

TESTING THE MARKET EFFICIENCY WHEN INTEREST RATES CHANGE: CASE IN INDONESIA

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ABSTRACT

Until the end of September 2023, the interest rate policy in the Republic of Indonesia shifted from 3.50% to 5.75%. The objective of this study is to examine whether changes in interest rates have an impact on the market efficiency in Indonesia. The daily market returns of Indonesia Stock Exchange (IDX) indices from January 3rd, 2022, until October 9th, 2023 are employed. To examine the market efficiency in weak form, this study conducts the normality test by the Kolmogorov-Smirnov test, the unit root problem test by Augmented Dickey-Fuller test, and the variance ratio test. This study finds that most market indices experienced a decline in returns and were less volatile when interest rates shifted to higher levels. This study also finds that most market indices tend to remain efficient in weak form at both low and high interest rates. The finding implies that those indices tend not to be influenced by policy changes in interest rates. However, the findings also show that several market indices experience changes in conditions when interest rates shift. As the studies on the relationship between changes in interest rates and market efficiency are scarce, the novelty of this study is the use of event windows to get specific impact of changes in interest rates on market efficiency.

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INTRODUCTION

Recently, more information on global issues related to changing conditions in the world economy continues to influence capital market conditions. As the result, more relevant information emerges and influences the basis for investors' decision-making in capital market. This is because capital market activities are closely related to a country's economic conditions (İcan & Çelik, 2023). The circumstance where the latest information is relevant to investors' decision-making in the capital market is often called market efficiency. According to Fama (1970) and Malkiel (2003), the market can be called efficient if the current relevant information is directly reflected in stock market prices so that no one can gain

extraordinary profits (no one can beat the market).

A macroeconomic factor that tends to be affected by global issues and plays an important role in the capital market is the interest rate (Eldomiaty et al., 2020; Wong, 2022; Alsharif, 2023; Ghosh, 2022; Bhattacharjee & Das, 2023). Recently, the interest rate policy in the Republic of Indonesia shifted from 3.50% to 5.75% until the end of September 2023. This study suspects that a shift in interest rates to a higher point tends to contribute to market efficiency, especially to returns of the index of each industry. Figure 1 shows that returns of the index of each industry tend to have varying trends. The objective of this study is to examine whether changes in

interest rates have an impact on the market efficiency of industries in Indonesia.

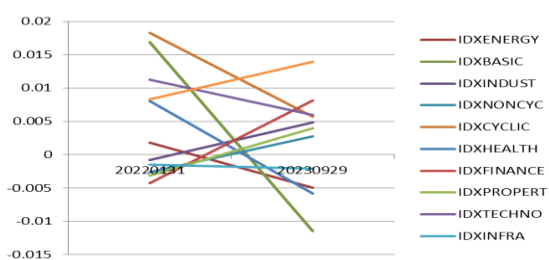


Figure 1. The returns of the index of each industry

LITERATURE REVIEW

The theory of market efficiency

Most market efficiency phenomena can be explained by the efficient market hypothesis (EMH) which refers to three market forms, which are weak, semi-strong, and strong (Fama, 1970). Fama (1970) and Malkiel (2003) emphasize that efficient market conditions will not create overvalued or undervalued. According to Fama (1970), this condition is caused by market prices reflecting the relevant information at that time.

The evidence of Chaudhuri and Wu (2003) shows that several emerging markets (such as Argentina, Brazil, India, and Malaysia) from January 1985 to February 1997 tended to be inefficient due to not being influenced by information from developed markets. Similarly, during the 1990s, Smith and Ryoo (2003) also find that most of the emerging markets (such as Greece, Hungary, Poland, and Portugal) were inefficient except for the Istanbul market. On other case, Agwuegbo et al. (2010) prove that information on stock prices in Nigeria tends to be untimely, thus providing opportunities for investors to gain profits. Setianto and Manap (2011) show that from April 1983 to December 2010, the efficient market in Indonesia was triggered by financial market liberalization and financial crisis.

According to Daver et al. (2013), relevant information is sufficient to cause

the capital market in Turkey from December 2007 to August 2013 to be in an efficient condition even though it is short term. Eren and Karahan (2020) consistently found that the Turkish Stock Market remained consistent according to the weak form efficient market hypothesis from January 1990 to December 2019. However, Hailu and Vural (2020) also find that most prices especially in the Turkish banking sector did not follow the random walk from January 4, 2010, to December 20, 2019. Moreover, Aktan (2022) finds that the Turkish stock market tends to become inefficient in the era of the global financial crisis 2008 until the COVID-19 pandemic. The findings of Chitenderu et al. (2014) imply that policymakers' guarantees regarding the good implementation of financial reporting standards, regulations, and risk management can make investors well-informed, well-protected, and confident.

Furthermore, Tahir et al (2017) found that the prices in the Karachi Stock Exchange were inefficient except during the financial crisis in 2007 and 2009. The finding by Rehman et al. (2018) shows that several emerging markets in South Asia (such as Pakistan, India, and Bangladesh) are inconsistent with the weak form of efficient market hypothesis from 30 June 2005 to 30 June 2017 which tends to be caused by irrational behavior by uninformed investors. Recently, Enow (2023) shows that the information around the COVID-19 pandemic contributed to the market efficiency of the JSE, NASDAQ, CAC 40, DAX, and Nikkei 225. In other cases, Pontoh and Budiarso (2023) show that risky assets in Indonesia tend to be more efficient, implying that relevant information is reflected more quickly in these assets. Rahman (2023) emphasizes that relevant information not directly reflected in share prices tends to cause market inefficiencies as happened in the UK in 1997 and 2017. On this condition, Al-Hamdooni (2023) confirms that inefficient market conditions result in investors

obtaining abnormal returns as happened in Iraq, Kuwait, and Dubai during 2021.

The implications of interest rate changes

The phenomenon of market efficiency as an implication of the central bank's policy of changing interest rates cannot be separated from the inflation issue. Conceptually, the policy of changing interest rates from the central bank is a follow-up action to reduce the inflation rate in maintaining economic stability (Thanh, 2015). According to Claeys (2015) and Tadle (2022), the policy of reducing interest rates is taken when the inflation rate is relatively in normal conditions and vice versa if the inflation rate is relatively high then interest rates will increase.

However, the policy of changing interest rates has its own consequences on capital market conditions, especially for investors who carry out portfolios based on optimal returns. Empirically, changes in interest rates have a varying impact on market price movements. For example, the evidence from Eldomiaty et al. (2020) in the case of non-financial firms shows that an increase in interest rates in the United States during the stable economic era (1999 to 2016) will be positively responded to by market prices. In addition, the study by Gu et al. (2022) in China during unfavorable economic conditions (from January 2005 to February 2018) shows that increasing interest rates tend to be responded positively by investors because they are indicated to create opportunities to obtain abnormal returns.

During the earlier of COVID-19 pandemic in Argentina, Australia, Canada, China, India, Italy, United Kingdom, United States, Singapore, Spain, Sweden, and Hong Kong, the evidence by Deng et al. (2022) shows that the cut-off for interest rates has a positive impact on investment activity in the capital market. Supporting that result, the examination by Wong (2022) during the Asian financial crisis (1997 until 1998) and the global financial crisis (2008

until 2009) in Malaysia, the Philippines, Singapore, Korea, Japan, the United Kingdom (UK), Germany, Hong Kong, and Indonesia also prove that policies to increase interest rates tend to result in a decrease in share prices in the capital market, even though it is only short term. Similarly, the findings by Moya-Martínez et al. (2015) in the Spanish stock market (from January 1993 to December 2012), Javangwe and Takawira (2022) in South African stock market (from 1980 to 2020), and Bhattacharjee and Das (2023) in Indian stock market (from January 1993 to December 2019) shows that the relationship between interest rates and market prices is not unidirectional. Based on a review of previous empirical evidence, the hypothesis of this study are as follows.

H0: market is inefficient as interest rate change

H1: market is efficient as interest rate change

RESEARCH METHOD

This study employs daily returns (the difference between current and previous prices divided by previous prices) of the market indices in Indonesia. The market indices are energy sector (IDXENERGY), basic materials sector (IDXBASIC), industrials sector (IDXINDUST), consumer non-cyclical sector (IDXNONCYC), consumer cyclical sector (IDXCYCLIC), healthcare sector (IDXHEALTH), finances sector (IDXFINANCE), properties & real estate sector (IDXPROPERT), technology sector (IDXTECHNO), infrastructures sector (IDXINFRA), and transportation & logistics sector (IDXTRANS).

The period of observation is January 3rd, 2022 until October 9th, 2023. This period is chosen because during that time, the interest rate in Indonesia starts to increase from 3.50% to 5.75%. This study uses the median of the interest rate of 5% and divided the period into two sub-periods. The first sub-period (SP1) is January 3rd, 2022 until November 16th, 2022 as it contains low interest rate while the second sub-period (SP2) is November

17th, 2022 until October 9th, 2023 as it contains high interest rate.

In terms of hypothesis testing, this study applies some procedures with several tests. First, detect the data normality with the Kolmogorov-Smirnov (KS) test at a significance of 10% as the best level. The null hypothesis of the KS test is that the returns have normal distributions and the alternative hypothesis is that the returns are not normally distributed. The formula of KS test is noted as follows.

$$D = \max_x |F(x) - S_n(x)|$$

Second, detect the unit root problem with Augmented Dickey-Fuller (ADF) test at a significance of 1% as the best level. The null hypothesis of the ADF test is that the returns have a unit root problem and the alternative hypothesis is that the returns have no unit root problem. The formula of ADF test is noted as follows.

$$\Delta y_t = a + Y_{yt-1} + V_t$$

Third, test the market efficiency in weak form of the efficient market hypothesis with the variance ratio (VR) test by formula as follows.

$$VR(k) = \frac{\sigma^2(k)}{\sigma^2(1)}$$

The z-statistics of variance ratio test is defined as follows.

$$z(k) = \frac{VR(k) - 1}{\sqrt{\phi(k)}}$$

$$\phi(k) = \frac{2(2k - 1)(k - 1)}{3kN}$$

On the formula, N is total observations while k is the lags of 2, 4, 8, and 16. The null hypothesis of the VR test is that the returns are efficient and the alternative hypothesis is that the returns are inefficient at a significance of 10% as the best level.

RESULT AND DISCUSSION

Table 1 shows descriptive statistics of market returns of each industry during two sub-periods. On average, most market indices (such as IDXENERGY, IDXBASIC, IDXINDUST, IDXNONCYC, IDXHEALTH, IDXFINANCE, IDXTECHNO, and IDXTRANS) have smaller returns when they are at SP2. This implies that a shift in interest rates to a higher level results in a decline in the most of market indices. Otherwise, several market indices (such as IDXPROPERTY and IDXINFRA) tend to experience an increase in returns, even though it is small.

Other result shows that IDXCYCLIC tends not to experience changes in returns even though there are changes in interest rates. In addition, the standard deviation for most indices (such as IDXENERGY, IDXBASIC, IDXINDUST, IDXNONCYC, IDXCYCLIC, IDXFINANCE, IDXPROPERTY, IDXTECHNO, IDXINFRA, and IDXTRANS) in SP2 tends to decrease compared to SP1. The results indicate that most indices are less volatile as long as the interest rate is higher. Otherwise, the finding shows that the standard deviation of IDXHEALTH tends to increase in SP2, indicating that this index is more volatile.

Table 1. Descriptive statistics

	Mean		SD		Skew		Kurt	
	SP1	SP2	SP1	SP2	SP1	SP2	SP1	SP2
IDXENERGY	0.0026	0.0002	0.0160	0.0134	0.2500	-0.3500	0.9100	0.8700
IDXBASIC	0.0002	-0.0002	0.0122	0.0098	-0.0200	-0.3600	-0.0500	0.3800
IDXINDUST	0.0007	-0.0004	0.0111	0.0081	0.1200	0.0600	0.9000	2.1400
IDXNONCYC	0.0004	0.0000	0.0084	0.0060	0.0500	0.1900	2.1800	-0.1700
IDXCYCLIC	-0.0002	-0.0002	0.0089	0.0074	0.4400	-0.1700	2.6300	1.8900
IDXHEALTH	0.0002	-0.0002	0.0087	0.0091	-0.2700	0.2800	0.8800	1.2800
IDXFINANCE	-0.0002	-0.0004	0.0101	0.0065	-0.4200	0.1700	1.4200	0.9300
IDXPROPERTY	-0.0006	0.0000	0.0086	0.0077	0.4600	0.4000	1.9500	0.3900
IDXTECHNO	-0.0012	-0.0022	0.0197	0.0156	0.1600	1.0600	0.3900	5.6700
IDXINFRA	-0.0003	0.0000	0.0092	0.0077	0.0300	-0.0400	0.7800	1.1500
IDXTRANS	0.0007	-0.0001	0.0176	0.0115	0.4800	0.0400	1.4000	0.9400

Table 2 presents the results of KS test for market indices at a level significance of 10%. During SP1, the results show that IDXENERGY, IDXBASIC, IDXFİNANCE, IDXTECHNO, and IDXINFRA are insignificant at 10%. The results imply that those indices are normally distributed during low interest rates. During SP2, the IDXENERGY, IDXNONCYC, IDXINFRA, and IDXTRANS show that the results are insignificant at 10%. The results imply that those indices are normally distributed during the period of high interest rates. On those findings, this study notes that the IDXENERGY and IDXINFRA remain in a

normally distributed condition during changes in interest rates. Otherwise, the IDXINDUST, IDXCYCLIC, IDXHEALTH, and IDXPROPERT still do not have a normal distribution even though interest rate changes exist. In addition, the findings show that IDXBASIC, IDXFİNANCE, and IDXTECHNO become non-normally distributed when shifting to a period when interest rates are higher. The results also show that the IDXNONCYC and IDXTRANS become normally distributed when shifted to a time when interest rates are higher.

Table 2. Normality test

	SP1		SP2	
	Statistic	Sig.	Statistic	Sig.
IDXENERGY	0.032	0.200	0.041	0.200
IDXBASIC	0.038	0.200	0.057	0.090
IDXINDUST	0.057	0.083	0.070	0.013
IDXNONCYC	0.081	0.002	0.031	0.200
IDXCYCLIC	0.074	0.006	0.074	0.006
IDXHEALTH	0.064	0.032	0.089	0.000
IDXFİNANCE	0.042	0.200	0.069	0.015
IDXPROPERT	0.065	0.030	0.060	0.055
IDXTECHNO	0.046	0.200	0.084	0.001
IDXINFRA	0.038	0.200	0.044	0.200
IDXTRANS	0.063	0.039	0.043	0.200

Table 3 presents the results of unit root tests for market indices. The ADF test shows favorable results where all indices have statistically significant values at 1%. Those results confirm that all indices did

not experience unit root problems since the implementation of low interest rates until they shifted to period when higher interest rates took effect.

Table 3. Unit root test

	SP1		SP2	
	Statistic	Sig.	Statistic	Sig.
IDXENERGY	-14.37649	0.0000	-13.01591	0.0000
IDXBASIC	-14.81015	0.0000	-13.41559	0.0000
IDXINDUST	-15.56972	0.0000	-13.16013	0.0000
IDXNONCYC	-16.02346	0.0000	-15.12406	0.0000
IDXCYCLIC	-12.88514	0.0000	-12.52208	0.0000
IDXHEALTH	-15.20580	0.0000	-15.89097	0.0000
IDXFİNANCE	-14.50191	0.0000	-15.19128	0.0000
IDXPROPERT	-14.19102	0.0000	-13.63594	0.0000
IDXTECHNO	-13.02135	0.0000	-14.81705	0.0000
IDXINFRA	-6.544519	0.0000	-13.76246	0.0000
IDXTRANS	-13.12912	0.0000	-13.81504	0.0000

Table 4 presents the results of the VR test used as a basis to justify the hypothesis of this study. The cases of IDXENERGY, IDXINDUST, IDXNONCYC, IDXHEALTH, IDXFINANCE, IDXPROPERT, and IDXTECHNO in SP1, the individual test results at lags 2, 4, 8, and 16 consistently show probabilities above 10%. Moreover, the result of joint test also shows that those indices have a probability of above 10%. In SP2, the individual test also shows consistent results so the joint test result shows a probability of more than 10%. The findings indicate that those indices tend to be efficient in the weak form during periods of low interest rates until changes occur at higher levels so the H1 of this study is accepted. The findings also imply that those indices are more resistant to policy changes in interest rates.

Furthermore, this study finds unique results on several indices such as IDXBASIC, IDXCYCLIC, IDXINFRA, and IDXTRANS. The IDXBASIC has consistent results by individual and joint tests in SP1. This implies that IDXBASIC tends to be efficient during low interest rates which makes the H1 is accepted. Figure 2 describes the movement of variance ratio statistic of IDXBASIC during SP1.

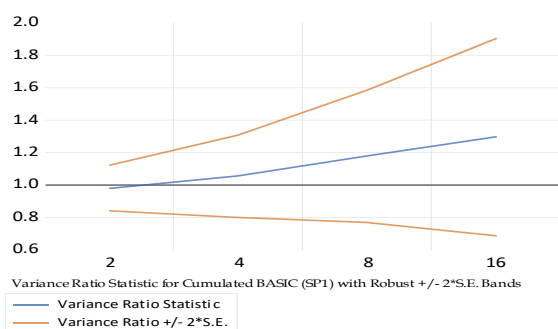


Figure 2. The VR of IDXBASIC during SP1

However, the results show that IDXBASIC has inconsistent probabilities by individual tests in SP2. By the individual test, the insignificant statistic value at lag 2 starts to become significant at lag 4 to lag 16. Figure 3 describes the movement of variance ratio statistic of IDXBASIC during SP2. These results imply that IDXBASIC is

in an efficient condition only at the beginning of the period when the interest rates changed to higher and became inefficient. The result of the joint test confirms that IDXBASIC is inefficient in periods of high interest rates and makes this study cannot rejects the H0.

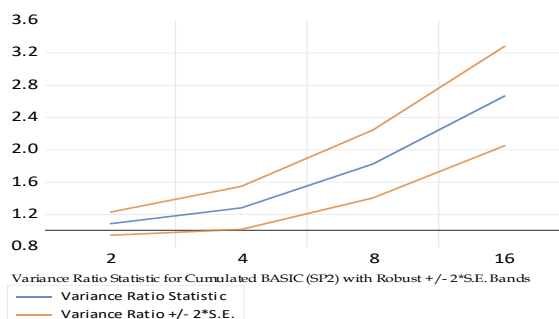


Figure 3. The VR of IDXBASIC during SP2

The IDXCYCLIC consistently has statistical values with a probability above 10% in SP1 through individual and joint tests. The results indicate that IDXCYCLIC tends to be efficient during low interest rates, so this study accepts H1. Figure 4 describes the movement of variance ratio statistic of IDXCYCLIC during SP1.

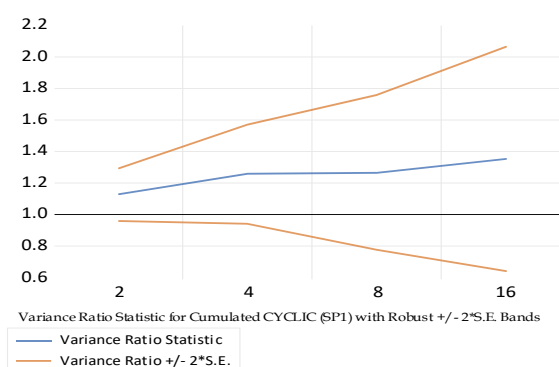


Figure 4. The VR of IDXCYCLIC during SP1

However, the results of the individual test in SP2 show that the statistical values at lags 2, 4, and 8 have a probability below 10% and change insignificantly at lag 16. The results indicate that IDXCYCLIC tends to be more efficient only at the end of the observation period at a time when the interest rates are high. In addition, the result of the joint test in SP2 on

IDXCYCLIC also provides statistical value with a probability below 10%. The result confirms that IDXCYCLIC tends to become inefficient during high interest rates so this study accepts H0. Figure 5 describes the movement of variance ratio statistic of IDXCYCLIC during SP2.

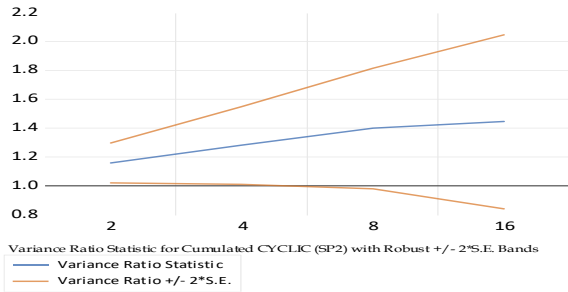


Figure 5. The VR of IDXCYCLIC during SP2

The IDXINFRA has a statistical value with a probability above 10% in SP1, especially at lags 2. Figure 6 describes the movement of variance ratio statistic of IDXINFRA during SP1. This result implies that IDXINFRA tends to be efficient at the beginning of the period when low interest rates apply. However, the statistical values of the individual test at lags 4, 8, and 16 then change to be significant so that the result of the joint test have a probability below 10%. The condition causes H0 is accepted where IDXINFRA tends to be inefficient during low interest rates.

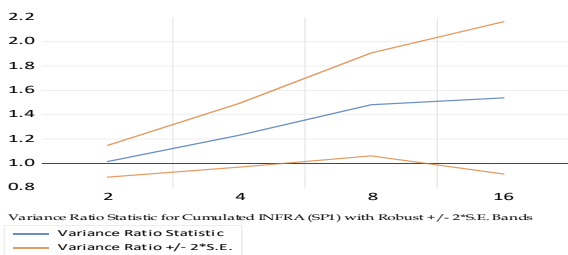


Figure 6. The VR of IDXINFRA during SP1

In SP2, the results from individual and joint tests consistently have a probability above 10%. These results indicate that IDXINFRA tends to be efficient in periods of high interest rate; therefore, this study accepts H1. Figure 7 describes the movement of variance ratio statistic of IDXINFRA during SP2.

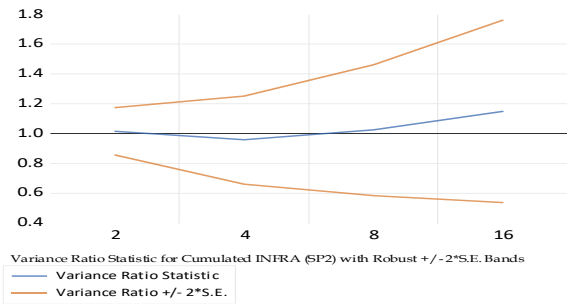


Figure 7. The VR of IDXINFRA during SP2

The IDXTRANS has a unique condition in SP1. By individual tests, the results of lags 4 and 8 are significant, thus implying that IDXTRANS tends to be inefficient but only in the middle of the low interest rate period. Figure 8 describes the movement of variance ratio statistic of IDXTRANS during SP1.

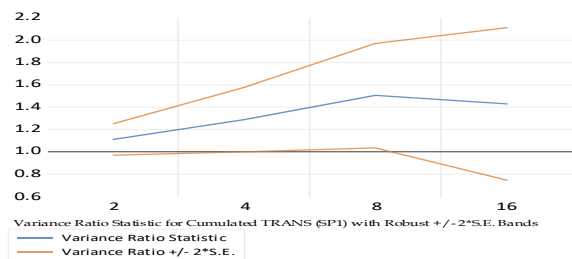


Figure 8. The VR of IDXTRANS during SP1

However, the statistical value of the joint test has a probability above 10%, thus implying efficient conditions and therefore this study accepts H1. The results of SP2, both individual and joint tests, provide statistical values above 10%, so H1 can also be accepted. Figure 9 describes the movement of variance ratio statistic of IDXTRANS during SP2.

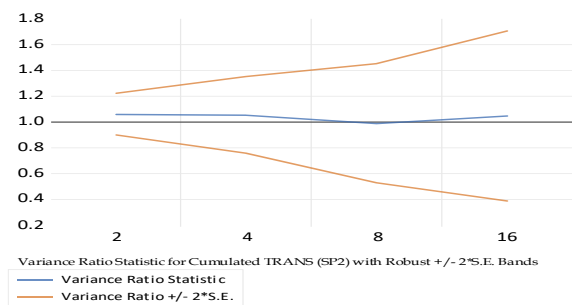


Figure 9. The VR of IDXTRANS during SP2

Table 4. Variance ratio test

	Individual test								Joint test	
	Lag 2		Lag 4		Lag 8		Lag 16			
	Stat.	Sig.	Stat.	Sig.	Stat.	Sig.	Stat.	Sig.	Stat.	Sig.
SP1										
IDXENERGY	0.282	0.778	0.262	0.794	-0.281	0.779	-0.709	0.479	0.709	0.926
IDXBASIC	-0.302	0.763	0.412	0.680	0.863	0.388	0.963	0.335	0.963	0.805
IDXINDUST	-0.814	0.416	0.357	0.721	0.747	0.455	1.433	0.152	1.433	0.483
IDXNONCYC	-0.801	0.423	-0.645	0.519	-0.426	0.670	-0.903	0.367	0.903	0.839
IDXCYCLIC	1.516	0.129	1.626	0.104	1.093	0.274	0.999	0.318	1.625	0.355
IDXHEALTH	-0.494	0.621	0.037	0.971	0.248	0.804	-0.411	0.681	0.494	0.979
IDXFINANCE	0.129	0.898	0.710	0.478	0.069	0.945	-0.543	0.587	0.710	0.926
IDXPROPERT	0.292	0.770	1.052	0.293	0.340	0.734	-0.050	0.959	1.052	0.749
IDXTECHNO	1.439	0.149	0.699	0.484	0.364	0.716	-0.001	0.999	1.439	0.478
IDXINFRA	0.224	0.822	1.752	0.079	2.277	0.023	1.710	0.087	2.277	0.088
IDXTRANS	1.571	0.116	1.999	0.046	2.165	0.030	1.268	0.205	2.165	0.116
SP2										
IDXENERGY	1.169	0.242	1.481	0.139	1.504	0.133	0.723	0.469	1.504	0.434
IDXBASIC	1.151	0.249	2.051	0.040	3.921	0.000	5.371	0.000	5.371	0.000
IDXINDUST	1.349	0.177	1.139	0.255	0.251	0.802	-1.094	0.274	1.349	0.542
IDXNONCYC	-0.751	0.453	-0.259	0.796	0.055	0.956	-0.059	0.953	0.751	0.910
IDXCYCLIC	2.289	0.022	2.068	0.039	1.901	0.057	1.466	0.143	2.289	0.086
IDXHEALTH	-1.537	0.124	-1.428	0.153	-1.573	0.116	-1.641	0.101	1.641	0.346
IDXFINANCE	-0.501	0.617	-0.718	0.473	-0.502	0.615	-0.234	0.815	0.718	0.923
IDXPROPERT	0.933	0.351	0.879	0.379	0.126	0.899	-0.473	0.637	0.933	0.822
IDXTECHNO	-0.109	0.914	0.328	0.743	0.906	0.365	0.701	0.483	0.906	0.837
IDXINFRA	0.181	0.857	-0.292	0.770	0.109	0.913	0.488	0.626	0.488	0.980
IDXTRANS	0.742	0.458	0.367	0.714	-0.041	0.967	0.141	0.888	0.742	0.914

CONCLUSIONS

This study examines the market efficiency by taking the setting in a period of low and high interest rates. During the observed period, most of the market indices experienced a decline in returns when interest rates shifted to higher levels. However, when interest rates are higher, the consumer cyclical sector tends to have constant returns, while the properties & real estate sector and infrastructures sector tend to experience increasing returns. Also, most of the market indices became less volatile when interest rates increased, except for the healthcare sector which became more volatile although there is a decline in returns.

This study complements the literature of EMH under circumstances implementing monetary policy regarding effective interest rates. Consistent with the efficient market hypothesis in weak form, most market indices tend to remain efficient at both low and high interest rates. This implies that those indices tend not to

be influenced by policy changes in interest rates.

However, it also needs to be underlined that several market indices experience changes in conditions when interest rates shift. For example, infrastructure sectors tends to become more efficient when interest rate increase. Otherwise, the basic materials and consumer cyclical sectors tend to experience changes where in periods with high interest rates both become inefficient. Another implication is that most efficiency indices do not provide opportunities for investors to obtain abnormal returns, although this is relatively not the case for several industrial sectors. This suggests that the investment portfolio needs to be set into account market efficiency gaps. This study is limited to the most recent period in Indonesia when relatively constant and low interest rates turned upward to higher levels.

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