Is There Any Sectoral Cointegration in Indonesia Equity Market?

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ABSTRACT

An efficient portfolio, the one with low risk adjusted return, can be constructed using a good asset diversification. Sectoral diversification is one of the ways to reduce the portfolio risk since there are unique relationship among sector classifications. This research analyzes short and medium-run cointegration relationship among 9 sectoral indices in Indonesia equity market (JCI), using 2012-2016 weekly closing prices as the data. This study analyzed the relationship among these sectors using Johansen-Julius Cointegration Test and predict the causal relationship using Engle-Granger Causality and model the causalities using Vector Error Correction Model. Using empirical results of Johansen cointegration tests, this study finds that there is no cointegration in the short-run as the sector indices performance are caused by unique moving factors that affect all sectors differently. However, there is a medium run relationship among the sectors as they are moved by macroeconomic and political conditions towards the same direction. Other two methods, Engle-Granger and VECM, are also supporting the results from Johansen cointegration tests. The findings from this research can be useful as an insight for investors and fund managers in minimizing portfolio risk by using sectoral diversification, which based on the research can only be applied in the short run period.

SARI PATI

Portofolio yang efisien, yang memiliki tingkat pengembalian disesuaikan dengan risiko rendah, dapat dibangun dengan menggunakan diversifikasi aset yang baik. Diversifikasi secara sektoral adalah salah satu cara untuk mengurangi risiko portofolio karena adanya hubungan diantara sektor-sektor tersebut. Penelitian ini menganalisis hubungan kointegrasi jangka pendek dan menengah diantara 9 indeks sektoral di Indeks Harga Saham Gabungan (IHSG) dengan menggunakan harga penutupan mingguan tahun 2012-2016 sebagai sampel. Analisa hubungan antar sektor ini menggunakan uji kointegrasi Johansen-Julius dan memprediksi hubungan kausal dengan kausalitas Engle-Granger, serta kemudian memodelkan kausalitas dengan menggunakan Vector Error Correction Model. Dengan

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menggunakan hasil empiris uji kointegrasi Johansen, penelitian ini menemukan bahwa tidak ada kointegrasi dalam jangka pendek karena kinerja indeks sektor disebabkan oleh faktor pergerakan unik yang mempengaruhi semua sektor secara berbeda. Namun, ada hubungan jangka menengah antar sektor karena mereka tergerak oleh kondisi makroekonomi dan politik menuju arah yang sama. Dua metode lainnya, Engle-Granger dan VECM, juga mendukung hasil uji kointegrasi Johansen. Temuan dari penelitian ini dapat bermanfaat sebagai wawasan bagi investor dan manajer investasi dalam meminimalkan risiko portofolio dengan menggunakan diversifikasi sektoral, yang berdasarkan penelitian hanya dapat diterapkan dalam jangka pendek.

INTRODUCTION

Indonesian financial market has been growing substantially over the past few years. According to Otoritas Jasa Keuangan (OJK), Indonesian capital market accounts for Rp7,5 billion transactions per day with the total market capitalization of IDR5,753 billion until 20 January 2017. There are 537 companies that are listed on the Indonesian Stock Exchange (IDX) currently. The rapid growth of the capital market in Indonesia attracts both foreign and domestic investors to invest in Indonesia's equity market. The investors are facing a more complex market, thus resulting in more challenges and opportunities in decision making to construct a portfolio.

Investment is the purchase of an asset with the hope that it will generate revenue or will appreciate before being sold for a profit in the future. Investors can invest in the capital market where they can optimize risk and return on the investments. To successfully undertake the optimized result, investors must build an efficient portfolio of assets that can generate the highest return with the least risk through diversification.

In managing a portfolio, diversification is a risk management technique that reduces risk by allocating investments into various financial instruments without affecting the portfolio return notably. If the assets in a portfolio have different reaction in regard to the current market condition, it can be an opportunity for the investor to gain their investment from minimizing the volatility.

For the past decades, fund managers have commonly used style (growth or value stock) and market capitalization (large-cap, middle-cap, or small-cap) to build their stock portfolios that can capture the greatest potential opportunities in the market. According to Fitriana (2009), the most common methods used by fund managers in Indonesia are Markowitz, single index, and CAPM. However, these classifications of equities can change over time due to company's performance and market condition.

Another way to minimize portfolio risk is to create an equity sector allocation method that will divide equities into some sub-groups or sectors that has some similar responses given a particular market condition. Vardharaj and Fabozzi (2007) found that there is a correlation between style and sector allocations as sectors change depending on the global macroeconomic condition at times. For example, information technology (IT) sectors overcame other sectors in USA capital market during IT bubble phenomenon in the

USA. Moreover, allocating a significant portion of a portfolio to a single economic sector, although containing many different stocks, may result in significant volatility due to near-term weakness in the sector. A publication by Fidelity Investments in 2012 also pointed out that sector exposure has been the second-most significant factor that accounts for stock returns in the US market during the past 20 years. For this reason, there is a need to conduct a test to know whether there is cointegration in Indonesia equity market.

The research objective is to analyze whether there is any cointegration among sectors in Indonesia equity market. This study will test the cointegration among 9 sectors to find the relationships among the sectors. Cointegration test is deemed to be more appropriate than another method for its result will provide direct answer whether diversification using sectoral allocation is applicable. After that, causality test is also performed to find out whether there is any causal relationship among the sector indices. The results can provide insights for investors and fund managers for applying sectoral diversified portfolio and asset allocation strategy in the complexity of Indonesian capital market.

Literature Review

There are several past works of literature about constructing efficient portfolio through diversification. In order to build an optimum portfolio, investors must consider the risk and the return. Success in minimizing the portfolio risk will result in an efficient portfolio.

Gupta & Basu (2011) stated the indifference between sector integration in developed and emerging equity market. They also found that a portfolio constructed using conditional correlations performs better, in the term of higher risk-adjusted return, than each country's benchmark index. Gupta & Basu also found that the correlations between asset returns change over time so an accurate estimation is needed to understand the changes and help investor in choosing a portfolio

that performs better in term of its risk–return. Jayasuriya (2008) also carried out a study which aimed to construct efficient portfolio frontier for China's and India's equity market. By using market capitalization as the weight and sector closing prices from January 1993 to November 2004 to make up portfolios for each country, the study found out that the investment portfolios constructed from all sectors are more efficient than those constructed from only three sectors with the largest capitalization as it is apparent that all sectors portfolio dominates in terms of risk minimization for a given portfolio return. Another study by Vardar et al (2012), which aimed to investigate the short run and long-run relationship in the Istanbul Stock Exchange over the period 1997-2011, shows that all sectors show evidence of a long-run relationship, limited short-term causal relationship because most of the sectors are likely to be influenced by macroeconomic condition and political events for long-term period. However, a study by Law & Ibrahim (2014) found that different sector reacts differently to a market condition, although they have an identical temporal result.

Meanwhile, Krishnankutty and Tiwari (2011) examined whether domestic investors could gain profit from sectoral diversified portfolio in Bombay Stock Exchange. They used fractional cointegration test using sample data from 1999 to 2011. The empirical result suggests that there is no evidence of cointegration in the sectoral indices of Indian stock market. Supporting the study, Yuksel and Guleryuz (2010) pointed out that there is no presence of cointegrating relationship among the sector indices in Istanbul Stock Exchange.

As Gupta & Basu (2011) found that sector diversification benefits do not depend on the level of sophistication of a financial market, the past studies about sector integration in other countries will mostly be able to accommodate literature for similar studies in another country. Those pieces of information gathered from the previous research concluded that the past studies regarding sectoral

integration method could result in different outcomes.

Some changes in macroeconomic and political conditions may give sectors different outcomes. Rahmanto et al (2016) pointed out that there is some significant short-term bivariate relationships among changes in global crude oil prices to some sectors listed in JCI, namely agriculture, mining, miscellaneous, trade, utilities, basic industries and consumer goods. On the other hand, financial sectors and crude oil price only have univariate relationship as the rise of crude oil prices could boost loan portfolio on crude oil sectors that will affect bank performance positively. Furthermore, the research did not find any causal relationship on property sector as property sector tend to have more stable revenue. Hence, this study presumes that some sector indices in Indonesia's equity market are moving in integration.

To that extent, this study would like to know if there is any cointegration between the sector indices in Indonesia Stock Exchange. This research took into account the possibility that different time period, short run and medium run, may result in different outcomes. In the end, this study aims to know whether sectoral diversification is applicable in Indonesia's equity market.

Data

In order to find out if there is any cointegration in Indonesia equity market, this research conduct a descriptive study using data from weekly closing indices prices during the short-term period (2016) and medium-term period (2012-2016) as the sample. The data is from sectoral indices of the Indeks Harga Saham Gabungan (IHSG).

There are 10 sector indices according to JASICA classification, however, this study only took 9 of them as the sample in the research because the 114 out of 122 stocks in JAKMANU sector (the Jakarta Manufacture Index) have already been included in other sector's stock, while the other 8 stocks have been delisted from the IDX. These 9 sectors are shown in Table 1 below.

This study examines two different periods of time in order to find the relationship among sectors in short term and middle term period, which may give different results. Five-year period of 2012-2016 is chosen to avoid economic crisis that occurred back in 2008 and to conform the nation's economic cycle which happened to be recovery phase.

METHODS

The model used in this study comprises three steps. Prior to conducting time series modeling,

Table 1. Sector Information in IDX according to JASICA

Sector Ticker	Sector Name	Number of Securities
JAKMINE	Jakarta Mining Index	43
JAKFIN	Jakarta Finance Index	89
JAKBIND	Jakarta Basic Industry and Chemicals Index	66
JAKMIND	Jakarta Miscellaneous Industry Index	42
JAKTRAD	Jakarta Trade & Service Industry Index	124
JAKCONS	Jakarta Consumer Goods Industry Index	39
JAKINFR	Jakarta Infrastructure, Utilization and Transportation Index	57
JAKPROP	Jakarta Construction, Property and Real Estate Index	62
JAKAGRI	Jakarta Agricultural Index	21

this research determines the order of integration of the variables for all series to be equal. The first step is to check the stationarity of the series by using Augmented Dickey-Fuller (Dickey and Fuller, 1979) t-statistic Unit Root Test. After ensuring that all series are stationary, this study apply cointegration test in order to check whether there is any integration in Indonesia equity market during the short and medium term period by using Johansen Cointegration Test and Engle-Granger causality test.

Unit root test is conducted in order to avoid the outcome would be spurious. The standard Dickey-Fuller test model equation is:

$$\Delta y_t = \alpha y_{t-1} + x_t'\delta + \varepsilon_t$$

where $\alpha = \rho - 1$. The null hypothesis is that α, the coefficient of y_{t-1} is zero. The alternative hypothesis is: $\alpha < 0$ and evaluated using the t conventional-ratio for α:

$$t_\alpha = \frac{\hat{\alpha}}{(se(\hat{\alpha}))}$$

where $\hat{\alpha}$ is the estimate of α, and $se(\hat{\alpha})$ is the coefficient standard error.

The second step is calculating the optimum lag which should be applied to avoid: errors in specification, caused by too few lags, and too many lost observations, caused by too many lags. Aside from that, determining the optimum lag is also important because cointegration test is very sensitive to the chosen lag structure. There are two parameters that are commonly be applied: *Akaike Information Criterion* (AIC) and *Schwarz Information Criterion* (SIC or BIC). Both parameters are able to show us the most optimum lag that should be applied in the further test. However, SIC is more relevant than AIC for SIC is able to give more consistent result. The SIC method result can be interpreted as the lower the SIC, the better the

model and vice versa. SIC model which is based on -2 times the average log-likelihood function is formulated as below:

$$SIC = -2\left(\frac{l}{T}\right) + \frac{k\log(T)}{T}$$

where l is the log value of the likelihood function having k parameters estimated using T *observations*.

Third, Johansen developed cointegration test based on VAR (vector autoregressive) using a Group object. The method estimates the maximum probability, whilst allows multiple cointegrating vectors in the multivariate system. VAR of order p is written as follows:

$$y_t = A_1 y_{t-1} + ... + A_p y_{t-p} + B\chi_t + \varepsilon_t$$

where y_t is a k vector of stationary I(1) variables, χ_t is a vector of deterministic variables and ε_t is a vector of innovations. The VAR could also be written as:

$$\Delta y_t = \Pi y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i y_{t-1} + B\chi_t + \varepsilon_t$$

where

$$\Pi = \sum_{i=1}^{p-1} A_i - I, \Gamma_i = -\sum_{j=1+1}^{p} A_j$$

If the coefficient matrix has reduced rank $r < k$, then there exists $k \times r$ matrices α and β each with rank r such that $\Pi = \alpha\beta'$ and $\beta'Y_t$ is I(0). r is the number of cointegrating relations (the cointegrating rank) and each column of β is the cointegrating vector. The elements of α are known as the adjustment parameters in the vector error correction model. In this method, the estimated Π matrix is from an unrestricted VAR and the test whether to reject the restrictions implied by the reduced rank of Π.

The next step is to test the direction of both short and medium term relationship should there is any cointegration is found in the series by using

Granger's causality test, which is an F-test model. According to Granger (1969), causality is defined between two stationary series, *x* and *y* in terms of how much historical values *y* explains the present *y* while adding lagged value of *x* can increase the proportion explained. The causality can also be two-way if *x* Granger causes *y* while *y* Granger also causes *x*. The causality test is based on vector error correction model framework (VECM).

Granger causality model can be formulated as below:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + ... + \alpha_1 y_{t-1} + \beta_1 x_{t-1} + ... + \beta_1 x_{t-1} + \varepsilon_t$$

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + ... + \alpha_1 x_{t-1} + \beta_1 y_{t-1} + ... + \beta_1 y_{t-1} + u_t$$

where the first equation is testing causality of *x* to *y*, the second equation is testing causality of *y* to *x*

and *l* represents the chosen lag length. The joint hypothesis for each of the equations will be:

$$H_0 = \beta_1 = \beta_2 = ... = \beta_t = 0$$

$$H_1 = not\ all\ of\ the\ \beta s\ are\ equal\ to\ 0$$

For instance, the null hypothesis for the first equation about Granger causality model above states that *x* does not Granger-cause *y* and if F-statistic is less than F-critical, the decision will reject the null hypothesis meaning that *x* does Granger-cause *y*.

RESULTS AND DISCUSSIONS

To know both medium-run and short-run relationship between sectors in Indonesia, it is needed to check the order of integration in each series, using Augmented Dickey-Fuller (ADF) unit

Table 2. Short-Run Data ADF test

	Level/First Difference	Optimum Lag (SIC)	t-Statistic	p
JAKAGRI	Level	0	-2,444439	0,135000
	First Difference	0	-8,674507	0,000000
JAKBIND	Level	0	-0,449585	0,892300
	First Difference	0	-6,794428	0,000000
JAKCONS	Level	0	-2,793421	0,066100
	First Difference	0	-8,180139	0,000000
JAKFIN	Level	0	-0,688399	0,840500
	First Difference	0	-7,029769	0,000000
JAKINFR	Level	0	-1,917454	0,322000
	First Difference	0	-7,087996	0,000000
JAKMIND	Level	0	-1,655786	0,447400
	First Difference	0	-7,009879	0,000000
JAKMINE	Level	0	-0,433657	0,895300
	First Difference	0	-7,921781	0,000000
JAKPROP	Level	0	-1,223994	0,657400
	First Difference	0	-6,117750	0,000000
JAKTRAD	Level	0	-2,523622	0,115800
	First Difference	1	-7,187036	0,000000

Note: Although the lag optimum for D(JAKTRAD) is 1, D(JAKTRAD) is already stationary in lag 0.

Test critical value with 95% confidence interval is -2,918778 for level order and -2,919952 for first difference order.

Table 3. Medium-Run Data ADF test

	Level/First Difference	Optimum Lag (SIC)	t-Statistic	p
JAKAGRI	Level	0	-2,065386	0,2591
	First Difference	0	-1.543.476	0
JAKBIND	Level	0	-1,843139	0,3591
	First Difference	0	-1.701.071	0
JAKCONS	Level	1	-1,720943	0,4195
	First Difference	0	-1.909.965	0
JAKFIN	Level	0	-1,481598	0,5416
	First Difference	0	-1.828.990	0
JAKINFR	Level	0	-2,573435	0,0998
	First Difference	0	-1.811.911	0
JAKMIND	Level	1	-3,105347	0,0274
	First Difference	0	-2.032.005	0
JAKMINE	Level	0	-2,465467	0,1252
	First Difference	0	-1.514.878	0
JAKPROP	Level	0	-2,00355	0,2853
	First Difference	0	-1.573.989	0
JAKTRAD	Level	0	-2,838593	0,0543
	First Difference	0	-1.594.338	0

Test critical value with 95% confidence interval is -2.872286 for level order and -2.872328 for first difference order

root test. It can be seen in Table 2 and 3 that the ADF test for short run and medium run periods show that there is not enough evidence to reject the null of existence of unit root in level order at 5% significance level. However, the series are stationary in first differences level, making all series are integrated of order 1, I(1).

After ensuring that the series are integrated in the same order, the next step is to examine both medium-run and short-run relationship between the sectors using the Johansen cointegration test. Since Johansen Cointegration test result is highly dependent on the number of lag used, it is important to adjust the used lag for each test, for short-run and medium-run, with one's optimum lag using SIC criterion. There are two criteria that can be chosen: Trace and Maximum Eigenvalue, which usually show similar results.

In the short-run period, both trace and maximum eigenvalue statistics indicate that there is no cointegration found at 5% significance level. While in the medium-run, there is only one cointegrating equation at 5% significance level. It is because, in the short run, all sectors are moved by its members' performance or by some specific economic condition that only affects limited sector. However, in the long run, all sectors in the market tend to move towards the same direction, resulting from the country's macroeconomic and political events. These results indicated that sectoral diversification method can be applied in the short run. However, there are limited risk reduction benefit in sectoral diversification method for medium-term horizon.

This research also apply Granger-causality test in both short and medium run to know about causal relationships among all sectors. For the

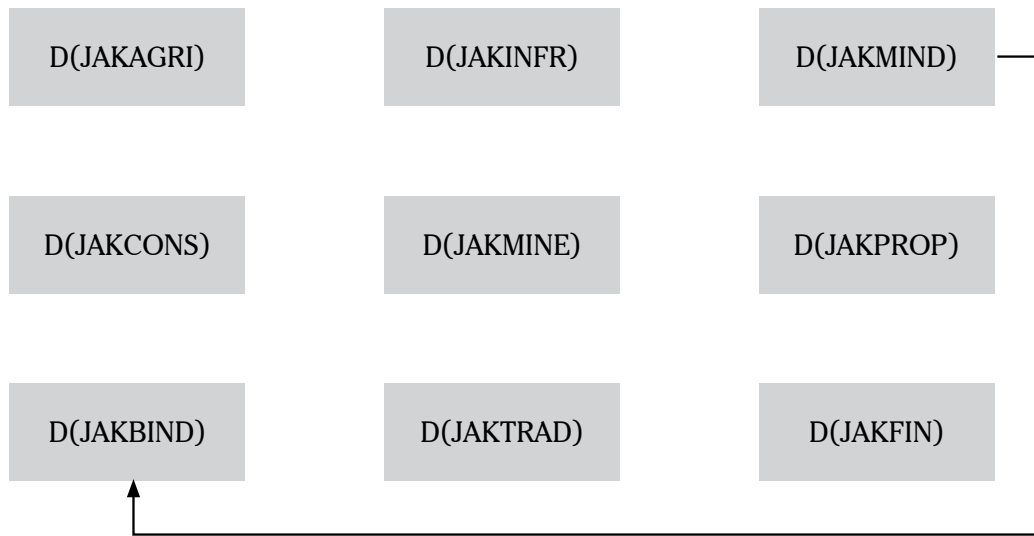Table 4. Short-Run Johansen Cointegration Test Results

	Maximum eigenvalue test				Trace test		
Null	Alternative	Statistic	95% critical value	Null	Alternative	Statistic	95% critical value
r = 0	r = 1	51,34780*	58,43354	r = 0	r ≥ 1	0,62748*	197,37090
r ≤ 1	r = 2	39,47551*	52,36261	r ≤ 1	r ≥ 2	0,53193*	159,52970
r ≤ 2	r = 3	30,36625*	46,23142	r ≤ 2	r ≥ 3	0,44232*	125,61540
r ≤ 3	r = 4	25,64626*	40,07757	r ≤ 3	r ≥ 4	0,38933*	95,75366
r ≤ 4	r = 5	16,98593*	33,87687	r ≤ 4	r ≥ 5	0,27867*	69,81889
r ≤ 5	r = 6	12,82782*	27,58434	r ≤ 5	r ≥ 6	0,21862*	47,85613
r ≤ 6	r = 7	12,27137*	21,13162	r ≤ 6	r ≥ 7	0,21021*	29,79707
r ≤ 7	r = 8	7,33041*	14,26460	r ≤ 7	r ≥ 8	0,13148*	15,49471
r ≤ 8	r = 9	0,85726*	3,84147	r ≤ 8	r ≥ 9	0,01635*	3,84147

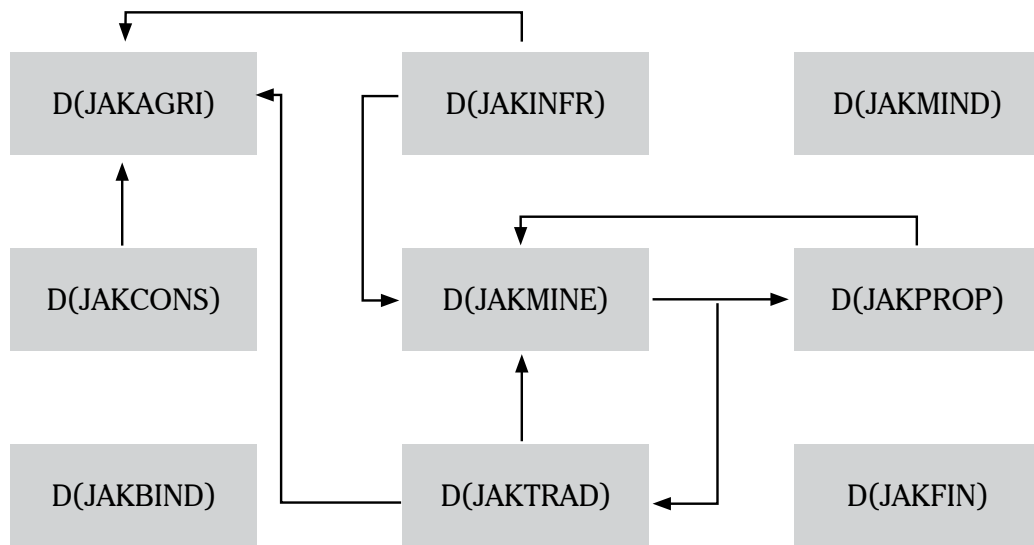Table 5. Medium-Run Johansen Cointegration Test Results

	Maximum eigenvalue test				Trace test		
Null	Alternative	Statistic	95% critical value	Null	Alternative	Statistic	95% critical value
r = 0	r = 1	67,55093*	58,43354	r = 0	r ≥ 1	209,2194*	197,3709
r ≤ 1	r = 2	37,7414	52,36261	r ≤ 1	r ≥ 2	141,6685	159,5297
r ≤ 2	r = 3	32,2221	46,23142	r ≤ 2	r ≥ 3	103,9271	125,6154
r ≤ 3	r = 4	21,16348	40,07757	r ≤ 3	r ≥ 4	71,70501	95,75366
r ≤ 4	r = 5	19,55146	33,87687	r ≤ 4	r ≥ 5	50,54153	69,81889
r ≤ 5	r = 6	13,86403	27,58434	r ≤ 5	r ≥ 6	30,99007	47,85613
r ≤ 6	r = 7	7,702966	21,13162	r ≤ 6	r ≥ 7	17,12604	29,79707
r ≤ 7	r = 8	5,798369	14,26460	r ≤ 7	r ≥ 8	9,423076	15,49471
r ≤ 8	r = 9	3,624707	3,841466	r ≤ 8	r ≥ 9	3,624707	3,841466

shorter horizon, the result showed that there is only 1 unidirectional causal relationship from D(JAKMIND) to D(JAKBIND) as most of the members in JAKBIND is providing input for JAKMIND members. While in the medium term horizon, there are 8 causal relationships, with two of them are bidirectional causal relationships from D(JAKMINE) to D(JAKPROP) and D(JAKTRAD) to D(JAKMINE). These results are in line with the prior findings that there are medium-term linkages among the sectors. As there are many relationships in the medium run, this study finds that there is no benefit of portfolio diversification.

After knowing that there is cointegrating equation according to Johansen cointegration test in the medium run, Vector Error Correction estimation is conducted to make models to predict changes in movement of a sector using past movements of other sectors. The results of final VECM model are presented in Table 6 and 7. The VECM models were then tested using Least Square estimator to make sure that the sum of the squares of the residuals is minimized. Table 8 and 9 provides the least square equation estimation. If the result is to reject the null hypothesis, it indicates that the estimated constants: X and Y, for the models are

Graph 1. Sectors Granger Causal Relationships for Short-run

Graph 2. Sectors Granger Causal Relationships for Medium-run

significant. On the other hand, if both constants are not significant, it indicates that the prediction model is not optimal.

The Vector Error Correction models above (Table 6 and Table 7) are not the final equation because a good estimator has to be the one with highest adjusted R-squared. Therefore, the models are then estimated using least square estimator (LSE) to ensure that they represent the prediction correctly. In Table 8 and Table 9 below are the result of the estimation with X-s represent the multiplier coefficients of VECM while Y-s represent the constant for each equation.

Table 6. Vector Error Correction Models for Short-Run

	DD(JAKAGRI)	DD(JAKBIND)	DD(JAKCONS)	DD(JAKFIN)	DD(JAKINFR)	DD(JAKMIND)	DD(JAKMINE)	DD(JAKPROP)	DD(JAKTRAD)
D(JAKAGRI(-1))	1,0000	-0,3533	1,9872	1,7421	-1,1715	2,6794	1,3913	1,0773	0,5959
		(0,0554)	(0,3131)	(0,2522)	(0,1642)	(0,4220)	(0,2104)	(0,1580)	(0,0992)
		[-6,3781]	[6,3467]	[6,9084]	[-7,1362]	[6,3501]	[6,6119]	[6,8204]	[6,0093]
D(JAKBIND(-1))	-2,8308	1,0000	-5,6255	-4,5957	2,5937	-7,5850	-3,9385	-2,6260	-1,8278
	(0,6137)		(1,2172)	(0,9051)	(0,5758)	(1,5145)	(0,8476)	(0,5669)	(0,3559)
	[-4,6128]		[-4,6218]	[-5,0775]	[4,5048]	[-5,0083]	[-4,6465]	[-4,6322]	[-5,1355]
D(JAKCONS(-1))	0,5032	-0,1778	1,0000	0,7378	-0,4906	1,3483	0,7001	0,4816	0,3535
	(0,1169)	(0,0410)		(0,1863)	(0,1132)	(0,3118)	(0,1636)	(0,1167)	(0,0733)
	[4,3048]	[-4,3345]		[3,9599]	[-4,3330]	[4,3248]	[4,2794]	[4,1267]	[4,8244]
D(JAKFIN(-1))				1,0000					
D(JAKINFR(-1))	-1,3079	0,4620	-2,5990	-1,8680	1,0000	-3,5043	-1,8196	-1,2496	-0,8043
	(0,2916)	(0,1025)	(0,5474)	(0,4698)		(0,7861)	(0,4075)	(0,2943)	(0,1847)
	[-4,4845]	[4,5054]	[-4,7476]	[-3,9762]		[-4,4579]	[-4,4649]	[-4,2467]	[-4,3540]
D(JAKMIND(-1))	0,3732	-0,1318	0,7417			1,0000	0,5192		
	(0,1788)	(0,0579)	(0,3539)				(0,2430)		
	[2,0870]	[-2,2759]	[2,0956]				[2,1372]		
D(JAKMINE(-1))	0,7188	-0,2539	1,4284	1,0499	-0,7130	1,9259	1,0000	0,6430	0,2584
	(0,1624)	(0,0590)	(0,3382)	(0,2644)	(0,1731)	(0,4425)		(0,1656)	(0,1040)
	[4,4258]	[-4,3005]	[4,2232]	[3,9705]	[-4,1197]	[4,3528]		[3,8822]	[2,4851]
D(JAKPROP(-1))								1,0000	
D(JAKTRAD(-1))									1,0000
C	-5,5255	1,9519	-10,9806	-7,4000	5,1744	-14,8053	-7,6876	-4,1091	0,0428

standard Errors in (), t-statistics in []

Table 7. Vector Error Correction Models for Medium-Run

	DD(JAKAGRI)	DD(JAKBIND)	DD(JAKCONS)	DD(JAKFIN)	DD(JAKINFR)	DD(JAKMIND)	DD(JAKMINE)	DD(JAKPROP)	DD(JAKTRAD)
D(JAKAGRI(-1))	1,0000	0,2541	-0,3840	0,0385	-0,2241	-0,0820	-2,8348	-0,2509	1,8302
		(0,0863)	(0,1456)	(0,0144)	(0,0851)	(0,0311)	(0,8944)	(0,0930)	(0,6098)
		[2,9442]	[-2,6381]	[2,6758]	[-2,6326]	[-2,6369]	[-3,1695]	[-2,6977]	[3,0015]
D(JAKBIND(-1))		1,0000					-16,1138		9,3898
							(5,8025)		(3,9559)
							[-2,7771]		[2,3736]
D(JAKCONS(-1))	-2,6038	-0,5186	1,0000	-0,0869	0,5834	0,2134	4,7201	0,5660	-3,7691
	(-0,5427)	(0,1249)		(0,0204)	(0,1195)	(0,0443)	(1,2784)	(0,1331)	(0,8716)
	[-4,7980]	[-4,1535]		[-4,2524]	[4,8818]	[4,8221]	[3,6922]	[4,2516]	[-4,3245]
D(JAKFIN(-1))	24,0483	5,5940	-9,2357	1,0000	-5,3885	-1,9711	-63,3733	-6,5124	37,8821
	(1,9553)	(0,4860)	(0,7137)		(0,3990)	(0,1489)	(5,2459)	(0,4782)	(3,5764)
	[12,299]	[11,511]	[-12,942]		[-13,504]	[-13,240]	[-12,081]	[-13,618]	[10,592]
D(JAKINFR(-1))	-4,4629	-1,0097	1,714	-0,1621	1,0000	0,3658	15,3767	1,0559	-7,0958
	(1,3326)	(0,3006)	(0,5020)	(0,0461)		(0,1086)	(3,1253)	(0,3262)	(2,1307)
	[-3,3490]	[-3,3595]	[3,4147]	[-3,5202]		[3,3691]	[4,9200]	[3,2367]	[-3,3302]
D(JAKMIND(-1))	-12,2005	-2,8160	4,6856	-0,4586	2,7337	1,0000	28,7862	2,9867	-19,7765
	(0,6240)	(0,1417)	(0,2384)	(0,0227)	(0,1392)		(1,4737)	(0,1530)	(1,0047)
	[-19,551]	[-19,880]	[19,659]	[-20,249]	[19,6364]		[19,5330]	[19,5201]	[-19,683]
D(JAKMINE(-1))							1,0000		
D(JAKPROP(-1))		-1,143356		-0,153553			19,8208	1,0000	-9,5869
		(0,5011)		(0,0757)			(5,2967)		(3,6111)
		[-2,2819]		[-2,0283]			[3,7421]		[-2,6548]
D(JAKTRAD(-1))									1,0000
C	-13,3453	-2,6622	5,1253	-0,4953	2,9903	1,0938	28,4438	3,2256	-16,9210

standard Errors in (), t-statistics in []

Table 8. Equation Estimation using Least Square Estimator for Short-Run

	X	Y	Adjusted R-squared
DD(JAKAGRI)	-0,63848*	1,804157	0,446202
	(0,101426)	(6,306181)	
	[-6,295059]	[0,286093]	
DD(JAKBIND)	-0,11265	0,420157	0,003168
	(0,104642	(2,298328)	
	[-1,076527]	[0,182810]	
DD(JAKCONS)	-0,161776	2,285765	0,030418
	(0,100941)	(12,47201)	
	[-1,602683]	[0,183272]	
DD(JAKFIN)	-0,007974	0,978059	-0,019154
	(0,032477)	(3,224011)	
	[-0,245519]	[0,303367]	
DD(JAKINFR)	-0,115714	1,109039	0,029481
	(0,072910)	(4,718859)	
	[-1,587084]	[0,235023]	
DD(JAKMIND)	-0,012832	2,722353	-0,012832
	(0,051167)	(8,524096)	
	[-0,250796]	[0,319371]	
DD(JAKMINE)	-0,290623*	1,117667	0,213091
	(0,079683)	(6,892859)	
	[-3,647240]	[0,162148]	
DD(JAKPROP)	-0,025917	0,529176	-0,005833
	(0,030757)	(1,919345)	
	[-0,842633]	[0,275707]	
DD(JAKTRAD)	-0,168832*	1,408098	0,093911
	(0,073099)	(2,924154)	
	[-2,309651]	[0,481540]	

MANAGERIAL IMPLICATIONS

This research's findings have several implications in investment diversification strategy. Through the findings, fund manager may get insights about sectoral integration, which enable them to know about the relationships, causalities, and prediction model among sectors in Indonesia's equity market. In the end, the managers may decide whether sector diversification is applicable and/or necessary in constructing an equity investment portfolio. As this study finds that there is no cointegration in the short-run, it is appropriate to apply sectoral diversification in short-term portfolio construction. While for short-term portfolio construction, the diversification effect is limited by the founding of cointegration.

Table 9. Equation Estimation using Least Square Estimator Medium-Run

	X	Y	Adjusted R-squared
DD(JAKAGRI)	0,001837	-0,192091	-0,0033710
	(0,010356)	(5,019713)	
	[0,177361]	[-0,038267]	
DD(JAKBIND)	0,033711*	0,044019	0,028217
	(0,011490)	(1,263876)	
	[2,933868]	[0,034829]	
DD(JAKCONS)	-0,130908*	0,046502	0,090507
	(0,025159)	(4,683720)	
	[-5,203143]	[0,009928]	
DD(JAKFIN)	0,130761	-0,006601	0,004622
	(0,087830)	(1,603856)	
	[1,488790]	[-0,004116]	
DD(JAKINFR)	-0,096671*	-0,000122	0,094822
	(0,018125)	(1,968663)	
	[-5,333464]	[-6,18E-05]	
DD(JAKMIND)	-1,23673*	0,060658	0,480382
	(0,079301)	(3,150690)	
	[-15,59541]	[0,019252]	
DD(JAKMINE)	-0,000473	-0,223011	-0,003754
	(0,003335)	(3,852707)	
	[-0,141719]	[-0,057884]	
DD(JAKPROP)	-0,033667*	-0,02716	0,039565
	(0,009804)	(1,165875)	
	[-3,434123]	[-0,023296]	
DD(JAKTRAD)	0,006688*	-0,011281	0,048705
	(0,001830)	(1,410359)	
	[3,655536]	[-0,007999]	

CONCLUSION

This research analyzes short and medium-run cointegration relationship among sectors in Indonesia equity market, using weekly data. This study's findings based on the empirical results of Johansen cointegration tests are there is no cointegration in the short-run as the sector indices performance are caused by unique moving factors that affect all sectors differently. However, there is long-run relationship among the sectors as they are moved by macroeconomic and political conditions towards the same direction. It implies that the empirical result concluded that sectoral diversification only gave benefit if applied in the short-run. Furthermore, this study also builds a prediction for the movement of the sectoral indices, which is estimated by the vector error correction models that have been shown above. ■

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