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Table of Contents

1 **Tomáš DUDÁŠ, Klaudia KARELOVÁ**
Counties Analysis of Threats to the Macroeconomic Stability in Visegrad Group 1555

2 **Alexander CHURSIN, Pavel DROGOVOZ, Tatiana SADOVSKAYA, Vladimir SHIBOLDENKOV**
A Linear Model of Economic and Technological Shocks in Science Intensive Industries 1567

3 **Leoš ŠAFÁR, Marianna SINICAKOVA**
Money Supply Influence on Gross Domestic Product throughout Stock Markets in United States and European Union 1578

4 **Natalia GRYZUNOVA, Elena SHUVALOVA, Aleksandra POLYAKOVA, Khayal KERIMOV**
Competitive Capacity of Companies as a Major Goal of National Monetary Policy in the Context of Financial Globalization 1585

5 **M. Shabri Abd. MAJID, Abdul HAMID, FARADILLA**
Assessing the Productivity of Insurance Companies in Indonesia: A Non-Parametric Approach 1593

6 **Olga Victorovna KITOVA, Ludmila Pavlovna DYAKONOVA, Victoria Michailovna SAVINOVA, Sergey Naymovich BRUSKIN, Tamara Petrovna DANKO, Vladimir Dmitriyevich SEKERIN**
About the System of Hybrid Forecast Models for Regional Situational Centers 1606

7 **Pavel KOZLOV, Yulia FINOGENOVA, Irina KHOMINICH**
On Equilibrium of the Financial Flows within the System of Compulsory Pension Insurance in the Russian Federation 1615

8 **Tomáš VALENTINY, Jaroslav GONOS, Veronika TIMKOVÁ, Martina KOŠÍKOVÁ**
Impact of Selected Factors on the Formation of Regional Disparities in Slovakia 1626

9 **Bala UMAR, Chin LEE, Kaliappan, Shivee RANJANEE, Ismail, Normaz WANA**
The Impact of Financial Development, Oil Price on Economic Growth in African OPEC Members 1640

10 **Patrick Omoruyi EKE, Kehinde Adekunle ADETILOYE, Esther Oluwafunmilayo ADEGBITE, Lawrence Uchenna OKOYE**
A Co-Integration Analysis of Interest Rate Spread and Corporate Bond Market Development in Selected African Economies 1654

11 **Jaka SRIYANA, Abdul HAKIM, HERAWATI**
Managing Fiscal Risk in High Public Debt: Evidence from Indonesia 1668

12 **Adedoyin Isola LAWAL, Tony Ikechukwu NWANJI, Ibrahim Joseph ADAMA, Adegbola O. OTEKUNRIN**
Examining the Nigerian Stock Market Efficiency: Empirical Evidence from Wavelet Unit Root Test Approach 1680

13 **Aleksei Valentinovich BOGOVIZ, Svetlana Vladislavlievna LOBOVA, Yuliya Vyacheslavovna RAGULINA, Lyudmila Bogdanovna LUCHITSKAYA, Tatiana Valerevna SHUTOVA**
Boosting Innovative Activity in Companies: Problems and Potential 1690

14 **Enikő KORCSMÁROS, Ladislav MURA, Monika ŠIMONOVÁ**
Identification of Small and Medium-sized Enterprises Development in Slovakia 1702

15 **Lidiia Vitaliivna PASHCHUK, Liudmila Oleksiivna YAROSH-DMYTRENKO**
Strengthening Competitiveness of Small and Medium Enterprises in Municipalities 1713

16 **Tulus SURYANTO, Eleftherios I. THALASSINOS**
Cultural Ethics and Consequences in Whistle-Blowing Among Professional Accountants: An Empirical Analysis 1725

17 **Fernando Luís ALMEIDA, José Duarte SANTOS, José Augusto MONTEIRO**
A survey of Innovation Performance Models and Metrics 1732

18 **Zuzana BIRKNEROVÁ, Miroslav FRANKOVSKÝ, Lucia ZBIHLEJOVÁ, Valéria PAROVA**
Gender Differences in Perception of Advertising in the Context of Expectations of Advertising 1751

19 **Michal KRAJŇÁK**
Application of Selected Quantitative Methods to Assess the Development of Personal Income Tax in the Czech Republic 1759

20 **Arsen A. TATUEV, Svetlana S. GALAZOVA, Georgiy N. KUTSURI, Sergey A SHANIN, Violetta V. ROKOTYANSKAYA**
New Sources of Debt Financing Investments in Russian Real Economy 1771

21 **INSUKINDRO, Chandra UTAMA**
Provincial Inflation Dynamics in Indonesia: Hybrid New Keynesian Phillips Curve Approach 1779

22 **Yilmaz Ulvi UZUN, Borash MYRZALIEV**
Evaluation of Influence of Direct Foreign Investments on Economic Growth of Kazakhstan 1789

23 **Katarína HOVORKOVÁ, Ľudmila LIPKOVÁ**
Iceland´s Integration Process into the European Union and Assessment of its Economic and Political Alignment with European Legislation 1805

24 **Marwa BILTAGY, Manar HAMDI, Noran Abd El NASSER, Heba HASSAN**
The Effect of Government's Health Expenditure on Economic Growth: Case Study of Turkey 1813

25 **Tatyana Vladimirovna PONOMARENKO, Oksana Anatolyevna MARININA**
Corporate Responsibility of Mining Companies: Mechanisms of Interaction with Stakeholders in Projects Implementation 1826

Examining the Nigerian Stock Market Efficiency: Empirical Evidence from Wavelet Unit Root Test Approach

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Abstract:

This study examines the Efficient Market Hypothesis (EMH) using data sourced on monthly bases on the Nigerian Stock Market. We employed recently developed frequency domain wavelet-based unit root test as well as two-time domain unit root tests that accommodates structural breaks. The results show that when frequency domain was factored into stock market efficiency framework for the Nigerian stock market, evidence abound to reject the null hypothesis, whereas no evidence not to do so with conventional time domain estimation techniques. The study recommends that investors should take advantage of the arbitrage opportunity that exist in the market; and that policy makers should see the stock market as a good platform that can aid economic growth as its vibrant arbitrage activities can attracts substantial fund for economic growth.

Keywords: efficient market hypothesis; wavelet unit root test; random walk; mean reversion; Nigeria.

JEL Classification: G10; G11; G14; C22; C32

Introduction

Economics and finance researchers have in the recent put considerable efforts to better understanding of emerging economics stock markets with special focus on markets efficiency. This is premised on the fact that inefficient stock market is very crucial to the promotion of higher economic growth (Tiwari and Kyophilavong 2014). At best, the results on market efficiency, can be described as mixed, for instance, Kavussanos and Dockery 1996, Lo and Mackinlay 1988, Al-Loughani and Chappell 1997, Poterba and Summers 1998, Grieb and Reyes 1999, Chaudhuri and Wu 2003, Narayan 2006, 2008, Hasanov 2009, Lawal *et al.* 2013, Gozbasi *et al*. 2014 all show that no evidence exist to support the existence of Efficient Market Hypothesis (EMH) for a number of economies they studied, others like Cheung and Coutts 2001, Buguk and Brorsen 2003, Narayan 2005, Qian *et al.* 2008, Munir and Mansur 2009, Alexeev andTapon 2011, are of the view that stock markets behave in a way that is consistent with the EMH.

The pioneer work on market efficiency can be traced to Fama (1970) Efficient Market Hypothesis where stock market efficiency was classified into three (3) categories – Weak, Semi-strong, and Strong market efficiencies.

Gozbasi *et al*. (2014) argued that at best emerging economies stock markets can be described to have weak form efficiency.

Though, a number of empirical studies have been conducted to examine the behavior of stock market as it relates to market efficiency in emerging economy with mixed results, little empirical analysis had been conducted on Nigeria.

Nigeria is the largest economy in Africa and one of the fastest growing economies in the world (WDI 2014). The nation has a vibrant stock market with a market capitalization of about eleven trillion naira. As at June, 2016, it has about one hundred and eighty (180) listed companies on the floor of the exchange. In term of market capitalization, the Nigeria Stock Exchange is the third largest exchange in Africa.

The essence of this paper is to examine the EMH for the Nigerian stock market using Wavelet unit root test approach. Wavelets are considered more powerful estimation techniques for signalling processing which offers more insight to the stock market efficiency framework by decomposing time series into time scale component. It allows analyzing stock market behaviour (which is time series in nature) within the context of frequency domain without losing the time information.

The paper also intends to know whether or not the Nigerian stock market is characterized with random walk or with mean reversion. Evidence of Random walk hypothesis, means reversion among other things is the basic condition used in empirical literature to determine market efficiency. Examining the efficiency level of the stock market has some important implication for virtually all the economic agents especially the policy makers and investors. When the behavior of financial series - stock market index included – cannot be predicted because they can change without limit in the long run, then it can be described as following a random walk, hence, any shocks to stock prices are permanent. The implication is that the long run volatility in stock prices will increase over time. On the other hand, mean reversion condition exists when stock prices follow a stationary trend, thus future returns can be forecasted by using historical prices (Tiwari and Kypohilavong 2014).

Briefly foreshadowing our main findings, it was observed that when frequency- domain was factored into the Nigeria stock market efficiency framework, evidence abound to reject the null hypothesis whereas, no evidence exist not to do so with conventional time-domain estimation technique. The rest of the paper is structured as follows: Section two presents the literature review, section three deals with data and methodology, section four presents the results while section five concludes the study.

1. Research background

The theoretical note that described the behavior of stock prices to follow a random walk mirroring efficiency could be traced to the works of Samuelson (1965), Fama (1965) and Mandelbrot (1966). Ever since, a number of studies have attempted to examine stock market efficiency using various techniques.

The random walk hypothesis explains that fluctuations in stock markets can change without limit in the long run, thus, making its prediction very impossible. The theory explains that, if stock market prices are characterized by random walk process, then innovation to the prices will be permanent, thereby making market prediction based on historical prices difficult, with attending potential for increase in long run volatility over time. However, if the stock prices are mean reverting such that is follows a stationary trend, prediction of future return based on historical data/prices is possible. Building on this framework, Fama (1970) observed that the link between information content and price prediction is necessary to determining whether or not stock market is efficient. The author further classified stock market efficiency tests into three viz: Weak form test, Semi strong efficiency test, and Strong efficiency test. In its Weak form, a market is efficient if all the publicly available information about the economy is incorporated into the stock prices, and prices response to arrival of new information effectively. As noted by Tiwari and Kyophilavong (2014), over the years' evidence of the existence of random walk hypothesis has been considered to be a sufficient condition for market efficiency.

Every sincere the work of Fama (1970), a number of studies has been carried out to examine efficiency of markets around the world with mixed results. For example, Tiwari and Kyophilavong (2014) examined the validity of random walk hypothesis on the BRICS stock indices using wavelet based unit root test proposed by Fan and Gencay (2010), the authors observed that evidence abound to reject the null of unit root for all the BRICS countries

except for the Russian Federation. This implies that stock markets in BRICS except for the Russian Federation are inefficient and are predictable. A major flaw of Tiwain and Kyophilavong's contribution lies in the coverage as the number of years covered are relatively small for accurate result.

In a related development, Narayan and Smyth (2006) observed that results from the empirical investigation of fifteen (15) European stock market supports existence of random walk hypothesis for the European economies examined. Similar results can also be found in Ozdemir 2008, Marashdeh and Shrestha 2008, Munir and Mansur 2009, Oskooe *et al.* 2010, for Turkey, UAE, Palestine and Iran stock market respectively.

In another development, some authors have documented that no evidence abound from empirical analysis to support the random walk hypothesis. Some of these scholars include Lima and Tabak (2004), Tabak (2003) and Soon *et al.* (2014) for stock markets of China, Singapore and Malaysia respectively.

Opponents of the random walk hypothesis relies majorly on Mean reversion framework which draws its strengths from stock market Overreaction hypothesis which stresses that investors' reaction in term of being pessimistic or optimistic often swings away stock prices from their basic value at least in the interim. They also identified irrational behavior of noise traders, stock market size and associated risk factors, price related microstructure –induced biases effect among others as the key factors that debunk the random walk hypothesis (see De Bondt and Thaler (1985), Shefrin and Statman (1985), Poterba and Summes (1988), Zarowim (1990), Richard (1997), Summers (1986), Conrad and Kaul (1993), Chan (1988), Ball and Kothari (1989)).

Early studies from Africa reveal that most African stock markets are inefficient. For instance, Dickson and Muragu (1994) documented that Nairobi Stock Market is inefficient, similar results were reported for Ghana and Namibia by Osei (1998) and Matome (1998) respectively. For some selected African economies, Gyamfi *et al.* (2016) noted that no evidence exists to support the EMH. The authors' submission was in line with the findings of Magusson and Wydick (2002) who used partial autocorrelation test to analysis the efficiency nature of a number of African stock markets – Nigeria inclusive- and observed that stock markets in Nigeria, Ghana and Zimbabwe did not in any way support the EMH (see also Smith 2008). Sunde and Zivanomoyo (2008), Uddin and Khoda (2009) are of the view that no evidence supports the random walk hypothesis for the stock market of Zimbabwe and Senegal respectively.

Empirical evidences on stock market efficiency from Nigeria like other emerging economies are at best mixed. For instance, while Samuel and Yacout (1981), Ayadi (1983) (1984), Omole (1997), Olowe (1999), Lawal *et al*. (2015) were of the view that evidence abound to support that EMH holds for the Nigerian Stock Market, others like Ekechi (1989), Oludoyi (1999), Adelegan (2001), Nwosa and Oseni (2011), Afego (2012), Babajide *et al*. (2015), (2016) are of the view that the Nigerian stock market is inefficient both at weak and semi-strong efficiency. Up till date, no empirical evidence has examined stock market behavior within the context of strong form efficiency in Nigeria.

A critical review of the Nigerian literature shows that existing literature were conducted within time-domain framework with no attempt to calibrate frequency domain. For instance, Ayadi (1983) employed Wald-Wolfwitz test and runs test to examine random walk property of the Nigerian Stock Market. As later noted by Inanga and Asekome (1992), Ayadi's submission is biased because he excluded zero runs in his tests. Samuel and Yacout (1981), Inanga and Asekome (1992), Omole (1997) and Adelekan (2004) all used serial correlation analysis to examined stock market efficiency in Nigeria at various time period.

The preference of frequency-domain over time-domain estimation techniques as recently emphasis in academic circle is what motivates the current study to examine stock market efficiency using data from the Nigerian economy.

2. Data and methodology

2.1. Data

In this study, we used the All Share Index (ASI) weekly data sourced from the Central Bank of Nigeria Statistical Bulletin (various issues). Our data spanned from 1985-2016. The choice of the scope of the data was induced by

the availability of data. Though the Nigeria Stock Exchange began operation in 1960, Stock market data become publicly available in 1985 and 2016 is the most current year.

2.2. Methodology

Different methods have been employed in empirical literature to examine market efficiencies especially in emerging economics. This study differs from previous work by using wavelet analysis to analysis weekly data sourced on the Nigerian economy for the period 1985 to 2016. Wavelet analysis outperforms earlier techniques like serial correlation, run test, Generalized Autoregressive Conditional heteroskedasicity, Q-test etc., because it has the ability to decompose data into several time scales and possess the ability to handle non-stationary data and localization in time. It also establishes both the long run and the short run relationship through the use of wavelet time scales, thereby providing an wholistic view on the entire relationship (Durai and Bhaduri 2009, Aloui and Hikiri 2014, Tiwari *et al.* 2016, Moya-Martínez 2015, Madaleno and Pinho 2015, Boubaker and Sghaier 2015, Hathroub and Aloui 2016, Li *et al*. 2014, Nury *et al* 2015, Xue *et al*. 2014, Yang *et al*. 2016).

The preference of wavelet analysis over other estimation techniques could also be justified from its ability to calibrate frequency domain into empirical analysis. Most of the existing estimation techniques are based on the time-domain framework with no attention paid to frequency domain. However, evidence abound that some appealing relationship among macroeconomic variables exist at different frequencies that time domain framework will not be able to capture (Andries *et al.* 2014, Bai *et al.* 2016, Jammazi, and Reboredo 2016, Bahmani-Oskooee *et al.* 2016). In addition, stochastic process can be decomposed into wavelet components with specific frequency band.

Another significant power of wavelet lies in its ability through the wavelet power spectrum to measure the contributions of the variance at a particular frequency band in comparison to the overall variance of the process (Boubaker and Sghaier 2015, Hathroubi and Aloui 2016, Li *et al.* 2014, Nury *et al.* 2015, Bai *et al.* 2016, Jammazi and Reboredo 2016, Bahmani-Oskooee et al. 2016, Xue *et al*. 2014, Yang *et al.* 2016).

Fan and Gencay (2010) describes the wavelet-based unit root tests as follow.

$$y_t = py_{t-1} + u_t \tag{1}$$

where: u_t is a weakly stationary zero mean error with a strictly positive long-run variance defined by $w^2 \equiv y_0 + 2\sum_{j=1}^{\infty} y_j$ given that y_j = E (μt $\mu t - j$) expressed as:

$$y_t = \mu + a_t + y_t^S \tag{2}$$

If H0: p = 1, then y_t^S is a unit root process, but if H0 :(p) < 1, then y_t^S is a zero mean stationary process, if α = 0. If H_0: ρ=1, y_t^S is a unit root process. If H0: ρ=1 <1 y_t^S is a zero mean static any process, α = 0 $\{y_t - \bar{y}\}$ *where* $\bar{y} = T^{-1}\sum_{t=1}^{T} y_t$ is the sample mean of $\{y_t\}$. If $\alpha \neq 0$, then we use the detrended series $\{\tilde{y}_t - \bar{\tilde{y}}\}$ where $\tilde{y} = \tilde{y}_t = \sum_{j=1}^{t}(\Delta y_j - \Delta\bar{y})$, $\bar{\tilde{y}}$.

Fan and Gencay (2010) further developed two test statistics for the demeaned and detrended series as follows $\hat{S}_{T,1}^{LM}$ and $\hat{S}_{T,1}^{Ld}$ using DWT wavelet. The two tests are defined as follows:

$$\hat{S}_{T,1}^{LM} = \frac{\sum_{t=1}^{T/2}\left(V_{t.1}^{M}\right)^2}{\sum_{t=1}^{T}\left(y_t - \bar{y}\right)^2} \tag{3}$$

$$\hat{S}_{T,1}^{Ld} = -\frac{\sum_{t=1}^{T/2}\left(V_{t.1}^{d}\right)^2}{\sum_{t=1}^{T}\left(\tilde{y_t} - \bar{\tilde{y}}\right)^2} \qquad \text{.....(4)}$$

To fitting into our specification, we employed Morlet's wavelet and expand equation (4) such that

$$\square^{M}(t) = \frac{1}{\pi^{1/4}} e^{i\omega_0 t} e^{-t^2/2} \tag{5}$$

where: $\omega_0$represent the central frequency of the wavelet, following Aloui and Hkiri (2014), the study used $\omega_0 = 6$, this is premised on the fact that evidence abound that setting ω_0 to 6 will enhance a good balancing between time and frequency localization (see also Rua and Nunes 2009, Vacha and Barunik 2012).

3. Presentation of results

Table 1 below presents the descriptive statistics of the All Share Index in Nigeria for the period studied. From the result, it can be deduced that the Kurtosis statistic is greater than 3; this implies that the distribution is peaked (Leptokurtic) relative to normal. The excess kurtosis strongly supports the evidence of non-normality as indicated by the Jargue-Bera test. The Skewness, which is a measure of asymmetry of distribution around its mean, is negative as reported in the Table 1.

Table 1. Descriptive Statistics of the ASI

Mean	0.5052
S.D	3.784
Skewness	-0.5051
Kurtosis	4.7250
J.B (Prob)	101.482 (0.000)
AR (1)	0.1179 (0.0065)
LB_Q-Stat.	5329 (0.0000)
AC(12)	0.812
ARCH LM(12)	3.2408 (0.0002)
ADF Test	- 0.6128(0) 0.9775

Source: Authors' computation (2016)

The results of the test statistics of for Equations 3, 4 and 5 of the wavelet-based unit root tests are presented in Table 2.

Tables 2. Wavelet-Based unit root tests

	Lag = 10	Lag = 20	Lag = 30
$\hat{S}_{T,1}^{LM}$	-47. 14758*	-42.87703*	-39.45521*
$\hat{S}_{T,1}^{Ld}$	-172.23335*	-157.1544*	-145.6549*
$\square^{M}(t)$	-206.2653**	-158.12254**	-145.6885**

Note: *; ** and *** denotes 1%; 5% and 10% significance respectfully.
Source: Authors' computation (2016)

In order to test the robustness of our results, the study followed Tiwani and Kyophilavong (2014) by using three different lags: 10, 20 and 30 from the results, It can be deduced that evidence abounds to reject the null hypothesis of existence of random walk in the All Share Index for the Nigerian economy. The result from Morlet's wavelet also provides sufficient evidence to reject the null hypothesis of random walk for the All Share Index.

To test the supremacy of the wavelet-based estimation techniques over the conventional time-domain estimation techniques, we used a set of unit root tests that considered structural breaks in our models. Specifically, we used the Narayan and Popp (2010) and GARCH-based unit root test proposed by Liu and Narayan (2011). Both tests incorporate at least two structural breaks in the data series.

The result of the time domain estimation techniques are presented in Tables 3 and 4. From the results, it can be deduced that both the test statistics do not provide any evidence to reject the null hypothesis – *i.e* they accept the null hypothesis type.

Table 3. Narayan and Popp (2010) unit root test with break test

	Model 1				Model 2			
	TB1	TB2	$\hat{p}[t_p]$	K	TB1	TB2	$\hat{p}[t_p]$	K
ASI	93:9	2003:10	-0.0808 [-4.790]	7	2003:10	2004:08	-0.0782 [-4.898]	1

Source: Authors' computation (2016)

Table 4. Liu and Narayan (2011) GARCH (1,1) unit root test with break test

	Periods	TB1	TB2	$[t_p]$
ASI	1985:1 – 2015:12	87:06	2003:08	-7.039

Source: Authors' computation (2016)

Conclusion

This paper examined the validity of the random walk hypothesis for the Nigerian stock market using a newly developed econophysics wavelet analysis. We employed a 3 lag lengthens so as to test the sensitivity of the results. Our results clearly reject the null hypothesis of random walk hypothesis for the Nigerian stock market. This implies that the Nigeria capital market is inefficient. The result further implies that the stock market can serve as a platform to advance economic growth in Nigeria as it provides opportunities for arbitrage activities thereby attracting funds both domestic and external, needed for economic growth.

The study further apply two time domain unit root test that considers structural breaks, the results from the time domain estimation techniques shows that evidence abound to accept the null hypothesis.

References

[1] Afego, P 2012. Weak Form Efficiency of the Nigerian Stock Market: An Empirical Analysis (1984 – 2009). *International Journal of Economics and Financial Issues*, 2 (3): 340 -347.

[2] Alexeev, V., and Tapon, F. 2011. Testing weak form efficiency on the Toronto Stock Exchange. *Journal of Empirical Finance*, 18: 661 – 691.

[3] Al-Loughani, N., and Chappell, D. 1997. On the validity of the weak-form efficient markets hypothesis applied to the London Stock Exchange. *Applied Financial Economics,* 7: 173 – 176.

[4] Aloui, C., Hkiri, B. 2014. Co-movements of GCC emerging stock markets: new evidence from wavelet coherence analysis. *Economic Modelling,* 36: 421–431.

[5] Andrieș, A.M, Ihnatov, I., and Tiwari, A.K. 2014. Analyzing time–frequency relationship between interest rate, stock price and exchange rate through continuous wavelet. *Economic Modelling,* 41: 227–238.

[6] Ayadi, F.O 1983. *The Nigerian Capital Market and the Random Walk Hypothesis*, Unpublished M'Sc Dissertation, University of Lagos, Nigeria.

[7] Ayadi, O. 1984. Random Walk Hypothesis and the Behaviour of Stock Price in Nigeria. *The Nigeria Journal of Economics and Social Studies*, 26(1): 57-71.

[8] Babajide, A.A., Lawal, A.I., and Somoye, R.O. 2015. Monetary Policy Dynamics and the Stock Market Movements: Empirical Evidence from Nigeria. *Journal of Applied Economic Sciences,* Volume X, Winter (8)38: 1179-1189.

[9] Babajide, A.A., Lawal, A.I., and Somoye, R.O. 2016. Stock Market Response to Economic Growth and Interest Rate Volatility: Evidence from Nigeria. *International Journal of Economics and Financial Issues,* 6(1): 354-360.

[10] Bahmani-Oskooee, M., Chang, T., and Ranjbar, O. 2016. Asymmetric causality using frequency domain and time-frequency domain (wavelet) approaches. *Economic Modelling,* 56: 66–78.

[11] Bai, Y., Dong, D., Wu, S., Liu, Z., Zhang, G. and Xu, K 2016. A wavelet transformation approach for multi-source gravity fusion: Applications and uncertainty tests. *Journal of Applied Geophysics,* 128: 18–30.

[12] Ball, R., and Kothari, S.P. 1989. Non-stationary expected returns: Implications for tests of market efficiency and serial correlations in returns. *Journal of Financial Economics*, 25: 51–74.

[13] Boubaker, H. and Sghaier, N. 2015. Semiparametric generalized long-memory modeling of somemena stock market returns: A wavelet approach. *Economic Modelling,* 50: 254–265.

[14] Buguk, C., and Brorsen, B.W. 2003. Testing weak-form market efficiency: evidence from the Istanbul Stock Exchange. *International Review of Financial Analysts*, 12: 579 – 590.

[15] Chancharat, S., Valadkhani, A. 2007. *Testing for random walk hypothesis and structural breaks in international stock prices.* Working Paper, No. 07–15, University of Wollongong.

[16] Chang, T., Chu, H., and Ranjbar, O. 2014. Are GDP fluctuations transitory or permanent in African countries? Sequential Panel Selection Method. *International Review of Economics and Finance*, 29: 380–399.

[17] Chaudhuri, K., and Wu, Y. 2003. Random walk versus breaking trend in stock prices: evidence from emerging markets. *Journal of Banking and Finance*, 7: 575 – 592.

[18] Cheung, K.C., and Coutts, J.A. 2001. A note on weak form market efficiency in security prices: evidence from the Hong Kong Stock Exchange. *Applied Economics Letters*, 8: 407 – 410

[19] Conrad, J., and Kaul, G. 1993. Long-term market overreaction or biases in computed returns? *Journal of Finance*, 48: 39–63.

[20] De Bondt, W.F.M. and Thaler, R. 1985. Does the stock market overreact? *The Journal of Finance*, 40 (3): 793–805, Papers and Proceedings of the Forty-Third Annual Meeting American Finance Association, Dallas, Texas, December 28-30, 1984 (Jul, 1985),

[21] Dickinson, J.P., and Muragu, K. 1994. Market Efficiency in Developing Countries: A Case Study of the Nairobi Stock Exchange. *Journal of Business Finance and Accounting*, 21(1): 133 – 150.

[22] Durai, S.R.S., Bhaduri, N.S. 2009. Stock prices, inflation and output: evidence from wavelet analysis. *Economic Modelling,* 26 (5): 1089–1092.

[23] Fama, E.F. 1965. The Behavior of Stock-Market Prices. *The Journal of Business*, 38(1): 34-105.

[24] Fama, E.F. 1970. Efficient capital markets: A review of theory and empirical work. *Journal of Finance*, 25: 383–417.

[25] Fan, Y., Gençay, R. 2010. Unit root tests with wavelets. *Economic Theory,* 26: 1305–1331.

[26] Gozbasi, O., Kucukkaplan, I. and Nazlioglu, S. 2014. Re-examining the Turkish stock market efficiency: Evidence from nonlinear unit root tests. *Economic Modelling,* 38: 381–384

[27] Grieb, T., and Reyes, M.G. 1999. Random walk tests for Latin American equity indexes and individual firms. *Journal of Financial Research*, 22: 371– 383

[28] Gyanfi, E.N., Kyei, K. and Gill, R. 2016. Long – Memory persistence in African Stock Markets. *EuroEconomica*, 1(35): 83 – 91.

[29] Hasanov, M., 2009. Is South Korea's stock market efficient? Evidence from a nonlinear unit root test. *Applied Economics Letters,* 16: 163 – 167.

[30] Hathroubi, S., and Aloui, C. 2016. On interactions between remittance outflows and Saudi Arabian macroeconomy: New evidence from wavelets. *Economic Modelling,* 59: 32–45.

[31] Inanga, E.L., and Asekome, M.O 1992. The Random Character of Equity Share Prices in the Nigerian Stock Market. *Management and Development, RVB Research Papers*, XII (1): 12 – 17.

[32] Jammazi, R., and Reboredo, J.C. 2016. Dependence and risk management in oil and stock markets: A wavelet-copula analysis. *Energy* 107, 866e888.

[33] Jefferis, K., Smith, G. 2005. The Changing Efficiency of African Stock Markets*, South African Journal of Economics*, 73: 54-67.

[34] Kavussanos, M.G., and Dockery, E. 1996. Testing the efficient market hypothesis using panel data, with application to the Athens stock market. *Applied Economics Letters,* 3: 121 – 123.

[35] Lawal, A.I., Awonusi, F. and Oloye, M.I. 2015. All share price and inflation volatility in Nigeria: An application of the EGARCH model. *Euroeconomica,* 34(1): 75 – 82.

[36] Lawal, A.I., Oloye, M.I., Otekunrin, A.O., and Ajayi, S.A. 2013. Returns on Investments and Volatility Rate in the Nigerian Banking Industry. *Asian Economic and Financial Review*, 3(10): 1298-1313.

[37] Li, L., Yao, S. and Duchesne, P. 2014. On wavelet-based testing for serial correlation of unknown form using Fan's adaptive Neyman method. *Computational Statistics and Data Analysis,* 70: 308–327.

[38] Lima, E.J.A., Tabak, B.M. 2004. Tests of the random walk hypothesis for equity markets: evidence from China, Hong Kong and Singapore. *Applied Economics Letters,* 11: 255–258.

[39] Lo, A.W., and Mackinlay, C.A., 1988. Stock market prices do not follow random walks: evidence from a simple specification test. *Review of Financial Studies,* 1: 41 – 66.

[40] Madaleno, M., and Pinho, C. 2014. Wavelet dynamics for oil-stock world interactions. *Energy Economics*, 45: 120–133.

[41] Magnusson, M.A., Wydick, B. 2002. How efficient are Africa's emerging stock markets? *Journal of Development Studies*, 38: 141-156.

[42] Mandelbrot, B. 1966. Forecasts of future prices, unbiased markets, and "martingale" models. *Journal of Business*, (S1) 39: 242–255.

[43] Marashdeh, H., Shrestha, M., 2008. Efficiency in emerging markets – evidence from the emirates securities market. *European Journal of Economics, Finance and Administrative Sciences,* 12: 143–150.

[44] Matome, T.K 1998. The Price Discovery Process of the Namibian Stock Exchange and the Informational Content of the Share Index. *Savings and Development*, 3(XXII), 283 – 301.

[45] Moya-Martínez, P., Ferrer-Lape˜na, R, and Escribano-Sotos, F. 2015. Interest rate changes and stock returns in Spain: A wavelet analysis. *BRQ Business Research,* 18: 95-110.

[46] Munir, Q., Mansur, K. 2009. Is Malaysian stock market efficient? Evidence from threshold unit root tests. *Economics Bulletin*, 29 (2): 1359–1370.

[47] Narayan, P.K. 2005. Are the Australian and New Zealand stock prices nonlinear with a unit root? *Applied Economics,* 37: 2161 – 2166.

[48] Narayan, P.K. 2006. The behaviour of US stock prices: evidence from a threshold autoregressive model. *Mathematics and Computer Simulation*, 71: 103– 108.

[49] Narayan, P.K. 2008. Do shocks to G7 stock prices have a permanent effect? Evidence from panel unit root tests with structural change. *Mathematics and Computer Simulation,* 77: 369 – 373.

[50] Narayan, P.K., Smyth, R. 2006. Random walk versus multiple trend breaks in stock prices: evidence from 15 European markets. *Applied Financial Economics Letters,* 2: 1–7

[51] Nury, A.H. *et al.* 2015. Comparative study of wavelet-ARIMA and wavelet-ANN models for temperature time series data in northeastern Bangladesh. *Journal of King Saud University – Science*. Available at: http://dx.doi.org/10.1016/j.jksus.2015.12.002

[52] Nwosa P.I., and Oseni, I.O. 2011. Efficient Market Hypothesis and Nigerian Stock Market. *Research Journal of Finance and Accounting*, 2(12): 37 - 46. Available at: http://pakacademicsearch.com/pdf-files/ech/519/38-46%20Vol%202,%20No%2012%20(2011).pdf

[53] Okpara, G. 2010. Stock market prices and the Random walk hypothesis: Further Evidence from Nigeria. *Journal of Economics and International Finance*, 2(3): 49-57.

[54] Olowe, R.A. 1999. Weak Form Efficiency of the Nigerian Stock Market: Further Evidence*, African Development Review*, 11(1): 54-68.

[55] Oludoyi, S.B. 1997. *Capital Market Efficiency and the Effects of Earnings Announcements on Share Prices in Nigeria*, Unpublished PhD Thesis, University of Ibadan, Nigeria.

[56] Omole, D.O. 1997. *Efficient Market Hypothesis and the Nigerian Capital Market under Financial Liberalization: An Empirical Analysis,* Unpublished PhD Thesis, University of Ibadan, Nigeria.

[57] Osei, K.A 1998. Analysis of Factors Affecting the Development of an Emerging Capital Market: The Case of the Ghana Stock Market. *African Economic Research Consortium Research Paper* 76.

[58] Oskooe, S.A.P., Li, H., Shamsavari, A. 2010. The random walk hypothesis in emerging stock market. *Int. Res. J. Finance Econ. Issues* 50: 51–61.

[59] Ozdemir, Z.A. 2008. Efficient market hypothesis: evidence from a small open-economy. *Applied E*conomics, 40(5): 633–641.

[60] Poterba, J.M., and Summers, L.H. 1988. Mean reversion in stock prices: Evidence and implications. *Journal of Financial Economics*, 22: 27–59.

[61] Qian, X.Y., Song, F.T., Zhou, W.X. 2008. Nonlinear behaviour of the Chinese SSEC index with a unit root: evidence from threshold unit root tests. *Physica* A 387 (2-3): 503-510. DOI: 10.1016/j.physa.2007.09.029

[62] Richards, A.J. 1997. Winner–loser reversals in national stock market indexes: Can they be explained? *Journal of Finance*, 52: 2129–2144.

[63] Rua, A., and Nunes, L.C. 2009. International comovement of stock market returns: A wavelet analysis. *Journal of Empirical Finance*, 16: 632–639

[64] Samuelson, P.A. 1965. Proof that properly anticipated prices fluctuate randomly. *Industrial Management Review,* 6(2): 41–49.

[65] Shefrin, H.M., and Statman, M. 1985. The disposition to sell winners too early and ride losers too long: Theory and evidence. *Journal of Finance*, 40: 777–790.

[66] Smith, G. 2008. Liquidity and the Informational Efficiency of African Stock Markets. *South African Journal of Economics*, 76(2): 161-175.

[67] Soon, S.V, Baharumshah, A.Z. and Chan, T.H 2014. Efficiency Market Hypothesis in an emerging market: Does it really hold for Malaysia? *Jurnal Pengurusan*, 42: 31 – 42.

[68] Summers, L.H. 1986. Does the stock market rationality reflect fundamental values? *Journal of Finance*, 41: 591–601.

[69] Sunde, T., Zivanomoyo, J. 2008. The random walk hypothesis for the Zimbabwe stock exchange: January 1998–November 2006. *Journal of Social Sciences,* 4 (3): 216–221.

[70] Tabak, B.M. 2003. The random walk hypothesis and the behaviour of foreign capital portfolio flows:Tthe Brazilian stock market case. *Applied Financial Economics,* 13: 369–378

[71] Tiwari, A.K, Mutascu, M.I., Albulescu, C.T. 2016. Continuous wavelet transforms and rolling correlation of European stock markets. *International Review of Economics and Finance,* 42: 237–256.

[72] Tiwari, A.K., and Kyophilavong, P. 2014. New evidence from the random walk hypothesis for BRICS stock indices: a wavelet unit root test approach. *Economic Modelling,* 43: 38–41.

[73] Uddin, G.S., Khoda, N. 2009. An empirical examination of random walk hypothesis for Dhaka Stock Exchange: evidence from pharmaceutical sector of Bangladesh. *International Research Journal of Financial Economics* 33: 87–100.

[74] Vacha, L., Barunik, J. 2012. Co-movement of energy commodities revisited: evidence from wavelet coherence analysis. *Energy Economics,* 34: 241–247.

[75] Xue, Y., Gençay, R., and Fagan, S. 2014. Jump detection with wavelets for high-frequency financial time series. *Quantitative Finance*, 14: 1427–1444.

[76] Yang, L., Cai, X.J., Zhang, H. and Hamori, S. 2016. Interdependence of foreign exchange markets: A wavelet coherence analysis. *Economic Modelling,* 55: 6–14.

[77] Zarowin, P. 1990. Size, seasonality, and stock market overreaction. *Journal of Financial and Quantitative Analysis*, 25:113–125.

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