COINTEGRATION ANALYSIS OF INDUSTRIAL SECTORS ON THE INDONESIA STOCK EXCHANGE: A MULTIVARIATE APPROACH

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Abstract - This study examines the diversification opportunities in the Indonesia Stock Exchange (IDX) by analyzing the movement of nine (9) sector stock indices, namely Agricultural Sector, Consumer Goods, Finance, Mining, Basic and Chemical Industries, Infrastructure, Manufacture, Construction and Services-Trade Sectors. The data used in this study is weekly stock price index in each sector during the period 2013-2018. This study used cointegration analysis with multivariate approach to study the relationship between sector stock indices during the study period. The results show that there is no cointegrationor long-term relationship between the nineIndex Sectors on the BEI. This suggests that the nine sector indices do not move simultaneously in the long run. This condition allows investors to diversify their stock portfolios in the Indonesia Stock Exchange. Further analysis with Var Decomposition and Impulse Responses also proves that each sector is independent and supports the statement that the market on the Indonesia Stock Exchange has a semi-strong or weak form.

Keywords - Diversification, Stock, Index, Cointegration.

I. INTRODUCTION

Stock markets around the world have become a means for investors to earn profits. In the globalization era like this, capital market integration is inevitable due to the development of time and technology. The integration of capital markets both internationally and locally causes investors to not get abnormal returns. A fully integrated market will create a close relationship with world capital markets. Such capital markets affect the movement of values of shares that have similarities. The movement of stocks also occurs simultaneously resulting in the same risk and return (Puspitasariet al., (2015) .Therefore, simultaneous movements will make it difficult for investors to diversify into the desired assets to generate higher risk-adjusted returns.Climent and Meneu (2003) argue that capital markets in a region tend to have the same movement and have a contagion effect so that the level of integration between capital markets becomes high. For example, the movement of crude oil prices affect world stocks index prices (Berk and Aydogan, 2012). The existing literature shows that the integration of the stock market takes place in local and international capital markets. Muhajir (2008) examined the integration of SBI or Indonesian Interest Rate and Composite Stock Price Index (IHSG) by using cointegration technique and found that the Composite Stock Price Index and SBI have long-term integration. However, several other studies show that there is no integration between the variables studied. Constatinouet al. (2005) examined the relationship between stock sector indices in Cyprus Stock Exchange and did not find long term relationship between indices. Judge and Rashidin (2002) examined the long-term relationship between the DJMI index and the W5000 market index and concluded that the DJMI index stands independently. Therefore, investors must manage their portfolios because portfolios with integrated stocks eliminate returns. Previous research results, therefore, are still not convincing. This study reviews whether there is or is not a long-term relationship between the stock index sectors in the Indonesian stock exchange. This study also developed previous research using nine sector indices.

II. THEORETICAL FRAMEWORK

Markowitz (1952)'s popular adviceis "do not put your eggs in one basket". The important message of Markowitz's advice is an investment asset has a correlation between one another. Therefore, the selection of available investment assets in the market is crucial so that the combination of assets will provide a good return and low risk. The combination of assets owned must have a low or opposite correlation. Therefore, it is important to understand the relationship between existing assets. To study this relationship, one way, is to use cointegrationanalysis especially for assets whose data is not stationary. Cointegration analysis was introduced by Engle and Granger (1987), which measures diversification based on the price of an asset in the long-term. Lanouar et al. (2015) conducted a study with the aim of finding diversification opportunities in local investors using Syariah and conventional index. The results of this study found thatconventional and sharia index in London and America are not cointegrated and only in the American countries SRI index and Syariah index are unintegrated. Clare et al. (1995) analyzed the cointegration of international bonds in the US, UK, Germany and Japan, with Johansen method and

univariate approach (pair-wise), no cointegrationwas found between the bonds. Then, Mills and Mills (1991) used the same international bond yield data but different approach (multivariate approach) to test the cointegrationof bonds, the result was the same (unintegrated). Another cointegrationanalysis such as those of Gilmore and Macmanus (2002) on the US and European stock indices, the results of the analysis found no cointegrationin each of these objects. However, Walid (2012) on the Qatari sector index found a long-term relationship between the tested indices.Muhajir (2008) and Efka (2002) tested long-term relationships on various indices on the Indonesia Stock Exchange and found a small correlation between the variables tested. In contrast to Danuprata (2003) who found that sector indices on the IDX are moving simultaneously, this study still uses correlation analysis that may not fit the stock index variables that usually have root units. This present study extend the previous studies by using all the existing sector indices so that it will provide more representative results of the long-term relationship between the existing stock index and include more attention to the presence or absence of the root unit of the variable to be tested.

III. DATA DAN FRAMEWORK

This study analyzed the time-series data obtained from the Indonesia Stock Exchange and Yahoo Finance from January 2013 to March 2018. The data used are weekly stock price (260 weeks) from sectorial stock index namely Agriculture Stock Index (JKAGRI), Consumer Goods (JKCINS), Finance (JKFINA), Mining (JKMING), Basic and Chemical Industry (JKBIND), Infrastructure (JKINFA), Manufacture (JKMNFG), Construction (JKPROP) and Sector Trade and Services (JKTRAD). To analyze the long-term relationships of all variables, VAR (VerctorAutoRegresive) Model is performed. Var has an advantage when compared to other methods because it does not separate exogenous and endogenous variables-all endogens-that require identification restrictions which are often invalid.

Cointegration test (Johansen Test) is usedto analyze the relationship of these variables in the long run. This test can be done if the data at the level is not stationary or has root unit. If a set of variables is all I (1), they should not be estimated using a regular regression analysis.However, among the variables, there may be one or more relations of equilibrium in the long run are equal to equilibrium (Cointegrated). We can estimate how many such relationships by using the Johansen technique. To fulfill this assumption then the data stationary must be tested. This research used ADF-test method to test the data stationary.

If Yt is series with lag length p,

So that: $\Delta Yt = \alpha 0 + \gamma Yt\text{-}1 + \beta i \sum_{i=1}^{p} Yt - i + 1\ \varepsilon t$

.

Where:

ΔYt: first difference

α0: Intercept

Y:Variabel

P: lag used

ε: Error term

Furthermore, optimum lag is used to anticipate the specification error when the selected lag is too low and reduce the degree of freedom when the selected lag is too long. The optimum lag determination in this study uses AIC or Akaike Information Criterion (AIC) criteria,

After unit root and optimum lag determination is determined, then next we performecointegrationtest with Johansen method or technique. The test was performed using a multivariate approach. In contrast to the pair-wise approach, Clare et al. (1995) are only pairing 2 variablesduringcointegrationtesting. In a multivariate approach, all variables (all indices) are tested simultaneously. From Johansen test results, weobtained Maximum Eigenvalue and Trace statistic value, to answer the following hypothesis:

H_0: Has no cointegration

H_1: Has Cointegration

In this research, the variables are ninesector indices in BEI, then there will be atmost 8 independent linear cointegration(<= 8). In this research, wealso performed further analysis in the form of Var Decomposition and impulse response test. That is to investigate how big the contribution variable to variable some time forward (in percent) on each index with other index.

IV. RESULTS AND DISCUSSIONS

Most time series data on economic variable have non stationary series such as GNP, interest rate, inflation, stock price and more. In certain tests, for example, between variables y and x I (1), if each variable has a unit root / not stationary then it is feared to have "nonsense correlation" (Yule 1926) between the two, such as in regression yt = βXt + e. However, economic variables may have long-term relationships, although those variables are I (1) and may drift away from the equilibrium briefly and return to the equilibrium. The equilibrium concept of the variable I (1) is called cointegration.

Cointegration is a combination of multiple variable I (1) that is linear. In this study, all the variables used stationary test by using ADF-test (Dicky and Fuller 1979) in groups. Table 4.1 provide the result that all variables are I (1), ordinary regression tests are feared will cause spurious regression in the variables used because all of them are integrated of order one. Therefore, this study conducted a cointegration test using Johansen technique (Brooks, 2008) for analyzing the relationship of variables

Table 4.1

Unit Root Testing	***I(0)***		***I(1)***	
	Statistic	Prob	Statistic	Prob
ADF-Fisher Chi Square	16.5515	0.5541	749.661	0.0000
ADF-Choi-Z Stat	0.20512	0.5813	-24.5927	0.0000

Table 4.1 shows that the data at the level does not reject H0 (H0: has the root unit), this can be seen from the probability value (0.5541) and statistics (16.5515). However, the data on the first difference shows the probability (0.000) and statistic (749.661), which means the data is stationary on its first difference. No stationary data at the level, it takes cointegration analysis to see the stability of forecast in the long term, especially in looking at the relationship between variables.

This research used the cointegration analysis with multivariate approach that is to look at the cointegration of ninesector indices simultaneously with the optimum lag one. Optimum lag is selected after Var lag optimum selection criterion, AIC (Akaike Information Kriterion), SC (Schwarz Criterion) and HN (Hannan-Quin Information Criterion) indicates the optimum lag criterion is in the first lag.

Based on the test results presented in Table 4.2, we can see the Maximum Eigenvalue and Trace statistic values of the Johansen test. At the $\alpha = 5\%$ level, the statistical trace value indicates the presence of atmost one cointegration relationship because the statistical trace value (203.997) is greater than the critical value (197.371), but the maximum eigenvalue value indicates no cointegration at either 5% or 1% significance. Trace statistic value at atmost one is slightly larger than its critical value. This indicates a cointegration relationship however, the signal tends to be weak. The max-eigen statistic value is all smaller than the critical value indicating the absence of cointegration.

The following tests, with a tighter level of significance that is at the level of $\alpha = 1\%$, indicate that both the value of trace statistics and maximum eigenvalue provide a smaller number than its critical value, so it can be concluded that the nine (9)sector indices on the Indonesia Stock Exchange has no cointegration or long-term relationships among indices. This allows the opportunities to diversify for investors. Because of each index does not move simultaneously toward the equilibrium point, an opportunity for diversification in the assets in each index is also persist.

This result is in line with research conducted by Lanouar et al. (2015) that finds no cointegration between London Stock Exchange and US Stock Exchange. Constatinou et al. (2005) examines Cyprus Stock Exchange and finds no cointegration between indices which provides potential diversification by local investors.

The analysis of Var Decomposition and Impulse Responses reinforces the results. The results of Var Decomposition and Impulse Responses analysis show that each sector is relatively independent. This means that any shock on one index has a relatively small effect on the other index. Based on Table 4.3 and Table 4.4.

Tabel 4.2 Johansen Test

		Critical Value			Critical Value	
Number of Cointegrating	Test Stastistic	5%	1%	Max-eig stat	5%	1%
0	203.997	197.371*	210.054	53.096	58.433	64.996
1	150.900	159.530	171.09	42.141	52.362	58.668
2	108.760	125.615	135.973	32.473	46.231	52.308
3	76.285	95.753	104.961	23.778	40.077	45.869
4	52.507	69.818	77.818	20.996	33.876	39.37
5	31.511	47.856	54.681	13.820	27.584	32.715
6	17.691	29.797	35.458	10.635	21.131	25.861
7	7.055	15.494	19.937	7.053	14.264	18.52
8	0.0018	3.841	6.634	0.0018	3.841	6.634

It appears that there is a lack of cointegration among the nine sector indices, Var Decomposition indicates a shock on an index caused by the movement of the index itself as well as the other index. In JKAGRI index, it is seen that stock price movement of JKAGRI index is slightly influenced by shock on other indices. JKBIND index movement is affected

by the shock of the JKBIND index itself. This is similar to JKMINGS index, it is affected by a small portion (less than 10%) of shock from other index (JKAGRI: 5.13%, JKCONS: 4.53%, JKBIND: 7.41%, JKFINA: 0.10%, JKINFA: 4.5%, JKMNFG: 2.36, JKPROP: 6.3%, J KTRAD: 3.2%) after 10 days. Other Indices JKCONS, JKFINA, JKINFA, JKPROP and JKTRAD are mostly independent index price movements. JKMNFG is seen to have the smallest effect on other indices.

The results of impulse responses analysis also provide information that each index in the analysis is independent. After 3 days the influence of shock from index one with the other only 10% -13%, which is relatively small. This makes it possible to get excess returns from certain index price movement against other index. It also indicates that the market in Indonesia Stock Exchange tends to be weak due to the slow response of an index caused by changes from other indices. Based on the results of this study, investors will have the opportunity to diversify on the assets contained in existing sectorial indices and minimize the risks that exist.

CONCLUSION

This study investigate the existence of a long-term relationship between the stock indices of nine sectors covering Agriculture, Consumer, Finance, Mining, Basic and Chemical Industries, Infrastructure, Manufacture, Construction and Trade and Service Sectors. Investors can split the investment funds held in the stock market on the existing sectors. Investing in various sectors provides an opportunity for investors to benefit from a diversified strategy. A diversification strategy is biased only if assets have low or opposite correlations so investments are made at a low risk level for investors. If each sector has a relationship with each other for example moving simultaneously both in short and long term, then diversification will not work. From the nine variable data (sector index) on the BEI, it was found that all variables have a root unit. To investigate whether each sector is moving simultaneously at the equilibrium point after the shock, cointegration analysis is performed. Cointegration analysis allows researchers to examine the long-term relationships of variables that have root units. By using Johansen Technique, cointegrationbetween the IDX sector indices is not found on the basis of trace-statistic values and e-eigen values. So it can be said that each index is independent, or does not move simultaneously in the long run, thus the possibility of investors to use diversification strategy can still be maintained. The results of decomposition analysis of Var and Impulse response also indicates that the shock that occurs in the index has little effect on other index, where the biggest stock price index change caused by the shock that occurs within the sector itself not by other sectors. This supports the cointegration results stating that each index is independent. The slightest surprise effect on other indices also suggests that slow market responses to shocks or the Indonesia Stock Exchange have low levels of information or are classified into weak or semi-strong markets.

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TABEL 4.3 Var Decomposition

Explaining Movemnet in	Days Ahead	Explained by Movements in JKAGRI	JKBIND	JKCONS	JKFINA	JKINFA	JKMING	JKMNFG	JKPROP	JKTRAD
JKAGRI	1	100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	5	97.15	1.4	0.09	0.03	0.31	0.063	0.1	0.47	0.31
	10	94.24	2.04	0.08	0.3	0.99	0.24	0.07	1.06	1.06
	20	89.15	2.25	0.08	1.8	2.25	0.35	0.05	2.2	2.18
JKBIND	1	9.7	90.3	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	5	8.15	84.58	0.001	0.8	0.78	2.21	0.17	1.03	2.32
	10	5.7	65.74	0.29	1.75	2.2	7.75	0.38	5.82	10.3
	20	4.2	40.86	1.86	2.09	4.11	8.5	0.505	19.44	18.42
JKCONS	1	2.55	28.36	69.08	0.000	0.000	0.000	0.000	0.000	0.000
	5	2.16	29.7	60.52	2.22	2.04	0.86	0.17	0.3	1.94
	10	1.51	28.5	47.76	8.5	4.23	2.27	0.34	0.62	6.25
	20	1.12	22.3	31.8	16.55	9.22	5.41	0.24	2.28	11.1
JKFINA	1	2.03	44.8	8.06	45.06	0.00	0.00	0.00	0.00	0.00
	5	2.12	36.3	7.3	50.46	1.75	0.07	0.05	1.15	0.78
	10	1.36	25.4	8.07	50.83	4.95	0.16	0.06	5.34	3.8
	20	0.84	15.36	8.24	43.09	9.5	0.56	0.05	15.04	7.23
JKINFA	1	2.5	33.4	5.45	6.12	52.4	0.00	0.00	0.00	0.00
	5	1.7	26.7	5.05	9.18	55.2	0.8	0.2	0.4	0.7
	10	1.97	21.9	4.5	10.1	54.5	1.3	0.6	2.3	2.7
	20	2.12	16.7	3.5	8.85	51.3	3.2	0.8	7.05	6.5
JKMING	1	10.54	5.45	0.46	0.28	0.55	82.7	0.00	0.00	0.00
	5	7.1	7.6	2.23	0.13	3.56	76.8	0.89	1.03	0.54
	10	5.13	7.4	4.53	0.1	4.5	66.4	2.4	6.3	3.2
	20	3.13	7.6	5.6	0.15	4.5	46.7	3.2	19.6	9.41
JKMNFG	1	5.9	58.26	29.4	0.5	0.04	0.02	5.82	0.00	0.00
	5	7	55.09	25.02	2.99	1.9	0.056	4.53	0.5	2.8
	10	6.3	46.4	19.8	6.05	4.19	0.04	4.06	2.28	10.7
	20	4.07	33.8	14.23	8.35	8.7	0.36	2.6	8.08	19.7
JKPROP	1	6.35	33.4	3.34	5.13	0.104	0.0023	0.434	51.14	0.00
	5	8.35	34.03	2.78	7.233	0.57	0.503	0.129	45.54	0.82
	10	9.5	27.6	3.31	10.38	4.103	0.323	0.09	40.46	4.13
	20	8.83	20.36	4.6	12.44	15.17	0.968	0.06	29	8.63
JKTRAD	1	6.57	21.75	10.93	6.32	0.689	2.59	0.581	3.79	46.75
	5	10.9	19.71	9.78	9.98	2.047	0.97	2.02	3.98	40.58
	10	20.27	15.56	9.08	14.31	3.48	1.4	3.73	2.86	29.27
	20	29.31	10.61	8.33	14.53	7.82	1.26	3.77	3.78	20.55

Table 4.4 Impulse Responses

Explaining the Movemnet of	Periods of Responses	Explained by movements in JKAGRI	JKBIND	JKCONS	JKFINA	JKINFA	JKMING	JKMNFG	JKPROP	JKTRAD
JKAGRI	1	54.58	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	5	49.4	-7.96	-1.7	-1.84	4.45	2.23	1.35	-4.71	-4.84
	10	38.47	-7.23	-0.76	-5.04	7.182	3.319	0.324	-6.22	-7.232
JKBIND	1	4.56	13.94	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	5	2.504	8.213	0.089	1.574	1.43	2.92	0.64	-1.96	-3.06
	10	0.659	5.23	1.23	1.75	2.377	4.184	0.928	-4.423	-5.27
JKCONS	1	8.5	28.33	44.21	0.000	0.000	0.000	0.000	0.000	0.000
	5	3.76	19.45	22.767	10.1	7.15	-5.3	2.38	-2.41	-8.68
	10	0.817	14.42	12.93	15.44	10.16	-7.71	2.09	-4.23	-13.05
JKFINA	1	2.54	11.98	5.08	12.01	0.00	0.00	0.00	0.00	0.00
	5	1.92	7.52	4.24	11.4	3.06	0.76	0.222	-2.79	-2.43
	10	0.69	5.55	5.087	11.43	5.35	0.5112	0.4604	-6.1	-4.92
JKINFA	1	3.7	13.4	5.4	5.7	16.77	0.00	0.00	0.00	0.00
	5	2.55	8.78	4.07	6.53	14.311	-2.03	1.15	-2.31	-2.78
	10	2.81	6.06	3.11	5.54	12.39	-2.82	2.08	-4.74	-4.89
JKMING	1	12.9	9.35	2.73	2.12	2.98	36.41	0.00	0.00	0.00
	5	8.22	10.32	8.03	-0.78	8.32	31.2	5.56	-7.01	-5.03
	10	4.54	9.44	10.16	-1.19	8.48	23.29	7.81	-15.6	-11.017
JKMNFG	1									
	5									
	10									
	20									
JKPROP	1	3.43	7.877	2.49	3.08	-0.44	-0.065	0.89	9.73	0.00
	5	3.43	5.38	1.75	3.63	1.58	-0.197	0.24	6.85	-1.91
	10	2.92	3.07	2.06	3.64	3.67	0.086	0.1	4.23	-3.29
JKTRAD	1	4.07	7.4	5.25	3.99	1.31	2.55	1.21	3.09	10.86
	5	4.99	4.028	3.087	4.58	1.92	1.03	2.44	1.77	5.19