment's ongoing change. Natural selection will assist produce new possibilities when the profit opportunities diminish due to competition (Urquhart & Hudson, 2013; Urquhart & McGroarty, 2016).
Andrew W. Lo (2005) proposes that even though individuals primarily act in their self-interest, they

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occasionally commit errors. Competition encourages innovation and adaptability because people learn from their failures and make adjustments. Market dynamics are ultimately determined by evolution. The AMH offers a variety of practical financial implications. At the beginning, the degree of risk premium undergoes fluctuations throughout time in accordance with the stock market environment and the demographics of investors in that context. The second conclusion is that there are occasionally arbitrage opportunities in the market. So, taking an evolutionary standpoint, dynamic and fluid financial markets suggest that there must be business prospects. Nevertheless, they vanish when they are used for profit. Yet when certain species and traders disappear, other possibilities keep appearing, and the theory of AMH proposes that instead of progressing towards heightened efficiency, intricate market dynamics encompassing trends, panics, bubbles, and crashes persistently manifest within natural market ecologies. The final point is that the unique market environment determines whether investment ideas are successful or unsuccessful. In contrast to the EMH, the AMH suggests that investment strategies may experience a temporary decline in profitability before recovering when their supporting conditions improve. This gives rise to the notion that market efficiency transcends binary categorization, embodying a dynamic characteristic subject to continuous flux both temporally and across diverse market domains. Andrew W. Lo, (2005) argues that it is erroneous to believe that the market must advance towards some ideal level of competence and likelihood of achieving or guaranteeing convergence to equilibrium is neither certain nor probable.

Investors in the AMH framework do make mistakes and learn to adjust their behavior appropriately, unlike investors in efficient markets. There are several useful ramifications of the AMH. Secondly, because of the preferences of the people in the market, the risk-reward relationship evolves with time. AMH provides a counterpoint to the concept of weak form efficiency where the history of pricing is useless, second, the movement of previous prices effects the existing preferences due to the processes of natural selection. Third, there are occasionally arbitrage possibilities in an adaptive market. From an evolutionary standpoint, business possibilities continuously come and vanish. This necessitates investment techniques that take the market environment into account. AMH indicates "complex market dynamics," which calls for active portfolio management, in other words. Fourth, innovation is essential for surviving, and AMH advises adjusting to shifting market dynamics to guarantee a steady level of anticipated returns. Market efficiency is a trait that continually changes as phase progresses and between markets it is not an all or nothing state. Hence, a financial market may experience both efficient and inefficient times.

Even though it is still in its beginnings, researchers are becoming interested in the AMH. Ito and Sugiyama, (2009) find cycles of efficiency and inefficiency in US Market between 1955 to 2006. Urquhart and Hudson, (2013) finds that Overall findings imply that the AMH is superior to the EMH in describing the behavior of stock returns. Noda (2016) finds that the empirical findings demonstrate that the TOPIX and TSE2's market efficiency changes with time. Urquhart & McGroarty, (2016) as per the findings, the predictability of returns in stock markets undergoes temporal shifts, aligning with the AMH. Furthermore, each market adjusts to distinct market conditions in its own distinctive manner. Khuntia and Pattanayak (2018) Market efficiency changes with time and supports the AMH in the bitcoin market. Xiong *et al.*, (2019) discover that the profitability varies over time in China, which is congruent with what the AMH suggests.

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This paper aims to concurrently investigate several facets of the AMH in BSE Sensex, Brazilian Index, FTSE, German DAX, Hang Seng Index, S&P 500, and Nikkei 225. According to the AMH, market efficiency varies over time, profit opportunities occasionally arise, and market circumstances have an impact on both the market efficiency and the profitability of trading methods. Our motivation for this research is ascertain empirically, efficacy of directional trading with the use of simple moving average and its superiority over traditional buy and hold strategy. It is also another motivation to test AMH over long period of time to ensure robustness in various periods of upward, downward and lateral movement of market.

Despite the fact several technical analysis method is used to find the efficiency of the market we focused on Simple moving average method (SMA) to analyses the efficiency and inefficiency of the market. In a number of ways, we add to the body of literature because this is the first research to analyze directional trades in the BSE Sensex and other financial markets indices from AMH with the use of SMA.

The subsequent segments are structured as follows: the second section provides an overview of the current body of literature, followed by the objectives in the third section and methodologies in the fourth section. The Fifth section showcases and thoroughly analyzes the empirical findings and conclusion.

2. LITERATURE REVIEW

Growing research on the AMH has stretched its attention from mature markets to emerging ones, where different reforms and regulations are being implemented. The goal is to determine if these markets move towards efficiency, how successful the implemented changes are, and under what circumstances anomalous returns are produced. In this view Lo (2004), verify the monthly profits of the S&P Index utilizing 5-year rolling windows from 1871 to 2003, first-order autocorrelation coefficients. However, the first-order autocorrelation shows that the level of efficiency fluctuates over a span of time in cyclical manner, with times in the 1950s when the market displays higher efficiency compared to earlier periods 1990s. By using asymmetric stationary periods of the G7 national stock indexes are discovered using the momentum threshold auto-regression (MTAR) model and E-G stationary tests. It is demonstrated that the asymmetric subseries and their neighboring non-stationary subseries each have distinctive statistical characteristics. These asymmetric stationary periods presence implies that there is an inefficiency in the market. Self and Mathur (2006), Moving forward in the same direction Mandaci, Taskin and Ergun, (2019) Examine how the AMH affects the indices of the Turkish stock exchange market (Borsa Istanbul), which is a developing economy. The analysis are performed on the BIST-100, BIST-30, and BIST-All indexes between January 2002 and April 2017. To study the market efficiency, two-year rolling windows and daily test values were computed using linear and nonlinear approaches. While the outcomes of nonlinear analysis support the presence of the AMH, the results of the variance ratio test show that index returns are volatile, indicating that the market is efficient. Smith and Dyakova (2014) Using three finite-sample variance ratio tests, the weak version of the EMH is examined for eight African stock exchanges. A rolling window is used to rate markets according to their relative predictability, capture short-horizon predictability, and track predictability change. The adaptive markets theory is supported by the fact that these stock markets go through periods of predictability followed by periods of unpredictability. Lekhal and El Oubani (2020) examine the Moroccan financial market they measured the changes in the level of efficiency as observed through linear and nonlinear tests, along through the outcomes from rolling window analysis, over the course of evolution, which

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show that occasional profit opportunities arise periodically and vanish formerly they are taken advantage of in the Moroccan financial market over the period from 1992 to 2019.

Phan Tran Trung and Pham Quang (2019) measures the correlation incorporating the relationship between present stock returns and those from the past in order to test the AMH in the two major Vietnamese stock exchanges, Ho Chi Minh City Stock Exchange (HSX) and Hanoi Stock Exchange (HNX). The tests used include the time-varying autoregressive (TV-AR) technique, the generalized spectral test, the automatic variance ratio test (AVR), the automated portmanteau test (AP), and the automatic variance ratio test (AVR). The empirical findings in the Vietnamese stock market support the AMH. The findings also imply that the development of HSX has played a significant role in the AMH.

Hiremath and Kumari (2014) inspect stock returns predictability and the AMH in India, with multiple linear and nonlinear tests conducted assessments on the returns of Sensex from 1991 to 2013 and Nifty from 1994 to 2013. The outcomes of the linear assessments reveal fluctuations between efficiency and inefficiency in the Indian stock market over time. Conversely, the results from nonlinear tests unveil substantial indications of nonlinearity in returns across the entire sample duration, with a suggestion that the extent of nonlinear dependence has diminished more recently. Collectively, the findings suggest a trend towards increased efficiency in the Indian stock market.

Hull and McGroarty (2014) Analyzed over a 16-year span encompassing 22 countries, this study employs the Hurst-Mandelbrot-Wallis rescaled range method to quantify efficiency. The findings highlight compelling indications of persistent long memory in volatility throughout time, a result that aligns with expectations. These outcomes, in turn, provide evidence contradicting the weak-form EMH.

Numapau Gyamfi (2018) Investigating the predictability of returns in the Ghana stock market, this study delves into two indices—the GSEALSH index and the GSEFSII index—spanning from 2011 to 2015. Employing multiple tests the research adopts a rolling window approach to monitor the evolution of predictability over time. Across all three methodologies followed in the research, the GSEALSH index consistently demonstrates higher predictability compared to the GSEFSII index. These findings corroborate the principles of the AMH. Kołatka (2020) the study examines the rationale for applying the AMH in relation to the Polish stock market. The primary aim of the article is to evaluate the extent of predictability in return rates for the dominant index on the Polish stock exchange. To validate the cyclical fluctuations in efficiency levels within the Polish stock market, daily logarithmic return rates were utilized, sourced from the WIG index covering October 1994 to December 2019. Subsequently, the study conducted both autocorrelation and BDS tests using a rolling-window framework of two years. These findings harmonize with the implications set forth by the adaptive market hypothesis.

Obalade and Muzindutsi (2020) used both linear and non-linear test, to determine whether the Tunisian Stock Exchange (TSE) experiences time-varying efficiency, daily stock index returns from April 1999 to February 2018 considered in order to investigate if market circumstances have an impact on return prediction, dummy regression models were used. Conclusions support the existence of AMH in Tunisian Stock Exchange (TSE) and demonstrate that the Tunisian Stock Exchange (TSE) experienced an era of predictability and unpredictability. Burhan and Aacr (2021) Examines return predictability and assesses the AMH in relation to the BIST100 index within Turkey's Borsa Istanbul stock exchange market. The analysis is conducted using daily closing price data spanning from 1988 to 2017 together with automated portmanteau and generalized spectral (GS) testing. Second, a Hidden markov model

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(HMM) is used to look at the times that produce yield expectedness. The findings show that there is substantial support for the validity of AMH within the parameters of Borsa Istanbul's BIST100. In addition, HMM findings support episodic predictability of the index elements.

However Fama (1970) delineated three tiers of market efficiency—weak, semi-strong, and strong each manifesting distinct levels across various markets. The Efficient Market Hypothesis (EMH), a subject of perpetual discourse among researchers and practitioners, remains a persistently debated topic, captivating the attention of ongoing research endeavors. Nonetheless, the efficient markets hypothesis has faced its share of challenges. Numerous studies have delved into the viability of certain price-centric tactics, commonly referred to as technical strategies, to potentially outperform the market while accounting for risk. Among these approaches, moving average strategies stand out as a favored choice among technical traders Brock, W., J. Lakonishok (1992) among the array of simple moving average, the simplest iteration is the straightforward moving average strategy. In this approach, a security is purchased as it commences trading above the mean of its closing prices over a defined number of preceding days or months. Conversely, the security is sold when its price descends below this identical average.

Lo (2004) suggest that Indications arise that markets do not maintain a static state of efficiency, but rather undergo a dynamic evolution, transitioning from states of inefficiency to varying degrees of efficiency. An intriguing facet emerges when evaluating the application of technical analysis trading rules in evolving markets, stemming from their less mature financial systems. This condition could potentially give rise to reduced levels of Efficient Market Hypothesis (EMH) adherence, or even extend to situations characterized by market inefficiencies. Lo and MacKinlay (1988) Conducted an examination and employed a test, revealing that market prices exhibit limited adherence to a random walk pattern. Lo and Wang (1995) Formulated an option pricing model while taking into account the existence of predictability in market behavior. Lo, Mamaysky and Wang (2000) introduce a methodical and automated framework for the recognition of technical patterns through the utilization of nonparametric kernel regression. This approach is subsequently employed to assess the efficacy of technical analysis by scrutinizing an extensive array of U.S. stocks spanning the period from 1962 to 1996, this forms the bedrock of technical analysis within studies pertaining to the AMH. Mobarek and Fiorante (2014) an investigative analysis was carried out to ascertain the extent of market efficiency in the equity markets of Brazil, Russia, India, and China (BRIC). The principal discoveries, derived from a dataset spanning from 1995 to 2010 and employing an unbiased statistical approach, suggest that these markets could potentially be moving toward a condition of relative weak-form efficiency from their prior non-efficient state. Which support adaptive market hypothesis (AMH) by Lo, (2004).

The ongoing discussion about the worth and efficacy of technical analysis persists, encompassing evaluations of trading expenses and associated risks. Anchored in the conviction that price fluctuations adhere to patterns rather than randomness, technical analysis asserts that prices follow trends that carry a degree of predictability. Evidently, mainstream media frequently spotlights technical analysts and their analytical insights. Brock, W., J. Lakonishok (1992) over a span of 90 years encompassing daily data from the Dow Jones Industrial Average Index, the study investigated the predictive efficacy of both variable and fixed moving averages, as well as trading range break rules. The outcomes unveiled that the utilization of these technical trading rules yielded signals for buying and selling that translated into

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returns surpassing the 'normal' returns achieved through a buy-and-hold strategy. Specifically, results pertaining to the variable moving average (VMA) and fixed moving average (FMA) rules demonstrated a significant trend, average buy returns outpaced average sell returns, a trend maintained even when factoring in transaction costs, over both the complete dataset and four non-overlapping segments. Bessembinder and Chan, (1995) conducted an evaluation to determine if basic forms of technical analysis could forecast stock price shifts within Asian markets. Their findings indicate substantial effectiveness of these rules within the emerging markets of Malaysia, Thailand, and Taiwan. However, the explanatory capacity of these rules diminishes within more developed markets like Hong Kong and Japan. Kresta and Franek (2015) implement moving averages to establish an automated trading system which includes simple moving average, weighted moving, and exponential moving average followed by an assessment of its profitability within the Czech stock market. The results are subjected to statistical examination, and from these findings, Kresta and Franek inferences regarding the viability of employing such an automated trading system in the context of the Czech stock market. Sobreiro *et al.*, (2016) emphasized that technical analysis tools have the potential to generate favorable alphas in comparison to a buy-and-hold strategy. The study focused on the primary stocks within BRICS and emerging markets, examining the timeframe from 2000 to 2015. Various combinations of moving average strategies and periods were analyzed. The key findings suggest that specific countries exhibited improved outcomes through certain combinations of moving average periods. Study confirm that the SMA-strategy yielded the most favorable risk and return ratio when assessed using the ratio between the return and its corresponding standard deviation.

Ellis and Parbery (2005) the inherent merit of the adaptive moving average in comparison to fixed-length SMA trading systems lies in its intrinsic capability to autonomously adapt to dynamic market circumstances contingent upon the prevailing volatility levels within the market milieu. Although the approach has been substantiated to possess a degree of market timing proficiency, the comprehensive outcomes evince that the returns yielded by the adaptive moving average are insufficient to offset the cost of trade.

The SMA stands as a widely recognized predictive technique, known for its accessible comprehension, straightforward interpretation, and user friendly application. When considering normal and cumulative values, SMA exhibits enhanced performance in both point forecasts and the accuracy of prediction intervals (Svetunkov and Petropoulos,2018).

3. OBJECTIVES OF THE STUDY

(1) To compute passive buy and hold strategy in major indices of the world over 25 years
(2) To develop an active trading strategy with the use of SMA in the context of AMH
(3) To conclude on findings related to active trading strategy v/s passive buy and hold strategy

4. METHODOLOGY

This paper examines into the dynamic progression of market efficiency using Simple Moving Average (SMA) trading systems as its focal point of investigation.

A Simple Moving Average (SMA) strategy is a popular algorithmic trading approach that uses the

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historical average prices of a financial instrument (such as a stock, currency pair, or commodity) over a specified time period to make trading decisions. Functioning as a lagging indicator, the SMA assists traders in recognizing market trends and determining potential entry or exit positions. Here is the basic idea of an SMA strategy:

The SMA is calculated by summing up the prices of the asset over a certain number of periods (usually days) and then dividing by the number of periods. For example, a M-day SMA is calculated by adding up the closing prices of the asset for the last m days and dividing by M.

For the above strategy, the formulation for SMA-m would be :

$$SMA - m = \frac{\sum_1^m P_t}{m} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

The SMA-m is generated with the help of evaluating where the minimum of the SMA-m appears or the maximum of the SMA appears. For our research, the value of m is set to equal 25, closely representing (slightly exceeding) the number of trading days in any month.

A directional signal is being used for SMA maximum and minimum points and when a minimum SMA is reached, a buy signal is generated and when a maximum SMA is reached a sell signal is generated.

For the minimum of the SMA to appear, the following condition needs to hold

$$SMA_{t-1} < SMA_t < SMA_{t+1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$
$$where\ 1 < t < m\ and\ m \geq 20\ for\ our\ purposes$$

For the maximum of the SMA to appear, the following condition needs to hold

$$SMA_{t+1} < SMA_t\ and\ SMA_t > SMA_{t-1} \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$
$$where\ 1 < t < m\ and\ m \geq 20\ for\ our\ purposes$$

It is important to back test it on historical data to evaluate its performance. Traders may also experiment with different SMA periods to optimize the strategy's effectiveness for specific market conditions. We back tested the strategy of minimum and maximum SMA on several indices including the BSE Sensex, Brazilian Index, Financial Times Stock Exchange Group, German DAX, Hang Seng Index, Standard and Poor's (S&P 500), Nikkei 225 and found that over 25 years starting 25th August 1998 and 25th August 2023, the strategy developed by us beats the buy and hold strategy in each index.

Specifically, we accumulate profit as follows, the accumulated profit across transactions divided by the profit in time t=0 or the price at which bought, in the first transaction

$$Total\ Profit = \sum_{i=1}^{N} \left(P_{sell,i} - P_{buy,i}\right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$
$$where\ N = total\ number\ of\ transactions\ in\ the\ strategy$$

$$Profit\ percent = \left(\left(\frac{Total\ Profit}{P_{buy,i=0}}\right) - 1\right) * 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

The profit percent of the strategy is compared to the passive buy and hold, which is calculated as the price today, divided by the price at time t =0

$$Passive\ Profit\ percent = \left(\left(\frac{P_{today}}{P_{buy,i=0}}\right) - 1\right) * 100 \quad \ldots\ldots\ldots\ldots\ldots\ldots (6)$$

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Table 1 : *Results of Traditional Buy and Hold Strategy and active AMH Strategy with SMA minima and maxima*

Traditional buy and hold (passive) strategy					Active AMH strategy which leverages SMA minima and maxima						
Earliest buy date	**Latest asset date**	**Buy at**	**Sell at**	**Profit %**	**AMH Earliest Buy date**	**AMH Last Sell date**	**AMH profit**	**AMH Investment**	**Profit %**	**No transactions**	**Ticker**
1998/08/26	2023/08/25	70	440	532%	1998/10/05	2023/05/24	940	63	1386%	268	S&P500
1998/08/25	2023/08/25	15,073	31,624	110%	1998/10/21	2023/07/28	100,602	14,216	608%	275	Nikkei 225
1998/08/25	2023/08/25	2,993	64,887	2068%	1998/10/05	2023/08/10	149,090	2,878	5080%	206	BSE Sensex
1998/08/25	2023/08/25	5,407	15,632	189%	1998/10/23	2023/08/14	53,401	4,480	1092%	249	German DAX
1998/08/25	2023/08/25	7,890	18,119	130%	1998/09/29	2023/08/09	119,538	7,838	1425%	229	Hang Seng Index
1998/08/25	2023/08/25	5,100	18,131	255%	1998/10/22	2023/07/18	63,637	4,656	1267%	249	FTSE (^FTMC)
1998/08/25	2023/08/25	7,648	115,837	1415%	1998/10/08	2023/08/22	472,614	6,175	7554%	260	Brazilian Index

Source: Authors estimation

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Fig: 1. Source: Authors estimation

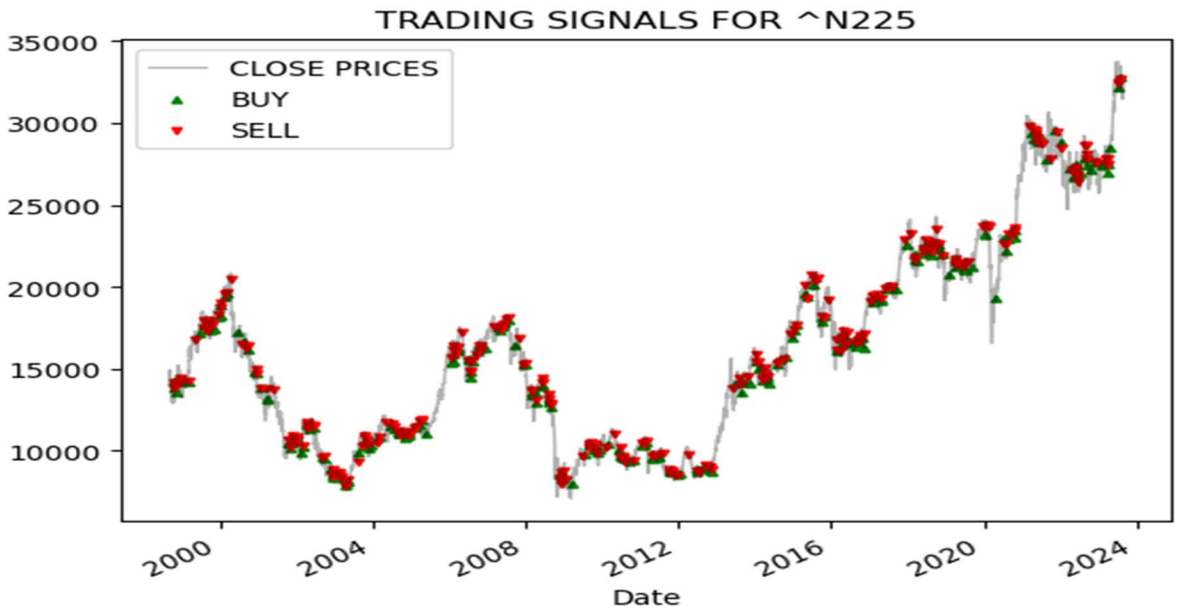

Fig: 2. Source: Authors estimation

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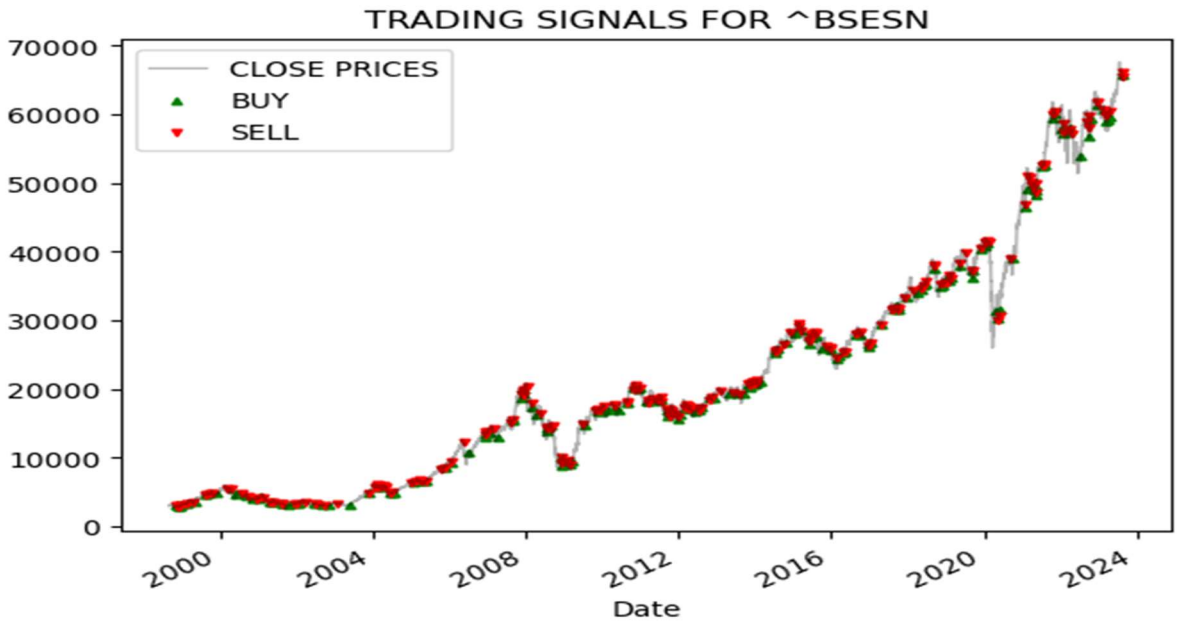

Fig: 3. Source: Authors estimation

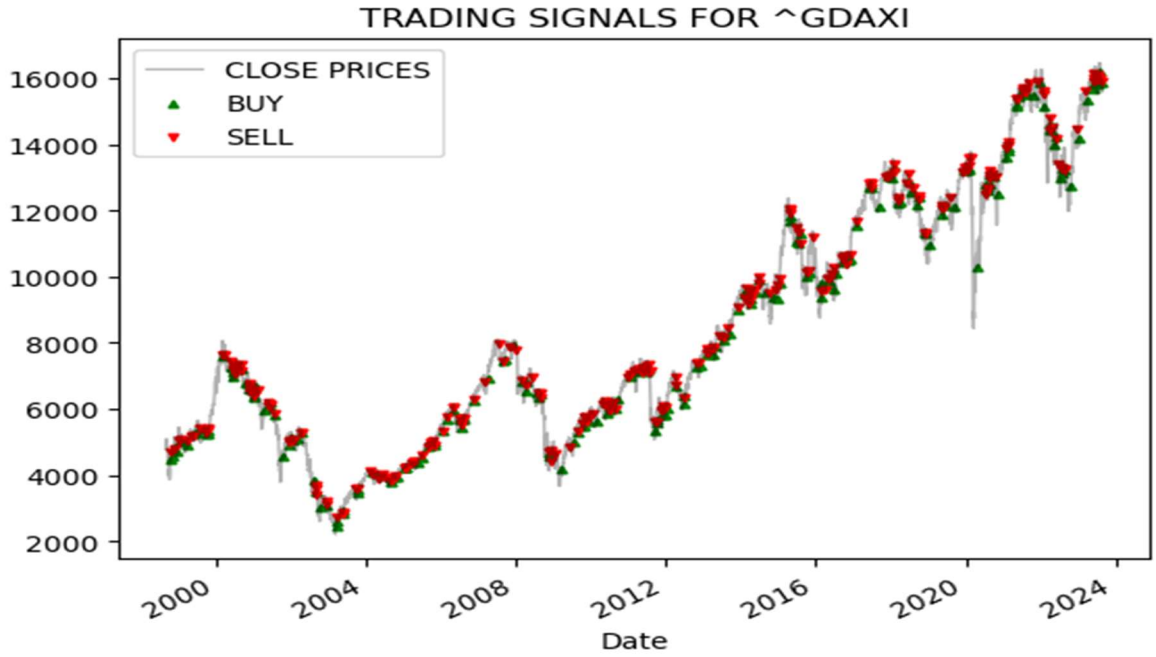

Fig: 4. Source: Authors estimation

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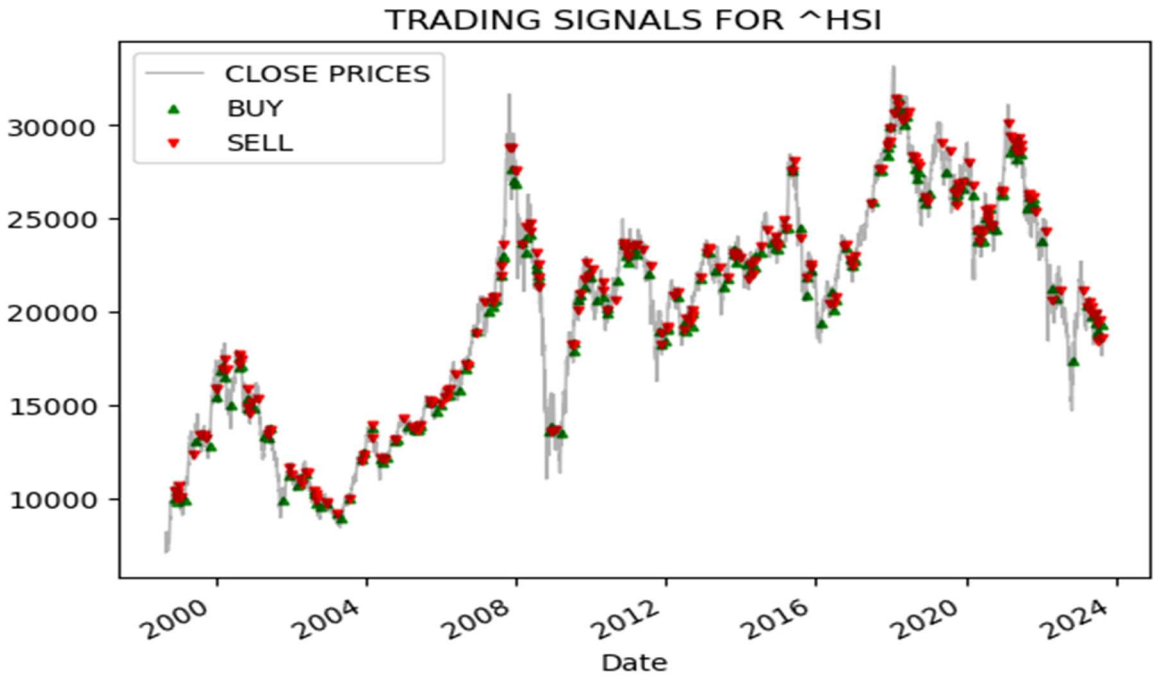

Fig: 5. Source: Authors estimation

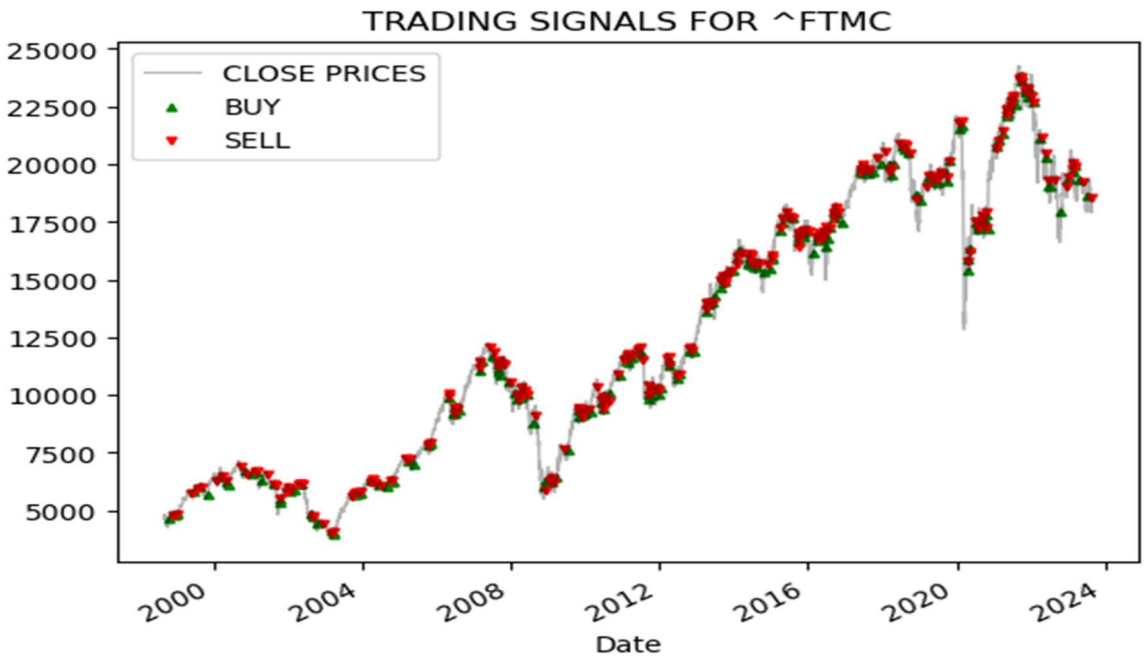

Fig: 6. Source: Authors estimation

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Fig: 7. Source: Authors estimation

Observations from Table 1

The first column represents the earliest buy-date for the Index, and it represents the investment base for the buy-and-hold strategy. As an example, the earliest buy date for the ^BSESN is 25th August, 1998[1]. The second column represents the Latest Asset Date and represents the last date of trade of the Index. Again, using ^BSESN as an example, the sell date is the last trade date when this research was conducted, which is recorded as 25th August, 2023. The third column is the Buy at price and represents the price at which the Asset was bought at for the buy and hold and in the case of ^BSESN the value is 2993. The fourth column is the Sell at price and in the case of ^BSESN it is 64,887 and the Profit thus calculated in the fifth column is the Passive Profit formula as represented in **Equation 6** above. The passive profit in the case of ^BSESN is 2068 % implying about a 20-fold increase in the underlying index value over 25 years. The sixth column is the AMH earliest buy date and this represents the first date on which the index was bought (the SMA-25 reached a minimum[2]). In case of ^BSESN the AMH earliest buy date is 5th October 1998, and this represents the earliest date on which the Index SMA-25 saw a minimum, when the index value was equal to 2878. The AMH last Sell date is the seventh column and it represents the last date on which the AMH strategy issued a sell signal. The example for the ^BSESN indicates that the sell was initiated on 10th August 2023. The AMH profit booked under the strategy is 149,090 is represented in the eight column. The investment in the index is given in the ninth column and is the value at which the index was bought for the very first time, in the case of ^BSESN

[1] For consistency across geographies which may use mm/dd/yy or dd/mm/yy for date formats, we use yyyy/mm/dd as the format where yyyy stands for year and mm stands for month while dd stands for date

[2] The first time the SMA reaches a minimum is the starting point of the analysis of any index, if a maximum occurs first, it is ignored

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the value is 2878. The profit % from the AMH strategy is in the tenth column and is calculated at 5080% or approximately 50 times the original investment. The eleventh column represents the number of transactions in the AMH strategy and in the case of ^BSESN it is 206[3]. Finally, the ticker symbol is displayed in column twelve.

5. FINDINGS, CONCLUSION, IMPLICATIONS AND FURTHER RESEARCH

It is observed that in each of the indices being analyzed in this research, the buy-and-hold strategy is being comfortably and comprehensively beaten by a simple AMH SMA-25 minimax strategy, and this is a major finding in the research. The Brazilian index has seen the largest profit percent of a whopping 7554% followed by the ^BSESN of 5080%. The Hang Seng index, S&P500 as well as the FTSE and German DAX have shown four-digit percent increases and the German index has an almost 10x improvement on the Passive buy-and-hold strategy, as does the Hang Seng index. The Nikkei 225, Brazilian index, and the FTSE display about 5x improvement over the buy-and-hold strategy while the ^BSESN and S&P 500 show an approximately moderate 2x improvement over the buy-and-hold strategy.

It seems evident that efficient market hypothesis can be subdued, overcome, and even beaten with simple SMA-25 minima and maxima directional trades. This has been proved over 25 years with various indices from different geographies. Thus, it is evident that AMH has demonstrated that it does exist, is feasible and robust and indeed market inefficiencies exist and opportunities for investment are rife.

Implications

Implications from this study are several. Firstly, the AMH lodges itself as a viable and feasible alternative to the efficient market hypothesis which purports that the markets cannot be predicted in time. Further, the market can indeed be timed. The points at which the SMA reaches a minimum represents a buy opportunity and could mean points at which the markets are either fearful or in an oversold condition. Specifically, the minimum point of SMA-25 represents buying opportunity of that particular index. In contrast, SMA-25 maximum indicates markets are in a fearless, overbought or possibly even greedy state or overvalued. The implication from AMH could lead to possible overlap with Contrarian strategies leading to value investing, as laid out by the Buffet Value investment style by Rotblut (2021) in Forbes magazine, Investopedia (2023) as well as Seeking Alpha (2021)

Further Research

Further Research can be conducted on time periods specific to shocks to the market like the Covid-19 pandemic of 2020 as well as the financial crisis of 2009 in addition to the internet bubble of 2001 to ascertain if there are specific trends and patterns in the SMA-25 minima and maxima strategies. In addition, other indices from the world can be studied in a manner like the current research and finally, a sectoral study connected to business cycles can also be conducted as an extension of this study. Finally additional research can be conducted by using other variables such as Exponential Moving Average Indicator (EMA), Weighted Moving Average Indicator (WMA), etc.

[3] The transaction cost is being ignored in the calculation of returns as it is expected to be averaged over relatively larger quantities of investment than itself

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http://magellanes.com/

REFERENCES

Andrew W. Lo. (2005). Reconciling Efficient Markets with Behavioral Finance: The Adaptive Markets Hypothesis. *Journal of Investment Consulting*, *7*(2), 21–44. https://doi.org/10.1016/s0883-5403(04)00612-6

Bessembinder, H., & Chan, K. (1995). The profitability of technical trading rules in the Asian stock markets. *Pacific-Basin Finance Journal*, *3*(2–3), 257–284. https://doi.org/10.1016/0927-538X(95)00002-3

Brock, W., J. Lakonishok, and B. L. (1992). Simple Technical Trading Rules and the Stochastic Properties of Stock Returns. *The Journal of Finance*, *47*(5), 1731–1764. https://doi.org/10.1111/j.1540-6261.1992.tb04681.x

Brock, W., Lakonishok, J., & LeBaron, B. (1992). Simple Technical Trading Rules and the Stochastic Properties of Stock Returns. In *The Journal of Finance* (Vol. 47, Issue 5, pp. 1731–1764). https://doi.org/10.1111/j.1540-6261.1992.tb04681.x

BURHAN, H. A., & ACAR, E. (2021). Adaptive Market Hypothesis and Return Predictability: A Hidden Markov Model Application in Borsa Istanbul. *Sosyoekonomi*, *29*(48), 31–58. https://doi.org/10.17233/sosyoekonomi.2021.02.02

Cheung, K., & Coutts, J. A. (2010). A note on weak form market efficiency in security prices : evidence from the Hong Kong stock exchange. *Applied Economics Letters*, *July 2014*, 37–41. https://doi.org/10.1080/135048501750237865

Ellis, C. A., & Parbery, S. A. (2005). Is smarter better? A comparison of adaptive, and simple moving average trading strategies. *Research in International Business and Finance*, *19*(3), 399–411. https://doi.org/10.1016/j.ribaf.2004.12.009

Fama, E. F., & French, K. R. (1988). Permanent and temporary components of stock prices. *Journal of Political Economy*, *96*(2), 161–174. https://doi.org/10.1504/IJEBR.2014.064119

Fama, E. F. (1965). The Behavior Of Stock-Market Prices. *The Journal of Business*, *38*(1), 34–105.

Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. *Journal of Finance*, *25*(2), 28–30.

Grossman, S.J., Stiglitz, J. E. (1980). On the Impossibility of Informationally Efficient Markets. In *The American Economic Review* (Vol. 70, Issue 3, p. 873). http://ezproxy.lib.monash.edu.au/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=4504970&site=ehost-live&scope=site

Hiremath, G. S., & Kumari, J. (2014). Stock returns predictability and the adaptive market hypothesis in emerging markets: evidence from India. *SpringerPlus*, *3*(1), 1–14. https://doi.org/10.1186/2193-1801-3-428

Hull, M., & McGroarty, F. (2014). Do emerging markets become more efficient as they develop? Long memory persistence in equity indices. *Emerging Markets Review*, *18*, 45–61. https://doi.org/10.1016/j.ememar.2013.11.001

Ito, M., & Sugiyama, S. (2009). Measuring the degree of time varying market inefficiency. *Economics Letters*, *103*(1), 62–64. https://doi.org/10.1016/j.econlet.2009.01.028

Jegadeesh, N., & Titman, S. (1993). Returns to Buying Winners and Selling Losers: Implications for

ISSN:1624-1940
DOI 10.6084/m9.figshare.2632574
http://magellanes.com/

Stock Market Efficiency. *The Journal of Finance*, *48*(1), 65–91. https://doi.org/10.2307/2328882

Khuntia, S., & Pattanayak, J. K. (2018). Adaptive market hypothesis and evolving predictability of bitcoin. *Economics Letters*, *167*, 26–28. https://doi.org/10.1016/j.econlet.2018.03.005

Kim, J. H., Shamsuddin, A., & Lim, K. P. (2011). Stock return predictability and the adaptive markets hypothesis: Evidence from century-long U.S. data. *Journal of Empirical Finance*, *18*(5), 868–879. https://doi.org/10.1016/j.jempfin.2011.08.002

Kołatka, M. (2020). Testing the adaptive market hypothesis on the WIG Stock Index: 1994-2019. *Prace Naukowe Uniwersytetu Ekonomicznego We Wrocławiu*, *64*(1), 131–142. https://doi.org/10.15611/pn.2020.1.11

Kresta, A., & Franek, J. (2015). Analysis of Moving Average Rules Applicability in Czech Stock Market. *Procedia Economics and Finance*, *30*(March 2016), 364–371. https://doi.org/10.1016/s2212-5671(15)01303-9

Lekhal, M., & El Oubani, A. (2020). Does the Adaptive Market Hypothesis explain the evolution of emerging markets efficiency? Evidence from the Moroccan financial market. *Heliyon*, *6*(7), e04429. https://doi.org/10.1016/j.heliyon.2020.e04429

Lo, A. W. (2004). The Adaptive Markets Hypothesis:Market Efficiency from an Evolutionary Perspective. *Journal of Portfolio Management*, *0920*(617), 176–221. https://doi.org/10.2307/j.ctvc7778k.9

Lo, A. W., & MacKinlay, A. C. (1988). Stock market prices do not follow random walks: evidence from a simple specification test. *Review of Financial Studies, 1(1), 41-66.*

Lo, A. W., Mamaysky, H., & Wang, J. (2000). Foundations of technical analysis: Computational algorithms, statistical inference, and empirical implementation. *Journal of Finance*, *55*(4), 1705–1770. https://doi.org/10.1111/0022-1082.00265

Mandaci, P. E., Taşkin, F. D., & Ergün, Z. C. (2019). Adaptive market hypothesis. *The American Economic Review, 70(3), 393-408*, *7*(4), 84–101. https://doi.org/10.35808/ijeba/333

Mobarek, A., & Fiorante, A. (2014). The prospects of BRIC countries: Testing weak-form market efficiency. *Research in International Business and Finance*, *30*(1), 217–232. https://doi.org/10.1016/j.ribaf.2013.06.004

Noda, A. (2016). A test of the adaptive market hypothesis using a time-varying AR model in Japan. *Finance Research Letters*, *17*, 66–71. https://doi.org/10.1016/j.frl.2016.01.004

Numapau Gyamfi, E. (2018). Adaptive Market Hypothesis: Evidence from the Ghanaian Stock Market. *Journal of African Business*, *19*(2), 195–209. https://doi.org/10.1080/15228916.2018.1392838

Obalade, A. A., & Muzindutsi, P. F. (2020). Validating the adaptive market hypothesis in the Tunisian stock market. *International Journal of Trade and Global Markets*, *13*(1), 42–51. https://doi.org/10.1504/IJTGM.2020.104906

Phan Tran Trung, D., & Pham Quang, H. (2019). Adaptive Market Hypothesis: Evidence from the Vietnamese Stock Market. *Journal of Risk and Financial Management*, *12*(2), 81. https://doi.org/10.3390/jrfm12020081

Self, J. K., & Mathur, I. (2006). Asymmetric stationarity in national stock market indices: An MTAR analysis. *Journal of Business*, *79*(6), 3153–3174. https://doi.org/10.1086/505252

Shiller, R. J. (2021). From Efficient Markets Theory to Behavioral Finance. *The Journal of Economic*

ISSN:1624-1940
DOI 10.6084/m9.figshare.2632574
http://magellanes.com/

Perspectives, *17*(1), 83–104. https://doi.org/10.36198/9783838587301

Simon, H. A. (1955). A Behavioral Model of Rational Choice. *The Quarterly Journal of Economics*, *69*(1), 99–118. https://www.suz.uzh.ch/dam/jcr:ffffffff-fad3-547b-ffff-fffff0bf4572/10.18-simon-55.pdf

Smith, G., & Dyakova, A. (2014). African stock markets: Efficiency and relative predictability. *South African Journal of Economics*, *82*(2), 258–275. https://doi.org/10.1111/saje.12009

Sobreiro, V. A., Cruz Cacique da Costa, T. R., Farias Nazário, R. T., Lima e Silva, J., Moreira, E. A., Lima Filho, M. C., Kimura, H., & Arismendi Zambrano, J. C. (2016). The profitability of moving average trading rules in BRICS and emerging stock markets. *North American Journal of Economics and Finance*, *38*, 86–101. https://doi.org/10.1016/j.najef.2016.08.003

Svetunkov, I., & Petropoulos, F. (2018). Old dog, new tricks: a modelling view of simple moving averages. *International Journal of Production Research*, *56*(18), 6034–6047. https://doi.org/10.1080/00207543.2017.1380326

Urquhart, A., & Hudson, R. (2013). Efficient or adaptive markets? Evidence from major stock markets using very long run historic data. *International Review of Financial Analysis*, *28*, 130–142. https://doi.org/10.1016/j.irfa.2013.03.005

Urquhart, A., & McGroarty, F. (2016). Are stock markets really efficient? Evidence of the adaptive market hypothesis. In *International Review of Financial Analysis* (Vol. 47). Elsevier B.V. https://doi.org/10.1016/j.irfa.2016.06.011

Xiong, X., Meng, Y., Li, X., & Shen, D. (2019). An empirical analysis of the Adaptive Market Hypothesis with calendar effects:Evidence from China. In *Finance Research Letters* (Vol. 31, Issue November). https://doi.org/10.1016/j.frl.2018.11.020