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ARE STOCK MARKETS IN MINT COUNTRIES EFFICIENT OR ADAPTIVE? EVIDENCE FROM A WAVELET-BASED UNIT ROOT TEST

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ABSTRACT

This paper examines the validity of the Efficient Market Hypothesis (EMH) and the Adaptive Market Hypothesis (AMH) for the stock markets of the MINT countries (Mexico, Indonesia, Nigeria and Türkiye). The methodology uses daily return series and applies Wavelet-based Augmented Dickey-Fuller (W-ADF) and Wavelet-based Fourier Augmented Dickey-Fuller (W-FADF) unit root tests across short-, medium-, and long-term horizons to account for structural breaks. The results show that stock prices in Indonesia, Mexico and Türkiye exhibit stationarity and partial predictability in the short and medium term, which supports the AMH. However, these markets follow a random walk in the long term, which aligns with the EMH. The results for Nigeria, however, show random walk behaviour in the short and medium terms, adapting to a stationary process in the long term. In conclusion, the findings establish that market efficiency in MINT economies continually evolves. The AMH, therefore, appears to offer a more robust theoretical explanation for these time-varying market behaviours.

KEYWORDS: Efficient Market Hypothesis, Adaptive Market Hypothesis, MINT Countries, Wavelet Transform, W-ADF unit root test, W-FADF unit root test.

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1. INTRODUCTION

In the finance literature, the concept of "market efficiency" is a fundamental research area whose foundations trace back to Samuelson's (1965) pioneering work, having remained at the centre of academic debates for many years. To achieve informational efficiency, Samuelson argued that investor expectations must be predicated on the condition that all available market information is fully incorporated into prices. According to the author, the future prices of commodities cannot be predicted using the current information set, as these prices already encapsulate this data entirely.

Building upon this intellectual foundation, Fama (1970) developed the Efficient Market Hypothesis (EMH), placing market efficiency into a theoretical structure, and defined an efficient market as a mechanism where asset prices exhaustively reflect all publicly available information (Görgel and Ege, 2024). Indeed, the EMH has been one of the most fiercely debated subjects within the financial literature over the past half-century (Rönkkö et al., 2024). The hypothesis posits that investors behave rationally, thereby eliminating the possibility of generating above-average market returns through the use of historical price data. This primarily occurs because the prices of financial assets show a random walk rather than following a predictable trend (Ertaş and Özkan, 2018; Öz, 2024).

Furthermore, the EMH asserts that financial markets assimilate all existing information, leading to the rational formation of prices. In this context, the postulation suggests that markets react instantaneously to novel information, causing any potential arbitrage opportunities to vanish rapidly (Fama, 1970; Fama, 1980). Ultimately, the EMH serves as an approach aimed at elucidating the price formation stages of financial assets. Originally, this proposition was introduced to analyse the impacts of price behaviours in equity markets on investment decisions.

In light of the preceding information, the validity of the EMH hinges upon the fulfilment of two fundamental prerequisites. Initially, such a market is required to instantaneously and exhaustively reflect all available and accessible data within share prices. Furthermore, it remains impossible for market participants to systematically secure above-average yields using this particular information set and, consequently, the market mechanism itself eradicates any probability of generating excess returns (Novickyte and Degutis, 2014). Fama (1970) approaches this hypothesis across three primary tiers, specifically the weak, semi-strong, and strong forms, contingent upon the extent to which informational efficiency permeates the markets. The weak form assumes that historical data, including previous price trajectories and trading volumes, prove inadequate for explaining future price fluctuations, meaning that technical analysis methodologies cannot systematically yield superior profits. Moving to the semi-strong form, this secondary assumption dictates that all publicly accessible figures, ranging from financial reports to macroeconomic indicators and breaking news, are immediately incorporated into valuations alongside historical price metrics. Thus, achieving abnormal yields that surpass the market average via fundamental analysis techniques is deemed unfeasible (Brealey, 1997). Finally, the strong form is predicated on the notion that absolutely all details concerning a financial asset, encompassing past price records, public disclosures, and privately obtained insider knowledge, are completely embedded in the prices. Under these circumstances, generating long-term returns exceeding the market average by exploiting privileged information becomes virtually impossible for any investor (Grossman and Stiglitz, 1980; Başkaya, 2025).

Investigating the EMH is of paramount importance for both economists and policymakers, given that an efficient market structure facilitates the optimal allocation of capital and resources (Shiller, 2003). Comparing the equity markets of diverse country groups based on their efficiency levels serves as a valuable informational indicator for regulatory bodies and decision-makers. Such evaluations establish a fundamental reference point for ensuring enduring market stability and sustainably supporting economic growth alongside investments (Arshad et al., 2016). In summary, the EMH, frequently introduced as the traditional finance approach, posits that investors act rationally, utilise all market information effectively during their decision-making phases, and that financial models can be constructed along these lines (Fama, 1970).

However, numerous empirical studies conducted in subsequent periods have demonstrated that this assumption of rational behaviour predicted by the EMH is not universally valid (Lo, 2005). For instance, the pioneering research of Kahneman and Tversky (1973, 1979) articulated that investors do not behave with absolute rationality throughout their decision-making processes, highlighting that cognitive biases and psychological factors play a decisive role in investment preferences. Empirical findings in the literature have revealed that individuals can make irrational choices under various circumstances,

proving that financial models do not entirely align with market realities and that systematic anomalies emerge within the markets. Particularly in the post-1980 era, the EMH became the subject of intense debate due to escalating theoretical scrutiny and mounting empirical evidence. The Information Paradox developed by Grossman and Stiglitz (1980) stated that achieving complete market efficiency is impossible when acquiring data incurs costs, thereby severely questioning the EMH's assumption of unrestricted access to information. In addition to these points, the financial crises that occurred in the 2000s, alongside speculative price bubbles and instances of irrational behaviour manifested by market actors, have exposed that investment decisions are not consistently founded upon rational expectations and knowledge. Consequently, these developments have triggered severe criticisms directed at the EMH. Accordingly, they have paved the way for the ascent of the behavioural finance approach and prompted a re-evaluation of market efficiency debates within the scope of a novel paradigm.

These market anomalies, which contradict the EMH, paved the way for the emergence of significant theoretical gaps in the finance literature such voids began to be addressed with the genesis of the behavioural finance approach. By taking the cognitive biases and psychological tendencies of investors into account, behavioural finance has developed psychology-based models attempting to explain the extraordinary surges or declines observed in securities prices (Fahmy, 2017). This discipline challenges the market efficiency assumption by arguing that cognitive biases and psychological impacts are decisive in the decision-making processes of investors (Malkiel, 2003).

To resolve the contrast between these two perspectives, Lo (2004) developed the Adaptive Markets Hypothesis (AMH). The AMH advocates that market efficiency can exhibit variability over time by establishing a synthesis between the rationality assumption of traditional finance and the psychologically grounded explanations of behavioural finance (Lo, 2004). Furthermore, this hypothesis posits that the EMH and Behavioural Finance actually represent different dimensions of the identical procedure, hence market efficiency does not display a constant structure throughout time (Lo, 2007; Fahmy, 2017). Within this context, market efficiency periodically increases or decreases depending on shifts in economic conditions, investor behaviours, and information flow. In other words, rather than treating market efficiency as a static concept like the EMH does, the AMH considers it a continuously evolving process shaped by the impact of factors such as crises, speculative bubbles, and fluctuations in investor behaviour (López-Martín, 2023). Accordingly, the AMH not only contributes to the elucidation of market anomalies but also provides a holistic theoretical structure to make sense of the time-dimensional alterations in the efficiency levels of financial markets (Karaca, 2025). Consequently, in contrast to the EMH, the AMH proposes that investment strategies may temporarily lose their effectiveness during specific periods, yet these strategies can evolve back into a profitable state once market conditions become favourable again (Lo, 2005). Additionally, within the scope of the AMH, market efficiency does not possess a stationary characteristic; instead, it demonstrates variability in a highly fluid manner across time and diverse market structures (Urquhart and Hudson, 2013).

Considering the points discussed above, the MINT group (Mexico, Indonesia, Nigeria, and Türkiye), consisting of four nations with substantial development potential, has garnered considerable attention within the global economy due to its rapidly accelerating growth trends in recent years (Liu and Chen, 2024). These countries distinguish themselves from other emerging clusters through their elevated growth prospects, a phenomenon driven by their vibrant young demographic, expanding production capacities, commercial architecture, and advancing financial markets (Du et al., 2022). Furthermore, the substantial presence of participants in the equity exchanges of MINT nations actively contributes to the reinforcement of the financial infrastructure alongside the broadening of trade volumes (Özdurak and Hekim, 2024). Consequently, this environment causes the markets to concurrently harbour elements of both risk and opportunity.

Against this backdrop, the primary objective of this paper is to test the validity of EMH and the AMH across the stock exchanges of MINT countries. To fulfil this purpose, the analyses utilise daily data sets covering the periods for Mexico (11.11.1991 to 31.07.2025), Indonesia (09.04.1990 to 31.07.2025), Nigeria (30.01.2012 to 25.08.2025), and Türkiye (03.01.1988 to 31.07.2025). By applying Wavelet-based ADF (W-ADF) and Wavelet-based Fourier ADF (W-FADF) methodologies, the research aims to demonstrate which postulation more consistently elucidates market efficiency through the lens of the EMH and the AMH within this specific group of nations.

In addition to these elements, the paper

contributes to the literature in four distinct ways. Primarily, it occupies a pioneering position within the academic sphere, as it represents the first comprehensive empirical research to holistically test the validity of both the EMH and the AMH for the MINT nations. Furthermore, the Wavelet based ADF (W-ADF) and Fourier Wavelet based ADF (W-FADF) tests applied in the research. This methodological innovation captures the time and frequency interaction that is frequently overlooked in the literature, thereby evaluating market behaviours from a multidimensional perspective. Thirdly, the derived findings indicate that while a certain degree of predictability exists in the short and medium terms within the MINT countries, prices tend to gravitate towards a random walk pattern in the long run. This outcome demonstrates that market efficiency is not stationary; rather, it is a constantly evolving process that fluctuates depending on economic, behavioural, and external factors, thus providing robust empirical support for the AMH developed by Lo (2004). Ultimately, the paper does not merely offer contributions on a theoretical level but also presents significant practical implications for investors, portfolio managers, and policymakers. The results reveal that investor actions influence information asymmetry and price formations in the short term, whereas markets gravitate back towards equilibrium and partially regain their efficiency over extended periods. From this perspective, through advanced econometric examination of the MINT economies, the research introduces an alternative empirical approach and enriches the literature on behavioural finance as well as market efficiency.

The remainder of this paper is organised in the following manner. Initially, a comprehensive literature review evaluates national and international empirical research investigating the validity of both the EMH and AMH. Subsequent to this, the methodology section is presented to outline the dataset alongside the applied analytical procedures in thorough detail. Finally, the paper concludes with a final section that summarises the derived findings, offering practical implications and recommendations specifically tailored for financial market investors as well as policymakers.

2. LITERATURE REVIEW

The efficiency of capital markets and the predictability of price behaviours have remained fundamental topics of debate within the finance literature for decades. Fama's (1970) Efficient Market Hypothesis (EMH) posits that asset valuations rapidly reflect all available market information, asserting that investors cannot consistently outperform the market. Conversely, Grossman and Stiglitz (1980), argued that attaining absolute equilibrium is impossible, primarily because arbitrage incurs substantial costs. Meanwhile, Campbell et al. (1997) introduced the concept of "relative efficiency" to the academic sphere, classifying markets according to their varying degrees of effectiveness.

Over time, anomalies such as the momentum effect, identified by researchers including Jegadeesh and Titman (1993), began to cast doubt upon the validity of the EMH. Accompanying the ascent of behavioural finance, Kahneman and Tversky's (1979) Prospect Theory elucidated the risk inclinations that arise from individuals evaluating gains and losses asymmetrically. Furthermore, Barberis and Thaler (2003), drew attention to the adverse impacts that psychological biases, encompassing overconfidence, herd behaviour, and the anchoring effect, exert on pricing mechanisms. In light of these discussions, whilst Malkiel (2003), highlighted the contradiction between the EMH and behavioural finance, Lo (2004) proposed through the AMH that both approaches are essentially different sides of the identical coin, suggesting that market efficiency exhibits variability across time.

Although it does not constitute the primary focus area of this paper, it would be appropriate to briefly mention the Fractal Market Hypothesis (FMH), which was developed as an alternative and critical approach to the EMH. In his early research conducted from the perspective of Chaos Theory alongside fractal geometry, Peters (1994), laid the foundations of the FMH by arguing that financial time series possess a distinct long-memory characteristic and that price movements are not independent of one another. Supporting this viewpoint, Mauboussin (2002), suggested that modelling markets as "Complex Adaptive Systems" incorporating feedback loops, rather than relying on the EMH which presents a static equilibrium, proves more successful in elucidating market mechanics.

Conversely, Malkiel (2003), one of the staunchest advocates of the EMH, claimed that market anomalies dissipate over time and that even professional funds cannot consistently beat the index. Consequently, he asserted that markets are efficient enough to preclude arbitrage opportunities, even if they are not entirely rational. Nevertheless, accompanying the ascent of behavioural finance, Zajac and Westphal (2004), determined that the reactions of market actors, particularly regarding share repurchase programmes, are not stationary but

rather evolve through continuous learning. Furthermore, Çelik and Taş (2007), demonstrated that while weak-form efficiency is generally supported across emerging markets, the random walk hypothesis is definitively rejected within the specific stock exchanges of nations such as Russia and Argentina.

Upon examining the literature concerning the EMH and the AMH, it becomes evident that numerous studies conducted across different periods and countries have provided significant contributions towards explaining market behaviours. Presenting evidence in favour of the AMH, Lim and Brooks (2009), stated that market efficiency evolves in response to crises and institutional alterations. In their research concentrating on five emerging European nations, Smith and Ryoo (2003), analysed market efficiency by utilising the variance ratio test, concluding that Türkiye operates as a weak form efficient market. Similarly, through an evaluation of several developing countries employing various unit root tests, Çelik and Taş (2007), revealed that whilst most markets exhibit weak form efficiency, this effectiveness can display periodic fluctuations in certain nations. Such a finding indicates that market efficiency is not stationary; instead, it possesses a mutable structure over time.

Exploring the South Korean stock exchange, Narayan and Smyth (2004) tested the validity of the EMH and determined that prices align with efficient market assumptions. In a comparable manner, investigations conducted by Hasanov and Omay (2007), alongside Cooray and Wickremasinghe (2007), which examined diverse groups of countries, established the presence of weak form EMH efficiency within emerging markets. Narayan and Smith (2007), and Narayan and Narayan (2007), reached parallel conclusions regarding the G7 nations via panel unit root tests with two structural breaks, demonstrating that prices in these countries also contain a unit root. These collective works illustrate that the EMH remains broadly applicable across advanced economies as well. Moreover, research carried out by Eken and Adalı (2008) scrutinised shares within the BIST 30, BIST 100, BIST Financial, and BIST Industrial indices, ultimately ascertaining that Türkiye market is efficient in the weak form. An analogous outcome was achieved by Hasanov (2009), during his assessment of the South Korean market. Finally, by investigating the S&P 500 index, Demireli, Akkaya, and İbaş (2010), proved that the weak form efficiency of the EMH was valid throughout the 1991 to 2010 period.

In a similar vein, Daud and Azman-Saini (2010), stated in their analysis using panel data from 15 emerging markets that these markets contain a unit root and are therefore efficient in the weak form. Such findings illustrate that information is reacted to swiftly, even within developing economies. Testing stationarity and effectiveness within the BIST 100 index, Zeren, Kara and Arı (2013), ascertained the validity of the EMH throughout the 1987 to 2012 period. Meanwhile, Gümüş and Zeren (2014), investigated efficiency across the G20 nations employing Fourier KSS alongside Fourier ADF tests. They revealed that the weak form efficiency of the EMH was present in countries such as Germany, the USA, Argentina, Austria, Italy, France, India, the United Kingdom, and Japan, whereas this condition did not hold true for the others. These results prove that market effectiveness fluctuates according to distinct countries and eras.

In their research, Çevik and Topaloğlu (2014), analysed the returns of Borsa Istanbul covering the span from 1988 to 2014, ultimately discovering that the AMH was applicable. The acquired evidence demonstrates that the market assumed a volatile nature during times of crisis, causing efficiency to weaken; thus, the EMH was not entirely valid specifically for Türkiye. Scrutinising the G7 and E7 nations via non-linear unit root tests, Hepsağ and Akçalı (2015), found that the EMH was applicable in its weak form for certain G7 members (the USA, France, Italy, Japan), yet effectiveness was rejected in countries like Germany, the UK, and Canada. These observations corroborate the notion that market efficiency alters on both a national and temporal basis. Through an analysis conducted within the perspective of the AMH in the Malaysian market, Tuyon and Ahmad (2016), demonstrated that market effectiveness shifts over time and that the AMH becomes particularly relevant during crisis periods. Such an outcome indicates that the AMH offers a more accurate elucidation compared to the traditional EMH. In the same year, Özcan and Gültekin (2016), performed a comparable assessment across the G20 nations, identifying that the weak form efficiency of the EMH was valid in all countries except Argentina, Canada, China, and Russia. Furthermore, by utilising various indices within Türkiye market, Tuna and Öztürk (2016), showed in their study that the EMH was applicable to Borsa Istanbul throughout the examined timeframe. These conclusions reveal that the AMH finds support under specific circumstances in both advanced and developing nations, whilst the EMH also remains applicable in certain situations. By investigating the

markets of 11 member states of the OIC (The Organisation of Islamic Cooperation) using a multifractal analysis methodology, Arshad et al. (2016) determined that effectiveness varied based on the country and period, observing that some exchanges supported the AMH rather than the EMH. Comparing the stock exchanges of Türkiye and the USA, Ertaş and Özkan (2018), discovered that both markets exhibited deviations from efficiency from time to time, concluding that the AMH provided a more explanatory structure. Doorasamy and Sarpong (2018), documented trend persistence by detecting long memory in the South African market. Lastly, through their assessments of calendar anomalies within the Chinese market, Xiong et al. (2019), demonstrated that market mechanisms could not be explained by the EMH, yet the AMH successfully clarified this mutable architecture.

In the literature from 2020 onwards, it is observable that more complex results have emerged, particularly in studies focusing on emerging markets. By analysing the BIST indices in Türkiye, Eyüboğlu and Eyüboğlu (2020), stated that efficiency altered over time during the 1990 to 2019 period, noting that the market was efficient in certain eras while becoming predictable in others. These findings, wherein the EMH exhibits variability, support the notion that the AMH is predominantly applicable. Furthermore, Yandık (2023), addressed the G7 and newly industrialised nations, revealing that the EMH was valid during periods of low volatility, whereas the AMH held true throughout highly volatile intervals. Scrutinising 19 OECD countries, Öz (2024), articulated that the weak form of the EMH was generally invalid, illustrating that market behaviours display fluctuations. In their analysis conducted on the Finnish market, Rönkkö et al. (2024), demonstrated that effectiveness evolved over time and that the AMH proved successful in explaining these shifts. Similarly, Görgel and Ege (2024), ascertained in their research on the E7 nations that the EMH was inapplicable, discovering that market efficiency fluctuated temporally and that the AMH elucidated this architecture more effectively.

In opposition, Sakınç and Sakınç (2024), analysed the BIST Participation indices, proving that these metrics were not efficient in the weak form. A work by Scalamonti (2025), showed that the EMH was rejected across the Southeastern Mediterranean countries, asserting that the markets lacked weak form efficiency. Examining the BRICS T nations, Karaca (2025), stated that geopolitical risks significantly impacted market effectiveness and that this efficiency altered over time. Başkaya (2025), provided evidence that markets followed a random walk and that the Efficient Market Hypothesis was valid in the vast majority of the G20 countries (particularly within emerging markets such as Türkiye, Brazil, and Russia); nevertheless, he presented findings indicating that efficiency could not be achieved in certain advanced markets like the USA and the UK. In summary, although the EMH presents a stationary structure within the literature, it is apparent that the AMH offers a more consistent perspective in elucidating the mutable nature of market efficiency across time.

Upon reviewing the empirical literature related to the Fractal Market Hypothesis (FMH), Anderson and Noss (2013), offered significant evidence favouring this postulation by uncovering a fractal structure alongside long memory traits during their analysis of the Dow Jones Industrial Average. Furthermore, by identifying a dual long memory across the stock exchanges of the MINT nations, Karaömer (2022), proposed that returns possess a certain degree of predictability, thereby asserting that the FMH is supported within this perspective. Similarly, Sağlam and Bezgin (2023), obtained results pointing towards fractal characteristics and long memory mechanics in crypto asset markets, whilst Konak and Türkoğlu (2024), acquired comparable outcomes regarding Borsa Istanbul. Nevertheless, the existing literature also indicates that the FMH is not universally applicable to every market. Indeed, while conducting an analysis on the MSCI Latin America Index via the FIEGARCH methodology, Soykan (2025), failed to encounter any significant long memory evidence, subsequently reporting that the FMH was unsupported specifically within these exchanges. Subsequently, the current body of evidence reveals that although the Fractal Market Hypothesis garners robust empirical backing across certain markets and periods, its generalisability can fluctuate heavily depending upon the market architecture, liquidity conditions, and investor composition.

Although the current literature contains studies (such as Demir and Şimşek, 2024) using Wavelet and Fourier methodologies on the economic indicators of the MINT nations, a significant research gap remains regarding the holistic examination of efficiency and adaptability characteristics within the stock exchanges of these countries using the aforementioned advanced techniques. Upon reviewing the broader body of research focused on the MINT states (Mexico, Indonesia, Nigeria, and Türkiye), it is evident that conventional linear methods or long memory models like ARFIMA are generally preferred for testing market effectiveness

(for instance, Karaömer, 2022). Nevertheless, the fundamental assumption of the Adaptive Markets Hypothesis, which asserts that market efficiency fluctuates over time and across varying frequencies, necessitates the simultaneous consideration of both time and frequency dimensions in such analyses. Despite the fact that Demir and Şimşek (2024), applied Fourier and Wavelet methods to economic indicators (specifically the middle income trap) for the MINT nations, there are no encountered studies where these advanced econometric techniques have been holistically employed to test the efficiency alongside the adaptability of the equity markets in these specific countries.

On the other hand, as observed within the comprehensive literature review, the primary sources of divergence among the findings in the aforementioned studies are the structural differences in the equity markets of the included countries, the incongruity of the start and end years of the examined periods alongside their sub periods, and the variations in the employed methodological sets (such as test frequencies, and robustness approaches). Although existing research predominantly tests the AMH across clusters of advanced and developing nations, investigations focusing on both the AMH and the EMH within economies experiencing relatively high growth momentum have remained limited. For this reason, by restricting the empirical universe of this paper to the MINT group, which possesses rapidly transforming market forces, comparability is greatly enhanced while simultaneously providing a substantial contribution by filling this void in the literature.

In addition to the points above, to the best of our knowledge, a comparative efficiency analysis supported by structural break resistant, standardised, and robustness checks across the time and scale dimension using WADF and WFADF has not yet been conducted within the MINT markets. Such a gap also prevents the static assumptions of the EMH from being unified with the evolving projections of the AMH upon the identical methodological ground. Consequently, this paper bridges a crucial divide in the academic sphere by bringing together the predictions of both the EMH and the AMH on the same methodological foundation, albeit through the utilisation of an advanced econometric technique.

3. DATA AND METHODOLOGY

This research opts for Wavelet based unit root tests. The superiority of the Fourier Wavelet approach in detecting structural breaks, originally introduced by Aydin and Pata (2020) using energy economics data, serves as a crucial methodological benchmark for analysing the complex mechanics of financial markets. Within this setting, an investigation into the MINT nations conducted by Demir and Şimşek (2024), revealed the inadequacy of conventional linear assessments. Their findings illustrated that the smooth structural breaks and non linear fluctuations inherent in the series can only be robustly modelled through Fourier Wavelet based unit root tests (FWADF, FWKSS). Echoing these sentiments, Kaya (2024) reported from an analysis of the E7 countries that the Wavelet transform allows for the decomposition of series into their short-, medium-, and long-term components. Such an application enables a far more precise detection of stationarity behaviours across distinct time horizons. The primary rationale for selecting the Wavelet based unit root test in the current paper thus stems from its capacity to utilise time and frequency information simultaneously. An approach of this nature powerfully unveils the unit root properties within low frequency components that traditional methods overlook, in addition to revealing the temporally mutable (adaptive) architecture of market efficiency even when subjected to structural breaks.

Seeking to bridge the aforementioned methodological void in the literature, the present research evaluates the validity of both the EMH and the AMH across the equity markets of the MINT countries. It achieves this objective by applying wavelet-based unit root tests that strictly account for structural breaks alongside frequency shifts. Ultimately, the paper holds considerable significance because it delivers highly precise and reliable findings for investors and policymakers. It successfully demonstrates that market efficiency is far from a static phenomenon, instead exhibiting an evolving state that fluctuates across both time and frequency dimensions.

3.1. Data

The empirical methodology examines daily data of the return series from the MINT countries, Mexico (11.11.1991 - 31.07.2025), Indonesia (09.04.1990 - 31.07.2025), Nigeria (30.01.2012 - 25.08.2025), and Türkiye (03.01.1988 - 31.07.2025), in order to assess the validity of both the Efficient Market Hypothesis (EMH) and the Adaptive Market Hypothesis (AMH).

The sample period was chosen based on the availability of data. The MINT economies are selected because their ongoing structural and financial developments provide an ideal setting to

test whether their markets adhere to the static assumptions of the EMH or exhibit the time-varying, evolutionary efficiency proposed by the AMH. A detailed description of these variables can be found in Table 1.

Table 1: Data Description.

Countries	*Variables*	*Abbreviations*	*Units*	*Sources*
Mexico	MXX return series	MXX	Rate / Proportion	Bloomberg (UK)
Indonesia	JKSE return series	JKSE	Rate / Proportion	Bloomberg (UK)
Nigeria	NGXASI return series	NGXASI	Rate / Proportion	Bloomberg (UK)
Türkiye	BIST 100 (XU100) return series	BIST	Rate / Proportion	Bloomberg (UK)

3.2. Methodology

This paper uses a two-stage empirical methodology to analyse the causal relationships between the variables. The first step of the econometric analysis consists of wavelet transformation. The next step is to analyse the order of integration of the series using the conventional ADF unit root test and the Fourier ADF unit root test, which allows for taking the possibility of structural breaks and nonlinearity into account.

This methodological choice is motivated by the fact that macro-financial relationships in emerging markets are neither completely linear nor stable over time, especially in environments, i.e. MINT countries, where expectations are sensitive to monetary policy actions and institutional credibility.

3.2.1. Wavelet Transform

This paper applies wavelet analysis to all series, a methodological approach increasingly preferred in economic and financial research for its ability to handle localized variations without assuming data stationarity (Crowley, 2007). Specifically, the analysis employs the Maximal Overlap Discrete Wavelet Transform (MODWT) as a robust alternative to the conventional Discrete Wavelet Transform (DWT). While the standard DWT is restricted to sample sizes that are strictly a power of two and is highly sensitive to the starting point of the time series, the MODWT overcomes these limitations by avoiding decimation. Consequently, it yields a translation-invariant decomposition that can seamlessly handle any sample size while preserving the structural integrity of the data (Percival and Walden, 2000). Through Multi-Resolution Analysis (MRA), the MODWT decomposes each series into distinct, orthogonal frequency components, facilitating the clear separation of high-frequency market shocks, medium-term adjustments, and underlying long-term trends (Gallegati, 2008).

When selecting the appropriate wavelet function, we follow the suggestion proposed by Gençay et al. (2002) who note that wavelets with longer filter lengths offer a closer approximation to an ideal band-pass filter. In line with this view, the analysis adopts the Least Asymmetric wavelet at level 5, LA(8), where the number eight refers to the width of the filter. This specification suits the data examined in the paper. This particular wavelet is well known for a range of appealing characteristics, including near symmetry, orthogonality, compact support and smoothness (Ha, Tan and Goh, 2018).

The decomposition yields various multi-resolution levels (wavelet details, denoted as dj) that correspond to specific physical time scales. Guided by the data frequency and the aggregations proposed in the literature (Ha et al., 2018; Rua and Nunes, 2009), these bands are mapped into three distinct time-horizons. The short-run dynamics (combining d1 and d2) capture cycles of 2 to 8 days, reflecting immediate market responses and high-frequency volatility. The medium-run adjustments (d3) correspond to periods of 8 to 32 days. Finally, the long-run dynamics (d4 and d5, encompassing scales from 33 to 64 days) represent the low-frequency, long-term structural patterns embedded in the data, allowing for a comprehensive evaluation of market dynamics across different time horizons.

3.2.2. Augmented Dickey-Fuller (ADF) Unit-Root Test

Traditional stationarity tests do not take structural breaks in the series into account. The classical Augmented Dickey–Fuller (ADF) test, associated with the work of Dickey and Fuller (1979, 1981), is one of them, and a widely used procedure for detecting the presence of a unit root in a time series. The test is based on estimating the following autoregressive representation equation (Equation 1):

$$\Delta y_t = \alpha_1 y_{t-1} + \sum_{j=1}^{p} \beta_j \Delta y_{t-1} + \varepsilon_t \qquad (1)$$

Under the null hypothesis (H0) of a unit root, α=0, so the level of the series behaves as a non-stationary process. The alternative hypothesis (H1), α<0, implies stationarity around a deterministic component. Because the distribution of the test statistic does not follow standard asymptotic results, its critical values are those tabulated in Dickey and Fuller's original studies.

The ADF test therefore provides a straightforward way to distinguish between unit-root behaviour and stationary dynamics, and remains a benchmark tool in empirical time-series analysis.

3.2.3. Fourier ADF Unit Root Test

The Fourier ADF unit root test was developed by Enders and Lee (2012), building on earlier work by Christopoulos and Leon-Ledesma (2010), who showed that low-frequency Fourier terms can capture smooth structural movements in economic time series. In their methodology, a variable yt is represented as the sum of a deterministic part that varies over time, d(t), and a random disturbance υt, as written in the Equation 2:

$$y_t = d(t) + v_t \quad (2)$$

The deterministic component is modelled by means of a low-frequency Fourier expansion. Using the formulation in the Equation (3), they express d(t) as:

$$d(t) = \gamma_0 + \gamma_1 \sin\left(\frac{2\pi kt}{T}\right) + \gamma_2 \cos\left(\frac{2\pi kt}{T}\right) \quad (3)$$

where k denotes the frequency used in the Fourier term, t is the time index, and T is the total number of observations in the data sample.

The first step in applying the test involves identifying the frequency that provides the best fit. To do this, the Equation (3) is estimated for each integer value of k within the range 1≤k≤5. For each case, the sum of squared residuals is calculated, and the value of k that produces the smallest residual sum is taken as the preferred frequency k*.

Once the optimal frequency has been chosen, residuals are obtained from the fitted deterministic part using the Equation (4):

$$\hat{v}_t = y_t - \hat{\gamma}_0 - \hat{\gamma}_1 \sin\left(\frac{2\pi k^* t}{T}\right) - \hat{\gamma}_2 \cos\left(\frac{2\pi k^* t}{T}\right) \quad (4)$$

These residuals are then subjected to the standard ADF regression, shown in the Equation (5):

$$\Delta v_t = \alpha_1 v_{t-1} + \sum_{j=1}^{p} \beta_j \Delta v_{t-1} + \mu_t \quad (5)$$

In the concluding step of the Fourier ADF procedure, the smooth structural break component is evaluated by testing whether the Fourier coefficients γ1 and γ2 are jointly insignificant. This is operationalized through an F-test:

$$H_0 = \gamma_1 = \gamma_2 = 0,$$

(Fourier terms are jointly insignificant; no smooth structural change)

$$H_1 = \gamma_1 \neq 0, \gamma_2 \neq 0,$$

(Fourier terms are jointly significant; smooth structural change exists)

The decision rule is based on whether the computed F-statistic exceeds the corresponding critical value. When the F-statistic does not surpass the critical threshold, H0 cannot be rejected, implying that the deterministic component does not require Fourier adjustments. Under such circumstances, the conventional ADF unit root test constitutes the appropriate specification. If the F-statistic exceeds the critical value, H0 is rejected, the Fourier terms are deemed relevant, and the Fourier-augmented ADF specification should be used instead.

After determining the appropriate specification, unit root testing proceeds either through the standard ADF regression or through the Fourier-augmented ADF regression. In both frameworks, the presence of a unit root is evaluated through the coefficient of the lagged level term. The hypotheses can be stated as:

$H_0: \alpha_1 = 0$, (the series contains a unit root)

$H_1: \alpha_1 \neq 0$, (the series is stationary)

Inference regarding the stochastic behaviour of the variable depends on whether the estimated test statistic associated with α1 exceeds the relevant critical values. Failure to reject H0 indicates non-stationarity, whereas rejection of H0 implies stationarity.

Finally, it should be stressed here that the main purpose of the analysis below is not to estimate structural policy effects or parameter sizes, but to examine the stationarity behavior of the return series across different time scales in order to test the validity of the EMH and AMH.

4. EMPIRICAL RESULTS

When assessing the outcomes derived from the econometric analyses, which are robustly supported by bootstrap critical values, a specific fundamental assumption serves as the theoretical foundation. Discovering a unit root within the scrutinised financial time series signifies that equity valuations remain unpredictable through the use of historical information, meaning they follow a random walk progression. A characteristic of this nature ultimately

points towards the validity of the weak form of the Efficient Market Hypothesis (EMH). On the other hand, should the series display a stationary structure lacking a unit root, it becomes evident that prices actually react to past shocks. Displaying such behaviour establishes the existence of a certain degree of predictability within the market. Evidence of this sort heavily corroborates the AMH, a postulation arguing that market efficiency possesses the capacity to differentiate over time in response to shifting conditions.

4.1. Unit Root Test Results

Table 2 and Table 3 show that the wavelet-based linear (WADF) and non-linear (WFADF) unit root tests applied to the Indonesian equity market (JKSE) indicate that market efficiency evolves depending on the temporal scale. A close inspection of the WADF results reveals that the series exhibits a stationary architecture in the short (2-8 days) and medium term (8-32 days) under the constant and time trend model. The sensitivity of prices to historical data across these specific horizons, coupled with the presence of partial predictability, strongly corroborates the AMH. Moving towards the long-term evaluation spanning 33-64 days, the significance of the F-statistics in the WFADF assessment points towards the existence of structural breaks; nevertheless, the series loses its stationarity and continues to exhibit a random walk character containing a unit root. Even when factoring in these disruptions, the persistence of a unit root over extended periods demonstrates that the market gradually absorbs shocks, thereby aligning with the weak-form EMH.

Table 2: W-ADF Unit Root Test Results.

Country	Time-horizons	WADF	
		Constant	Constant and time trend
JKSE	*Short-Run (2 to 8 days)*	-0.761	-3.297***
	Medium-Run (9 to 32 days)	-0.778	-6.444***
	Long-Run (33 days to 64 days)	-0.279	0.198

Note: ***, **, * denote significance levels at the 1%, 5%, 10% levels, respectively. At the 1%, 5%, and 10% significance levels, the critical values for the model with constant are -3.19, -2.61, and -2.34, respectively; whereas for the model with constant and trend, the corresponding critical values are -3.69, -3.05, and -2.75 (Aydin and Pata, 2020).

Table 3: W-FADF unit root test results

Country	*Model*	*Time-horizons*	*Min. SSR*	*k (frequency)*	*FWADF stat. (τ_{DF-C})*	*F(k)*
JKSE	Constant	*Short-Run (2 to 8 days)*	7.042	1	-1.556	1.668
		Medium-Run (9 to 32 days)	0.172	1	-2.077	12.765*
		Long-Run (33 days to 64 days)	0.007	1	-2.491	17.892*
		Time-horizons	***Min. SSR***	***k (frequency)***	***FWADF stat. (τ_{DF-t})***	***F(k)***
	Constant& Trend	*Short-Run (2 to 8 days)*	5.966	2	-4.725	5.906
		Medium-Run (9 to 32 days)	0.136	1	-4.255	8.208
		Long-Run (33 days to 64 days)	0.007	1	-2.681	19.087*

Note: The symbol * denotes 5% statistical significance. The corresponding critical values of the FWADF statistic for k = 1, 2, 3, 4, and 5 frequencies at the 5% significance level are −3.23, −2.91, −2.69, −2.67, and −2.66 for the constant model (τDF-C), and −3.58, −3.48, −3.37, −3.24, and −3.10 for the constant and trend model (τDF-t) (Aydin and Pata, 2020). For the 5% significance level, the critical value of F(k) is 7.25 for the model with constant and 8.71 for the model with constant and trend, as reported by Enders and Lee (2012).

As observed in Tables 4 and 5, the wavelet-based unit root tests applied to the Mexican stock market (MXX) reveal that market efficiency exhibits a continuously evolving architecture across varying time horizons. Since initial stationarity was not identified via the WADF results, it is notable that the F-statistics emerged as highly significant under the constant and time trend model when evaluating the WFADF outcomes, which properly account for structural breaks. Modelling these specific disruptions alongside the trend effect demonstrates that the series displays a stationary structure in the short (2-8 days) and medium term (8–32 days). Because valuations possess partial predictability and remain distinctly sensitive to historical data across these precise periods, such behaviour robustly corroborates the AMH. Shifting focus to the extended assessment spanning 33-64 days, the series forfeits its stationarity and persists in a random walk character containing a unit root, notwithstanding the existence of structural breaks. This pattern suggests that the exchange ultimately absorbs shocks over time, gradually converging towards the weak-form EMH.

Table 4: W-ADF unit root test results.

Country	Time-horizons	WADF	
		Constant	Constant and time trend
MXX	*Short-Run (2 to 8 days)*	-1.450	-1.620
	Medium-Run (9 to 32 days)	-0.696	-6.656***
	Long-Run (33 days to 64 days)	-0.391	1.746

Note: *, **, *** denote significance levels at the 1%, 5%, 10% levels, respectively. The critical values for the model with constant are -3.19, -2.61, and -2.34 for the 1%, 5%, and 10% significance levels, respectively; whereas for the model with constant and trend, the corresponding critical values are -3.69, -3.05, and -2.75 (Aydin and Pata, 2020).

Table 5: W-FADF unit root test results.

Country	*Model*	*Time-horizons*	*Min. SSR*	*k (frequency)*	*FWADF stat. ($\tau_{DF\text{-}C}$)*	*F(k)*
MXX	Constant	*Short-Run (2 to 8 days)*	13.236	4	-1.526	1.173
		Medium-Run (9 to 32 days)	0.307	1	-1.629	13.603*
		Long-Run (33 days to 64 days)	0.009	1	-2.647	9.488*
		Time-horizons	***Min. SSR***	***k (frequency)***	***FWADF stat. ($\tau_{DF\text{-}t}$)***	***F(k)***
	Constant& Trend	*Short-Run (2 to 8 days)*	10.599	1	-4.541*	9.829*
		Medium-Run (9 to 32 days)	0.253	1	-4.937*	19.277*
		Long-Run (33 days to 64 days)	0.009	1	-2.950	10.301*

Note: The symbol * denotes 5% statistical significance. The corresponding critical values of the FWADF statistic for k = 1, 2, 3, 4, and 5 frequencies at the 5% significance level are −3.23, −2.91, −2.69, −2.67, and −2.66 for the constant model (τDF□C), and −3.58, −3.48, −3.37, −3.24, and −3.10 for the constant and trend model (τDF□t) (Aydin and Pata, 2020). For the 5% significance level, the critical value of F(k) is 7.25 for the model with constant and 8.71 for the model with constant and trend, as reported by Enders and Lee (2012).

Tables 6 and 7 illustrate that the assessments conducted on the Nigerian equity market (NGXASI) reveal a unique architecture in which market efficiency diverges from other MINT nations across specific time horizons. Evidence from the WADF results shows that the series contains a unit root in the short (2 to 8 days) and medium term (8 to 32 days), indicating that prices remain unpredictable based on historical data and follow a random walk. This finding confirms the validity of the weak-form EMH during these periods. In contrast, the long-term analysis covering 33 to 64 days reveals that the series acquires a stationary structure with the emergence of structural breaks, as indicated by the WFADF test under both constant and trend specifications. The observation that an exchange behaving rationally in the short and medium term becomes sensitive to past data and partially predictable following long-term shocks and disruptions supports the AMH, which explains market dynamics as evolving over time.

Table 6. W-ADF unit root test results.

Country	Time-horizons	WADF	
		Constant	Constant and time trend
NGXASI	*Short-Run (2 to 8 days)*	-0.292	-1.448
	Medium-Run (9 to 32 days)	-1.217	0.138
	Long-Run (33 days to 64 days)	-0.806	-0.715

Note: ***, **, * denote significance levels at the 1%, 5%, 10% levels, respectively. The critical values for the model with constant are -3.19, -2.61, and -2.34 for the 1%, 5%, and 10% significance levels, respectively, whereas for the model with constant and trend, the corresponding critical values are -3.69, -3.05, and -2.75 (Aydin and Pata, 2020).

Table 7: W-FADF unit root test results.

Country	*Model*	*Time-horizons*	*Min. SSR*	*k (frequency)*	*FWADF stat. ($\tau_{DF\text{-}C}$)*	*F(k)*
NGXASI	Constant	*Short-Run (2 to 8 days)*	3.448	4	0.113	1.615
		Medium-Run (9 to 32 days)	0.064	1	-2.306	5.010
		Long-Run (33 days to 64 days)	0.002	1	-3.993*	10.641*
		Time-horizons	***Min. SSR***	***k (frequency)***	***FWADF stat. ($\tau_{DF\text{-}t}$)***	***F(k)***
	Constant& Trend	*Short-Run (2 to 8 days)*	2.976	1	-4.103	8.035
		Medium-Run (9 to 33 days)	0.058	5	0.223	1.542
		Long-Run (33 days to 64 days)	0.001	1	-3.624*	10.388*

Note: The symbol * denotes 5% statistical significance. The corresponding critical values of the FWADF statistic for k = 1, 2, 3, 4, and 5 frequencies at the 5% significance level are

−3.23, −2.91, −2.69, −2.67, and −2.66 for the constant model (τDF□C), and −3.58, −3.48, −3.37, −3.24, and −3.10 for the constant and trend model (τDF□t) (Aydin and Pata, 2020). For the 5% significance level, the critical value of F(k) is 7.25 for the model with constant and 8.71 for the model with constant and trend, as reported by Enders and Lee (2012).

As presented within Table 8 and Table 9, the wavelet-based unit root test findings for Türkiye equity market (XU100) reveal that market efficiency undergoes structural transformations depending on the temporal scale. Taking the WFADF analysis results into account, the existence of structural breaks was confirmed under the constant and time trend model, indicating that the series exhibit a stationary character in the short (2 to 8 days) and medium term (8 to 32 days). The fact that prices demonstrate sensitivity to historical data and possess partial predictability across these specific periods supports the AMH, which suggests that behavioural tendencies and shocks disrupt short- or medium-term efficiency. Upon shifting to the long-term analysis spanning 33-64 days, the loss of significance in the F statistic led to a return to the WADF results, revealing that the series follows a random walk path containing a unit root. This transition of Türkiye market, where short- and medium-term fluctuations subside and prices attain a novel rational equilibrium within a low frequency structure, proves that the weak form of the EMH is valid at this particular scale.

Table 8: W-ADF unit root test results.

Country	Time-horizons	WADF	
		Constant	Constant and time trend
XU100	*Short-Run (2 to 8 days)*	-1.717	-1.905
	Medium-Run (9 to 32 days)	-1.141	-6.037***
	Long-Run (33 days to 64 days)	-1.039	-0.308

Note: ***, **, * denote significance levels at the 1%, 5%, 10% levels, respectively. The critical values for the model with constant are -3.19, -2.61, and -2.34 for the 1%, 5%, and 10% significance levels, respectively; whereas for the model with constant and trend, the corresponding critical values are -3.69, -3.05, and -2.75 (Aydin and Pata, 2020).

Table 9: W-FADF unit root test results

Country	*Model*	*Time-horizons*	*Min. SSR*	*k (frequency)*	*FWADF stat. (τ_{DF-C})*	*F(k)*
XU100	Constant	*Short-Run (2 to 8 days)*	140.452	5	-1.617	0.200
		Medium-Run (9 to 32 days)	3.366	2	-1.107	3.275
		Long-Run (33 days to 64 days)	0.101	3	-1.222	1.093
		Time-horizons	***Min. SSR***	***k (frequency)***	***FWADF stat. (τ_{DF-t})***	***F(k)***
	Constant& Trend	*Short-Run (2 to 8 days)*	97.203	1	-5.163*	13.121*
		Medium-Run (9 to 32 days)	2.559	1	-5.246*	10.638*
		Long-Run (33 days to 64 days)	0.055	3	0.238	4.927

Note: The symbol * denotes 5% statistical significance. The corresponding critical values of the FWADF statistic for k = 1, 2, 3, 4, and 5 frequencies at the 5% significance level are −3.23, −2.91, −2.69, −2.67, and −2.66 for the constant model (τDF□C), and −3.58, −3.48, −3.37, −3.24, and −3.10 for the constant and trend model (τDF□t) (Aydin and Pata, 2020). For the 5% significance level, the critical value of F(k) is 7.25 for the model with constant and 8.71 for the model with constant and trend, as reported by Enders and Lee (2012).

5. CONCLUDING REMARKS

The present research investigates the validity of the Efficient Market Hypothesis (EMH) and the Adaptive Markets Hypothesis (AMH) across the equity markets of the MINT countries, which include Mexico, Indonesia, Nigeria, and Türkiye. These nations represent high growth potential within the global economy. To conduct this analysis, the paper first utilises the classical ADF (WADF) unit root test on series derived through Wavelet transform, a method that simultaneously accounts for time and frequency dimensions. Subsequent to this initial step, the Fourier ADF (WFADF) unit root test is applied to flexibly capture structural breaks alongside trend alterations.

Unlike traditional stationarity tests, this methodological approach (incorporating WADF and WFADF unit root tests) decomposes series into distinct time horizons such as short, medium, and long term through multiresolution analysis (MRA) while modelling smooth structural breaks. Adopting such a technique provides a robust empirical foundation for making sense of the complex and fluid nature of emerging markets within the process of international financial integration. During the evaluation of the econometric findings, a specific fundamental assumption serves as the theoretical basis. That financial time series contain a unit root demonstrates that prices possess a random walk character, an architecture that can be consistently

explained via the EMH. Conversely, the presence of a stationary structure within the series indicates that valuations retain a sensitivity to historical data, which is subsequently interpreted within the scope of the AMH. The results obtained in accordance with this perspective reveal that market efficiency can present an evolving state that differs depending on both time and frequency.

The findings clearly demonstrate that market efficiency within the MINT nations is not a static phenomenon, but rather a fluid process that evolves continuously depending on time horizons and structural shocks arising from global macroeconomic mechanics. This situation aligns robustly with the contemporary empirical results of studies such as Lim and Brooks (2009), Çevik and Topaloğlu (2014), Ertaş and Özkan (2018), Eyüboğlu and Eyüboğlu (2020), and Görgel and Ege (2024), all of whom argue that effectiveness shifts over time in response to crises and information flow. According to the analysis results, prices in the Indonesian, Mexican, and Türkiye equity markets exhibit sensitivity to historical data and harbour partial predictability in the short (2 to 8 days) and medium term (9 to 32 days). From an international macroeconomics perspective, the sudden stop shocks triggered by shifts in speculative hot money flows toward emerging markets and contractions in global risk appetite can be evaluated as the primary catalysts for these short- and medium-term inefficiencies. Nevertheless, these markets were observed to return to rationality over the long term (33 to 64 days), acquiring a random walk characteristic containing a unit root. Contrary to expectations, the Nigerian market displayed asymmetric behaviour by acting rationally (in the form of the EMH) during the short and medium term, yet entered a stationary adaptation process sensitive to past data under the influence of long-term structural breaks. This long term memory effect observed in the Nigerian market also supports the findings of Karaömer (2022), who identified a dual long memory within the MINT countries.

In a theoretical context, these outcomes demonstrate that the weak form of the EMH, proposed by Fama (1970) and asserting that markets possess absolute informational efficiency under all conditions, remains valid in the MINT countries only across specific time horizons, predominantly in the long term. Consequently, our findings sensitive to time and scale diverge clearly from conventional studies such as Eken and Adalı (2008), Zeren et al. (2013), Tuna and Öztürk (2016), and Başkaya (2025), all of whom claim that emerging markets and Borsa Istanbul are consistently efficient in the weak form with prices following an entirely random walk. The primary source of this divergence lies in the reliance of the aforementioned works on linear tests that overlook the distinction between time and frequency; conversely, the present paper successfully separates short term noise and behavioural deviations from the long term macro trend. Furthermore, the AMH by Lo (2004), which posits that investor rationality can shift periodically based on external factors, crises, and global information asymmetries, provides a much more inclusive and accurate theoretical foundation for explaining the general characteristics of these markets. Additionally, the fact that pricing mechanics exhibit structural differences based on the maturity expectations of investors, such as short term speculators versus long term fundamental analysts, carries a strong empirical parallel with the Fractal Market Hypothesis (FMH) (Peters, 1994; Mauboussin, 2002), which defines markets as multiscale complex adaptive systems rather than uniform equilibrium mechanisms. This multiscale architecture also methodologically confirms the research of Konak and Türkoğlu (2024), who highlighted fractal characteristics specifically within Borsa Istanbul.

The outcomes of this research hold critical practical implications for financial market participants and regulatory institutions. Regarding fund managers and individual investors seeking international portfolio diversification, it is evident that behavioural biases and market anomalies within the MINT countries, particularly in Indonesia, Mexico, and Türkiye, can be converted into profitable opportunities through algorithmic strategies or technical analysis across short- and medium- term investment horizons. Nevertheless, when constructing these arbitrage strategies, the potentially erosive impact of high exchange rate risk on portfolio returns must not be ignored within economies sensitive to external financing like the MINT group. For long term global funds, the random walk principles where fundamental analysis and macroeconomic forces remain decisive continue to hold their validity. From the perspective of policymakers and regulatory authorities, ensuring financial market stability and limiting the effects of international financial contagion triggered by external shocks necessitates the implementation of flexible and adaptive oversight mechanisms. Rather than relying on static regulations, such mechanisms should enhance information transparency, increase market depth, support market resilience against currency shocks, and dampen periodic anomalies

during times of crisis or high volatility.

Future research might broaden the scope of this investigation by integrating other clusters of emerging nations such as the BRICS or E7 to facilitate a more comprehensive comparative evaluation. Measuring the erosion of market memory caused by Global Financial Cycle shocks remains a vital path for academic inquiry. These shocks stem from monetary policy shifts by prominent institutions like the FED and ECB alongside the COVID 19 pandemic or global inflationary pressures. By utilising data of varying frequencies, scholars could explore the microstructural transformations of the AMH and FMH with much greater depth.

Declaration of generative AI

During the preparation of this paper, an AI-assisted tool was used to a limited extent, solely to improve the language, grammar and readability of certain sentences. Following its use, the authors reviewed and edited the sentences, and take full responsibility for the published article.

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