Scientific contribution

Testing Market Efficiency in Emerging Markets' Stock Indices with Runs Tests

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Abstract:
According to the efficient market hypothesis (EMH), the prices of securities reflect all the available information on the market. Efficient markets have an important consequence – it is not possible for an investor to consistently outperform the market by using information that is not already reflected in the prices of securities. No matter how much resources one deploys into security analysis, no excess return can be made, which means that investors seeking higher returns must bear higher risk given the risk-return trade-off. Inefficient markets, on the other hand, offer investors opportunities for higher returns at the same risk profile. In this scientific contribution, we test seven emerging markets' stock indices for a weak form of market efficiency. Numerous previous research indicates that emerging markets are not fully efficient and that prices on their stock markets do not follow a random walk. We performed runs tests on weekly and monthly returns of stock indices and found statistically significant results in three indices for weekly and three indices for monthly returns, which indicates that these indices violate weak form of market efficiency. We found insignificant results, which indicate efficient markets, only for weekly and monthly returns on the Indian BSE Sensex 30 Index. Thus we come to similar conclusions as other authors that emerging markets persist to violate weak form of market efficiency and remain an attractive opportunity for investors seeking to exploit inefficiencies.

Keywords: Market efficiency; Efficient market hypothesis; Random walk; Emerging markets; Stock Exchange Index; Runs test

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1. Introduction

1.1. Market efficiency

Market efficiency corresponds to the information efficiency of the market, that is the degree of information reflected in the market price of financial security. The efficient market hypothesis (EMH) states that the prices of securities reflect all information available (Busse and Green, 2002). New information that causes security prices to change is unpredictable because predictable future information is captured in the prices today. When new information arrives on the market, the security price will either increase or decrease through a random process. This is the so-called random walk hypothesis, under which stock price movements are random and unpredictable (Aktan et al., 2017). There are three forms of market efficiency – weak, semi-strong and strong form. According to the weak form of market efficiency security's price captures all available past information, which conveys that we cannot predict price changes based on the past prices of security (Fama, 1970). In practice, this means that with technical analysis of past security prices, we cannot achieve returns above the market. Under a semi-strong form of efficiency, all publicly available information is captured and reflected in the price of a security, which means that even with a fundamental analysis of security one cannot achieve returns superior to the market. The most rigorous form of market efficiency is the strong form, which states that securities' prices reflect all past price information, all publicly available information and also all private (often called insider) information. If a market is efficient in strong form, there is no possibility for abnormal returns for investors and we can see that under the strong form, we satisfy also the semi-strong and weak form of market efficiency (Aktan et al., 2017).

Efficient markets are very important in the financial world, as no matter how much resources one deploys into security analysis, no excess return can be made (given the assumption of strong form efficiency). This means that investors seeking higher returns must bear higher risk given the risk-return trade-off. Efficient markets also mean that well-educated and experienced investors cannot make any higher returns than beginners for the same level of risk exposure. If markets are inefficient, investors can benefit from the under- or overvaluation of the security and make higher returns for the same risk profile. Numerous research shows that prices on stock markets of emerging economies don't follow a random walk (Aktan et al. 2017), which means that the security's price will deviate from the fair value. This is only one of the reasons why emerging markets remain in high popularity among investors.

Emerging markets are defined as markets in development, which do not meet all the requirements of a fully developed market (MSCI, 2022). Definitions vary broadly and so do the countries that are included in the emerging market indices, however, Brazil, China, India, Indonesia, Russia, Saudi Arabia, South Korea, Taiwan and Turkey are generally included. In the MSCI Emerging Markets Index, there are currently 24 countries of which 5 are from the Americas region, 11 from EMEA and 8 from Asia.

1.2. Methodology to test market efficiency

There are different statistical tests which help researchers and investors determine the presence of weak form market efficiency. To test broader, but still particular, stock market efficiency we use stock market indices, which consolidate changes in prices of individual securities listed on the stock exchange and included in the stock index. Not all public companies are included in a particular index, however, such indices provide information on overall movements in the stock market and are universally used in the financial world. Each statistical analysis begins by calculating the returns of a particular index since we are analysing price changes and not prices per se. There are two straightforward methods for testing weak form market efficiency, autocorrelation test and runs test – the usage of which we demonstrate in the next paragraph. With the autocorrelation test, we determine whether returns are influenced by their own lagged values over time. Insignificant autocorrelation for all selected lags indicates efficient markets (Aktan et al. 2017).

2. Methods

To demonstrate the testing of the weak form efficient market hypothesis we will use runs tests on weekly and monthly returns of seven emerging market indices. We have extracted prices from the base date for each stock index from Refinitiv software and calculated weekly and monthly returns to exclude noises on daily basis. Selected indices include Shanghai Stock Exchange Composite Index (SSE, China), S&P Bombay Stock Exchange Sensitive Index (BSE Sensex, India), Indice de Precios y Cotizaciones Index (IPC Bolsa, Mexico), Russian Trading System Index (RTS, Russia), Korea Composite Stock Price Index (KOSPI, South Korea), Taiwan Capitalization Weighted Stock Index (TAIEX, Taiwan) and Borsa Instanbul National 100 Index (BIST 100, Turkey).

Runs test checks the randomness of runs in a sequence of returns of an index. It is an especially useful test since it does not require the returns to be normally distributed (Sharma et al. 2015). We analysed the occurrence of the same events (a sequence of positive or negative returns) that are separated by the occurrence of a sequence of returns of the opposite sign (Hawaldar 2017). The mean and variance are calculated as shown in **Equation (2**) (mean) and **Equation (3)** (variance), where n^+ is the number of positive returns in the data set, n^- is the number of negative returns in the data set and N:

$$N = n^+ + n^-. \tag{1}$$

$$\mu = \frac{2\ n^+\ n^-}{(n^+ + n^-)}\ , \tag{2}$$

$$\sigma^2 = \frac{2\ n^+\ n^-\ (2\ n^+\ n^- - n^+ - n^-)}{(n^+ + n^-)^2\ (n^+ + n^- - 1)} = \frac{2\ n^+\ n^-\ (2\ n^+\ n^- - N)}{N^2\ (N - 1)}\ . \tag{3}$$

Standard z-statistics is used to conduct the runs test. A statistically significant test (p-value $\leq \alpha$) indicates that returns are *non*-random and thus violate a weak form of market efficiency (Hawaldar et al. 2017). Before carrying out the tests we form a null and alternative hypothesis.

H_0: Sequence of index returns is random.

H_1: Sequence of index returns is not random.

3. Results

We analysed 14 data sets (seven stock indices on a weekly and monthly basis) from their base date. The highest average weekly return of 0.80% was achieved on the Turkish BIST National 100 Index, while the lowest average weekly return of 0.20% was achieved on Korean SE Composite Index. Turkish BIST National 100 Index recorded also the highest weekly standard deviation (6.0%) on a weekly level, while Korean SE Composite Index recorded the lowest one (3.3%). Similarly, the Turkish BIST National 100 Index recorded the highest average monthly return and the highest monthly standard deviation, while Korean SE Composite Index recorded the lowest average monthly return and the lowest monthly standard deviation. This shows that based on weekly and monthly historical data, higher risk brought higher returns. We used Microsoft Excel (Version 2212) to calculate descriptive statistics, which are provided in **Table 1**.

Table 1. Descriptive statistics for weekly and monthly returns of selected indices.

Index	Mean	Min.	Max.	Std. dev.	Skewness	Kurtosis
Panel A: weekly returns						
SSE	0.0031	-0.2285	0.9339	0.0511	4.5510	74.9881
BSE Sensex 30	0.0034	-0.2061	0.3940	0.0366	0.6211	8.5551
IPC Bolsa	0.0041	-0.1974	0.3066	0.0378	0.5531	7.3161
RTS	0.0033	-0.3266	0.4076	0.0584	0.1006	5.8113
KOSPI	0.0020	-0.1746	0.1994	0.0335	0.0274	4.0350
TAIEX	0.0025	-0.2158	0.2159	0.0375	-0.1696	3.4175
BIST National 100	0.0080	-0.3082	0.4155	0.0603	0.4438	3.8776
Panel B: monthly returns						
SSE	0.0155	-0.3200	1.5619	0.1360	5.0191	49.5797
BSE Sensex 30	0.0148	-0.2856	0.5280	0.0769	0.7473	4.7088
IPC Bolsa	0.0179	-0.2522	0.4689	0.0781	0.7815	4.9043
RTS	0.0160	-0.5492	0.5454	0.1292	-0.0331	2.8593
KOSPI	0.0088	-0.2725	0.4837	0.0713	0.6957	4.3174
TAIEX	0.0119	-0.3836	0.4360	0.0925	0.5786	3.8935
BIST National 100	0.0364	-0.5048	1.0000	0.1471	1.8102	8.2609

Table 2 provides Z-values and corresponding *p*-values for weekly and monthly returns of selected indices. We used Microsoft Excel (Version 2212) to calculate aforementioned statistics and corresponding *p*-values. There are three statistically significant runs tests on weekly returns (Chinese, Russian and Taiwanese stock indices), which indicates the presence of market inefficiency. Statistically insignificant results indicate the presence of a weak form of market efficiency. When performing runs tests on monthly returns we found three results to be statistically significant (Mexican, South Korean and Turkish stock indices).

Table 2. Results of runs tests.

	Weekly Returns		*Monthly Returns*	
	Z value	*p-value*	*Z value*	*p-value*
SSE	-2.010	0.044**	-1.353	0.176
BSE Sensex 30	0.597	0.550	-0.473	0.636
IPC Bolsa	0.696	0.486	-2.086	0.037*
RTS	-3.170	0.002***	-1.195	0.232
KOSPI	-1.118	0.263	-1.994	0.046*
TAIEX	-4.014	0.000***	-1.070	0.285
BIST National 100	-0.659	0.510	-2.051	0.040*

The stars indicate significance at 1% (***), 5% (**) and 10% (*)

4. Conclusions

Based on the results of the runs test we can conclude that certain previously mentioned emerging markets' stock indices violate weak form of market efficiency. The only stock index with statistically insignificant results both for weekly and monthly returns was the Indian BSE Sensex 30 Index.

With runs tests, we have proven that emerging markets are not completely efficient, which might partially explain institutional investors' interest in those markets while searching for higher returns and arbitrage opportunities. Violation of the Efficient market hypothesis suggests that it is possible for an investor to consistently outperform the market because information and collective knowledge of market participants is not fully reflected in the price of a security.

Conflicts of Interest: The authors declare no conflict of interest.

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