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Modeling the Relationship Between Malaysia Exchange Rate and Sectoral Stock Market Indices

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Abstract: This study investigates the relationship between MYR/USD exchange rate and 10 sectoral stock markets indices after the pegging period which is starting from August 2005 to -December 2015. The Vector Auto Regressive or Vector Error Correction Model (VAR/VECM) framework is used in this study, nonetheless unit root tests (ADF and KPSS) as well as cointegration test will be implemented before using VAR/VECM framework. Since, there are long-run relationship between the significant sectoral markets which have been chosen from regression analysis, VECM is employed. Meanwhile, the results from Granger causality test indicates that there exists positive unidirectional from exchange rate to consumer product, finance and industrial product respectively. In short, high exchange rate has affected these three sectoral stock markets over the period under study. However, in long-term forecast, the variance decomposition results have shown that the impact of exchange rate on each sectoral stock price is ranging from 1.87-15.74%.

Key words: Exchange rates, VEC model, granger causality, variance decomposition, causality

INTRODUCTION

It can be seen from social media, there is always big change or impact on the Malaysia economy market when there is fluctuation in Malaysia Ringgit (MYR)/United States Dollar (USD) exchange rate. A few months ago, Malaysia's currency hit a 16 years, low as a crisis over economic troubles and political corruption scandal. The Prime Minister made the 20 billion ringgit (USD$4.6 billion) pledge to boost confidence amid the crisis.

When Malaysia currency was facing the 1997 East Asian financial crisis, Malaysia sectoral stock price indices were greatly affected. Our government had launched the policy that bank negara to peg Ringgit (MYR) to the Dollar (USD) at the rate of 1 USD = 3.80 MYR from September 1998 to July 2005 as one of the initiatives to face the crisis. Our nation's exchange rate has significant impact on our sectoral stock price indices market. Malaysia exchange rate can influence the input and output prices of the companies which are operating in Malaysia and also their competitiveness in local market and international market. Investors and stock buyers might lose confidence on the companies and thus their stock's prices would be affected (Yusuf and Rahman, 2012).

This study intends to understand the basic affiliation between Malaysia exchange rate and sectoral stock price indices. For instance, is there a long-run relationship between exchange rate and sectoral stock price indices? What is the impact of exchange rate on sectoral stock price indices? Which sectors influenced significantly by the exchange rate? This information is of particular importance as either government, companies, investors and personal stock buyers need to have a good understanding of the particular relationship to launch wise policy onto the nation to plan better strategies and to make the correct decision to obtain profit from investment.

Based on the motivation above, there are three objectives of this study. Firstly, is to study the relationship between MYR/USD exchange rate and sectoral stock market indices. Secondly, is to forecast the impacts of the exchange rate on sectoral stock price indices in the future 1 year. Thirdly, is to forecast the impacts of a particular variable on the others.

Literature reviews: Some of the recent literatures that discuss the relationship between exchange rate and stock market index are (Ibrahim, 2008; Zhao, 2010; Yong *et al*., 2011; Tsai, 2012; Kollias *et al*., 2012; Ho and Huang, 2015; Jiranyakul, 2012).

Among the studies that focus on exchange rate and the main stock market index are (Zhao, 2010; Tian *et al*., 2011; Tsai, 2012; Kollias *et al*., 2012; Noman *et al*., 2012; Jiranyakul, 2012; Ho and Huang, 2015). While articles that examine exchange rate and sectorial indices are (Ibrahim, 2008; Yong *et al*., 2012; Vardar *et al*., 2012). From these study, the models used to

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find the relationship include OLS model, GARCH model, VAR model and VEC model. The finding shows that there exists an interaction among exchange rate, main stock market index and some of the sector indices.

This study aims to model the relationship between the Malaysia exchange rate (MYR/USD) and sectoral stock market indices in Malaysia after the 2005 pegging period. The process of choosing the main sector indices that contribute to the exchange rate will be based on the statistical method which is regression analysis.

MATERIALS AND METHODS

In this study, all the data used are obtained from datastream. The source of the data is Bursa Malaysia or previously also known as KLSE (Kuala Lumpur Stock Exchange). The daily data of MYR/USD exchange rate and the 10 sector's stock price indices are collected for the period from August 2005 to December 2015 which is after the pegging period of MYR to USD due to the 1997 Asian financial crisis. The analysis will focus on real Exchange Rate (EXR) and 10 sectoral stock markets in Malaysia which are Consumer Product (COP), Construction (CON), Finance (FIN), Industrial (IND), Industrial Product (INDP), Plantations (PLA), Properties (PRO), Technology (TECH), Tin and Mining (TIM) as well as Trade and Service (TRS). All data are transformed into natural logarithm to reduce the variation in the data. The time series plots of all series are presented in Fig. 1. Moreover, Table 1 reveals that the distribution of all

Table 1: Descriptive statistics

Index	Mean	Median	SD	Skew	Kurt
EXR	0.52	0.52	0.03	0.76	3.34
CON	2.37	2.39	0.10	-1.01	2.96
COP	2.60	2.64	0.14	-0.32	1.70
FIN	4.07	4.11	0.12	-0.45	1.85
PLA	3.80	3.87	0.14	-1.18	3.25
IND	3.42	3.43	0.06	-0.57	2.29
INDP	2.02	2.04	0.09	-0.47	2.25
PRO	2.96	3.00	0.13	-0.36	1.97
TIM	2.61	2.62	0.11	-0.13	2.43
TEACH	1.28	1.26	0.11	0.06	1.93
TRS	2.25	2.27	0.09	-0.34	2.03

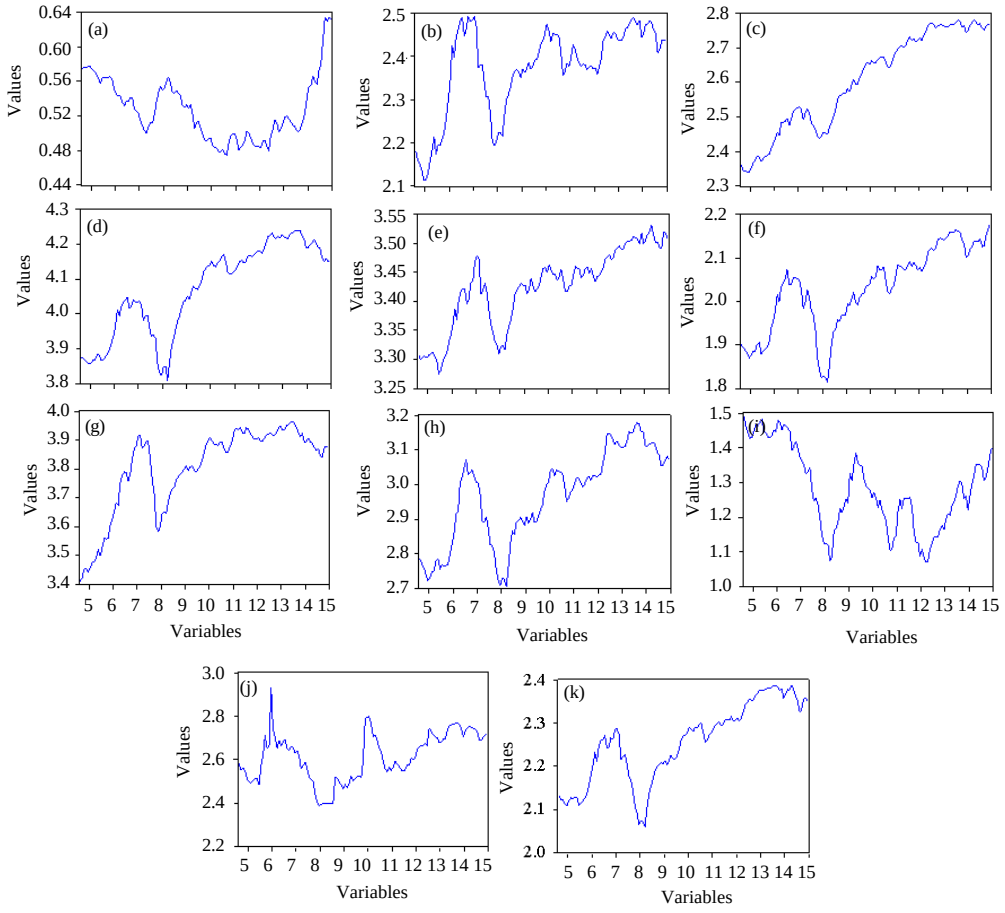

Fig. 1: Time series plot: a) Exchange rate; b) Construction; c) Consumer product; d) Finance; e) Industrial; f) Industrial product; g) Plantations; h) Properties; i) Technology; j) Tin and mining and k) Trade and service

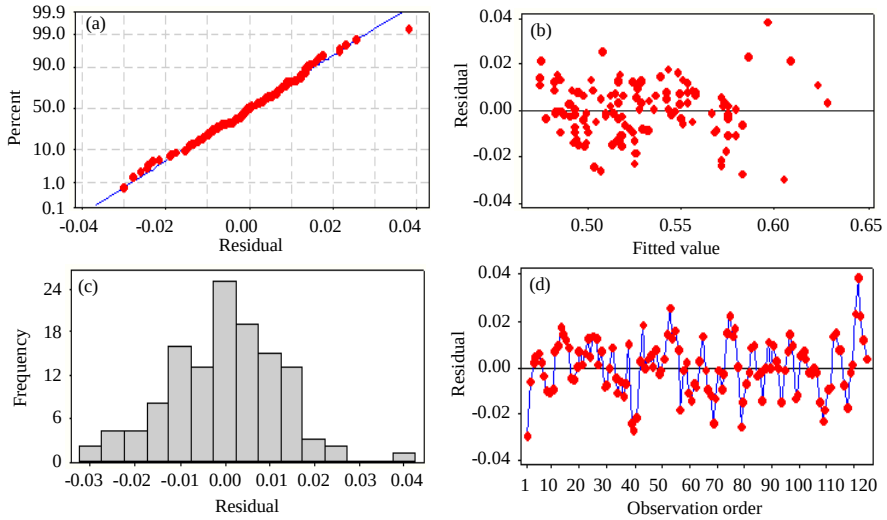

Fig. 2: Residual plots: a) Normal probability plot; b) Versus fits; c) Histogram and d) Versus order

Table 2: Regression analysis

Predictors	Coef.	SE coef.	t-values	p-values
Constant	1.55050	0.24380	6.36	0.000
Construction	0.11957	0.05567	2.15	0.034
Consumer product	0.49184	0.05442	9.04	0.000
Finance	-0.82013	0.05997	-13.68	0.000
Industrial	0.38040	0.11250	3.38	0.001
Industrial product	0.48576	0.09873	4.92	0.000
Plantations	-0.38883	0.03552	-10.95	0.000
Properties	-0.05852	0.06829	-0.86	0.393
Technology	0.02117	0.02538	0.83	0.406
Tin and mining	0.00977	0.01933	0.51	0.614
Trade and service	0.02760	0.15330	0.18	0.858

S = 0.0124428, R^2 = 89.28, R^2 (Adj.) = 88.28; the regression equation is: exchange rate = 1.55+0.120 construction; +0.492 consumer product; -0.820 finance; +0.380 indutrial; +0.486 industrial product; -0.389 plantations-0.0585 properties +0.0212 technology; +0.0098 tin and mining; +0.028 trade and service

the data are nonsymmetrical and either leptokurtic or platykurtic. First and foremost, regression analysis is carried out using the original data set which has been transformed into logarithm form. The sectoral market will be eliminated based on the p-value that is >0.05. Based on the results shown in Table 2, there are only six sector indices left at the end of the elimination process. Therefore, the exchange rate is related to construction, consumer product, finance, industrial, industrial product and plantation indices. Moreover as seen in Fig. 2, the histogram shows a bell curve and the normal probability plot shows a linear line. Thus, it can be concluded that the residual is approximately normal. The variance of the data is constant since the graph of the residual versus fitted value does not show any pattern. From residual versus observation order graph, it also does not show any specific trend. In addition, the R^2 value shown in the result is 89.2% and the adjusted R^2 value is 88.2%, both considerably high indicating that the model is a good fit to the data.

Table 3: Test of stationarity

	ADF statistic		KPSS statistic	
Series	Level	1st difference	Level	1st difference
Exchange rate	0.04	-3.20	0.24	0.12
Consumer product	-1.19	-9.34	1.30	0.14
Construction	-3.37	-8.62	0.66	0.07
Finance	-2.40	-8.04	1.12	0.10
Industrial	-2.82	-9.20	1.09	0.04
industrial product	-2.53	-7.92	1.03	0.04
Plantations	-2.43	-7.19	0.95	0.24

Secondly, in order to model the relationship, two tests need to be conducted. The two tests are stationary test and the cointegration test. According to Brooks (2012), it is better to jointly use of stationarity and unit root tests for stationary testing which is known as confirmatory data analysis. Therefore, in this study the ADF test by Dickey and Fuller (1981) with the null hypothesis of a unit root while the KPSS test by (Kwiatkowski *et al*., 1992) with the null hypothesis of stationary will be applied. Results in Table 3 indicate all the series are non-stationary at the level data where the null hypothesis is rejected for the KPSS test and accepted for the ADF test. However, all the series became stationary after first differences where the null hypothesis is not rejected for the KPSS test and rejected for the ADF test. This result indicates all the series are stationary at the same level which is 1. Hence, the assumption for further test and research of long term relationships between specified variables is met.

Next, the cointegration test is carried out to investigate whether all the series are cointegrated or not. Cointegration test helps to determine whether is there any long run relationships between the series. Vector Auto Regression (VAR) analysis will be performed at first difference if the variables are cointegrated, otherwise, Vector Error Correction Model (VECM) analysis will be

carried out at the level. In this study, the Johansen test going to be executed. The Johansen test is based on two test statistics, the Trace statistic and Max-eigen statistic (Johansen, 1998; Johansen and Juselius, 1990).

Thirdly, the cointegration test only provides information regarding the existence of causality between a two series but it does not indicate the direction of the causal relationship. Hence, the Granger causality test needs to be run to capture the direction of causal relationships. Finally, variance decomposition will be performed. Variance decompositions offer a slightly different method for examining VAR/VECM system dynamics. It gives the proportion of the movements in the dependent variables that are due to their 'own' shocks, versus shocks to the other variables. A shock to the ith variable will directly affect that variable but it will also be transmitted to all of the other variables in the system through the dynamic structure of the VAR/VECM model.

RESULTS AND DISCUSSION

The number of optimal lags need to be determined before the Johansen cointegration test is being employed.

Table 4: Johansen cointegration test

Hypothesized No. of CE(s)	Trace statistics	Maximum eigenalue statistics
None	159.160	48.510
At most 1	110.640	44.500
At most 2	66.140	26.370
At most 3	39.770	19.470
At most 4	20.290	10.270
At most 5	10.020	9.640
At most 6	0.385	0.385

Table 5: Pair-wise granger causality test

Null hypothesis	χ^2-statistic	Causal inference
EXR does not granger cause COP	1.85	No causality
COP does not granger cause EXR	0.69	No causality
EXP does not granger cause CON	4.72	Causality
CON does not granger cause EXR	0.68	No causality
EXR does not granger cause FIN	4.19	Causality
FIN does not granger cause EXR	0.76	No causality
EXR does not granger cause IND	1.53	No causality
IND does not granger cause EXR	0.04	No causality
EXR does not granger cause INDP	4.93	Causality
INDP does not granger cause EXR	1.41	No causality
EXR does not granger cause PLN	1.83	No causality
PLN does not granger cause EXR	0.69	No causality

There are several lag length criterions can be used to investigate the optimum lag length among other are Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), Hannan-Quinn information criterion (HQ) and Bayesian Information Criterion (BIC). In this study, lag one is chosen because this order is being chosen by all 5 criterions.

Based on Table 4, both tests reject the null hypothesis of no cointegration at 0.05 level as both tests indicate two cointegration equations at 0.05 level. Therefore, we can conclude that there are cointegrating relationships between the variables at the 0.05 level. As a result, we are going to employ VEC model since there exists a long run relationship among the variables.

Based on VEC model, Granger causality test results are presented in Table 5. It can be seen that the cause and effect relationship is unidirectional only. From the result, we can see that the stock price indices of sectors of consumer product, finance and industrial product are affected by the MYR/USD exchange rate only. As seen from Table 6, after a year variance decomposition of exchange rate is mostly explained by its value in the long-term forecasts. For sectoral markets, plantations have the highest increasing impact on exchange rate with 13.19%. By revitalizing agricultural production, the impact of inflation from the lower ringgit and the introduction of GST can be lessened dramatically. Revitalizing agriculture and small scale manufacturing are the best tools to fight inflation and unemployment which will be two major issues for the Government to face later in the year. Meanwhile, the impact of industrial and industrial product increases minimally whereas construction, consumer product and finance have less impact on exchange rate of not >1%.

The summarize of all the results on Table 6 are as follows. The variance decomposition of exchange rate and construction are accounted for by own indices whereas the variance decomposition of consumer product, finance, industrial, industrial product and plantations are accounted for by construction price index. From variance decomposition result, the impact of exchange rate on each sectoral stock price range from 1.87-15.74% over the

Table 6: Variance decomposition

Months	Construction	Consumer product	Finance	Industrial	Industrial product	Plantations
Exchange rate						
1	0	0	0	0	0	0
2	0.006435	0.0293230	0.031130	0.202088	0.457490	1.759396
3	0.004874	0.0789720	0.169343	0.594840	1.227079	5.248861
4	0.008301	0.1160220	0.289316	1.059412	1.902562	8.703598
5	0.030082	0.1237300	0.325588	1.532077	2.375834	11.138910
6	0.064742	0.1102670	0.309063	1.994555	2.687163	12.502630
7	0.104362	0.0933300	0.277181	2.442593	2.895095	13.124110
8	0.145004	0.0850410	0.246398	2.870715	3.040558	13.336040
9	0.185220	0.0882370	0.220598	3.271197	3.147501	13.359560
10	0.224198	0.1001970	0.199632	3.637395	3.229275	13.312870
11	0.261173	0.1169640	0.182553	3.966067	3.293532	13.248668
12	0.295508	0.1354479	0.168446	4.257523	3.345028	13.185850

Table 6: Continue

Months	Construction	Consumer product	Finance	Industrial	Industrial product	Plantations
Construction						
1	81.486910	0	0	0	0	0
2	79.826900	0.1713440	0.066853	1.398935	0.054020	0.533384
3	78.809669	0.6867530	0.053493	3.963924	0.205004	1.365230
4	77.760800	1.4684200	0.047646	6.683119	0.302489	1.819967
5	76.657080	2.3976350	0.067904	9.054410	0.326353	1.819777
6	75.496190	3.3709370	0.115505	10.991450	0.314457	1.609045
7	74.322800	4.3092780	0.173796	12.549640	0.292160	1.365261
8	73.212960	5.1622760	0.227527	13.802550	0.269456	1.155694
9	72.222750	5.9070980	0.270882	14.812770	0.249221	0.990073
10	71.372290	6.5416280	0.304240	15.630610	0.231857	0.861070
11	70.655590	7.0757720	0.329947	16.296770	0.217081	0.759607
12	70.054650	7.5242500	0.350240	16.843980	0.204501	0.678457
Consumer product						
1	41.771590	40.2597100	0	0	0	0
2	38.415560	38.3456300	0.201828	2.976563	0.402914	0.608700
3	38.467160	33.6554600	0.661967	7.496487	0.974937	1.898803
4	39.805410	29.1463200	0.932807	11.549710	1.311822	2.986285
5	41.432400	25.5589300	0.989639	14.784370	1.449546	3.518278
6	42.935690	22.7588600	0.949708	17.390440	1.490738	3.628153
7	44.198930	20.5167700	0.884373	19.548960	1.492531	3.526047
8	45.228140	18.6806900	0.820642	21.362760	1.479306	3.349017
9	46.065220	17.1569600	0.765907	22.891820	1.460824	3.162847
10	46.752900	15.8924400	0.720673	24.180580	1.441022	2.992623
11	47.325030	14.8314200	0.683453	25.267980	1.421565	2.844643
12	47.806590	13.9375400	0.652514	26.189030	1.403197	2.717859
Finance						
1	48.755840	6.9119470	24.953310	0	0	0
2	47.538390	4.8112121	21.857433	1.857433	0.018009	0.497548
3	47.159070	3.3614400	19.537880	4.213507	0.010649	1.496817
4	47.478760	2.4653760	18.476450	6.324390	0.016376	2.499979
5	48.150050	1.8925800	17.614170	8.111239	0.022572	3.161978
6	48.916890	1.5121240	16.825920	9.626265	0.024410	3.452445
7	49.626670	1.2571610	16.107850	10.922460	0.023563	3.493993
8	50.219500	1.0887190	15.475290	12.033990	0.021809	3.411565
9	50.694520	0.9795560	14.934340	12.984450	0.019950	3.284425
10	51.074050	0.9094660	14.479790	13.794000	0.018242	3.151979
11	51.382270	0.8641270	14.099940	14.482090	0.016734	3.030008
12	51.637800	0.8341100	13.781480	15.067450	0.015417	2.922753
Industrial						
1	43.034210	13.0458900	0.851873	29.881510	0	0
2	43.679170	17.8257000	1.829656	22.703480	0.215573	1.283220
3	48.816720	17.6162200	3.058475	16.412710	0.675546	3.014073
4	55.630590	14.9718100	3.548246	12.732250	0.978397	3.725665
5	61.913940	12.0738200	3.402160	11.218590	1.072139	3.481967
6	66.612120	9.7796600	3.022450	10.981030	1.052179	2.919155
7	69.694280	8.1962890	2.627191	11.376700	0.988706	2.408468
8	71.569290	7.1761490	2.285965	12.0.7970	0.194757	2.035661
9	72.670830	6.5384810	2.008468	12.733830	0.843559	1.777204
10	73.313650	6.1412480	1.786388	13.400150	0.779667	1.595661
11	73.692550	5.8900380	1.608246	13.992150	0.724058	1.464047
12	73.919690	5.7269870	1.463901	14.504250	0.676296	1.365650
Industrial product						
1	56.318370	5.5003330	3.171800	0.005680	18.388550	0
2	52.708850	3.8737910	4.913092	2.713371	18.173060	2.075732
3	50.437760	2.5505960	6.769416	6.590099	16.068370	6.185521
4	49.060420	1.7120690	7.614428	9.861036	14.208340	9.559268
5	48.536980	1.2349270	7.672301	12.363780	13.047750	11.289180
6	48.516700	0.9903360	7.391731	14.363810	12.387700	11.798670
7	48.682760	0.8973830	7.024620	16.036320	11.992750	11.663780
8	48.869320	0.9015330	6.672738	17.455070	11.723260	11.266340
9	49.019900	0.9615460	6.367612	18.653110	11.515420	10.804820
10	49.128610	1.0475950	6.112589	19.656140	11.344480	10.365480
11	49.204980	1.1408700	5.901334	20.491760	11.201160	9.977155
12	49.259600	1.2313440	5.725562	21.188550	11.080830	9.643101

Table 6: Continue

Months	Construction	Consumer product	Finance	Industrial	Industrial product	Plantations
Plantations						
1	29.44970	13.697440	0.115048	0.497139	4.902143	35.53183
2	24.96296	13.028020	0.220469	0.536081	3.637600	41.34269
3	24.20927	11.068410	0.508435	2.391394	2.713896	43.65819
4	25.22035	8.844663	0.910312	5.479886	2.160295	42.93929
5	26.85821	6.931863	1.413767	9.098508	1.827015	40.30119
6	28.49968	5.528536	1.939104	12.695650	1.616356	36.88984
7	29.90087	4.602088	2.406301	15.959840	1.475866	33.47373
8	31.02764	4.031952	2.780607	18.773090	1.378004	30.41838
9	31.92159	3.696348	3.065538	21.131810	1.307927	27.82711
10	32.63516	3.504063	3.280149	23.085430	1.256933	25.67702
11	33.21163	3.395939	3.444156	24.699980	1.219352	23.90142
12	33.68331	3.336431	3.572702	26.039800	1.191225	22.42879

12th month. This means that the exchange rate has an impact on the sectoral stock market in the long term. There are also relationships among the sectoral stock prices that is when one sectoral price index increases, the other stock price index will increase or decrease.

CONCLUSION

The currency crisis which involved Malaysia Ringgit (MYR)/United States Dollar (USD) that either happened in the 20th or 21st century seems to have impacts on the Malaysia economy market. This statement is supported by several evidences from relevant articles. There are three intentions which inspire to start this study in relation to the above statement. The first objective is to study the relationship between MYR/USD exchange rate and sectoral stock market indices. Then, the second objective of this study is to forecast the impacts of the exchange rate on sectoral stock price indices in the future 1 year. Ultimately, the third objective is to know the forecasted results of the impacts of a particular variable on the others.

Granger causality uncover a one directional causality between exchange rate (MYR/USD) and three sector indices namely consumer product, finance and industrial product. Thus, the fluctuation of the exchange rate has greatly impacted on these three sector indices. This statement shows that our first objective is achieved.

To determine whether a second or third objectives are achieved, we can discover from the results of variance decomposition analysis. From the results, exchange rate indicates moderately small scale decreasing impacts on price indices of sectors of finance and plantations whereas moderately big scale decreasing impacts on construction, consumer product, finance and industrial impact in the future 12 months. Besides, the impacts of exchange rate on the sectoral price indices in the future 1 year are quite small which ranged between 1.87 and 9.7%. Thus, the second objective is fulfilled.

Eventually, the results also shows that the price index of construction has a great impact of around 50% on that of consumer product, finance and industrial product and around 70% on the industrial index in the future 1 year. However, other sectors do not show significant impact on one and another sectors. Therefore, the third objective is also fulfilled through this project.

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