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VAR Model: The Economic Indicators and the Inflation in Malaysia

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ABSTRACT

Inflation is the dominant enemy for the cost of living. Meanwhile, cost of living is a sensitive issue for *rakyat* and also focused by the government. Nowadays, implementation of Sales and Service Tax (SST), decreasing the Overnight Policy Rate (OPR), fuel price and fuel subsidy issue and fluctuation of Ringgit Malaysia had been worried will increase the cost of living in Malaysia. This paper is investigating the relationship between the inflation with the interest rate, money supply and the exchange rate in Malaysia. As the model is not cointegrated, the Vector Autoregression (VAR) model is applied. The results revealed that the interest rate have a negative relationship with the inflation meanwhile the money supply and the exchange rate have a positive relationship with the inflation. Bank Negara Malaysia should ensure that the money supply is in suitable level because the relationship of the money supply have significant positive relationship at 5% of the confidence intervals with the inflation in Malaysia.

1.0 INTRODUCTION

Inflation is one of the major indicator for each country in term of the macroeconomics. Every government in each country will try their best to control the inflation in the low or middle rate for ensuring that their people will not influenced by the inflation. Hyperinflation which the inflation rate continuous over 6% will increase the cost of living (Mishkin, 1995). When the cost of living is high, it will create economic problems and social problems such as the increasing of poverty rate, increasing of crime, decreasing in quality of life and others. Besides that, people will try to fight with the government through the demonstration if the government is unable to control the inflation rate in a stable condition. The credibility of the government will be lost and it will make the change of the government in a country.

Inflation is defined as the rate of increase in prices over a given period of time (Oner, C. 2010). Inflation can be broad calculated and be the narrow calculated. By the way, the inflation shown that how much more expensive the relevant set of goods and services has become over a certain period. In overview, inflation in Malaysia is affected by the external factor and the internal factor. The long run inflation rate in Malaysia is 2.9% before year 2010 because of the price shock of the global oil and the increasing of the food price (Bank Negara Malaysia, 2010). Between the year 2010 to year 2013, the inflation rate in Malaysia is recorded as 2.18% because of the effort of the Malaysia government who implement the two economic stimulus packages in order to recover the economy of Malaysia after the economic recession 2008. However, government had decided to abolish the subsidy for the petrol RON 95 and diesel since 1 December 2014 in purpose to reduce the expenditure of the government. Moreover, the government also start the implementation of the Goods and Services Tax (GST) on the 1 April 2015 to increase revenue of the Malaysia (Royal Malaysian Customs Department, 2015). Hence, these two main issues directly increased the consumer price index and the inflation rate of Malaysia increased during this period.

Inflation has a positive relationship with the cost of living. When the consumer price index which increase inflation in price increased, it will increase the cost of living (Jacobs, Pereca, and Williams, 2014). Hence, cost of living due to inflation is an important issue in Malaysia and always be concerned by the *rakyat*. Malaysian or *rakyat* are sensitive with inflation because most of the Malaysian is come from the low-income (B-40) and middle-income (M-40) group. The commodities under the price mechanism which controlled by the government will affected their cost of living (Bank Negara Malaysia, 2010). For example, the increasing of the fuel price will increase the consumer price index under the transportation. Hence, it directly contribute to the

increment of inflation. *Rakyat* is sensitive with the inflation which can be proved through the 14th general election which held on 9 May 2018. The failure of the previous government to control the inflation rate make the *rakyat* loss confident to them.

With the substitution of the GST, the *Pakatan Harapan* government of Malaysia introduce the Sales and Service Tax (SST) since 1 September 2018 (Royal Malaysian Customs Department, 2018). Although the SST will narrow the tax base compared to the GST, but the tax rates that start from 5% to 10% will burden the consumers in the future. This is because the price of the goods and services will be increased due to the tax. Besides the tax, Bank Negara Malaysia (BNM) which is the central bank of Malaysia had decreased the Overnight Policy Rate (OPR) from 3% on 7 May 2019 fixed to 2.75% since 22 January 2020 and nowadays fixed to 2.5% start from 3 March 2020 for the objective to stimulate the economy (NST 2019; NST 2020; The Star, 2020). The decreased of OPR meaning that it encouraged the commercial bank to reduce their interest to the fixed deposit and the borrowing. Hence, this situation encourages people to borrow more than saving. The increasing of money supply and decreasing of interest rate also will increased the aggregate demand and causes the price of goods and services increased. For the fuel price, the new government changed back the price system from monthly basis to the weekly float system start on 1 January 2019. Hence, the fluctuation of the fuel price will continue affect the consumer price index for the transportation. Furthermore, the government nowadays announced the implementation of subsidy for the fuel to the B-40 group only which means that the subsidy to fuel which provided by the new government will be abolished start from year 2020 (The Star, 2019). This means the fuel price will be floated by the market and it is afraid that will be increase the price of the goods and services. Besides the internal factors, there is external factor influence the inflation in Malaysia. The Ringgit Malaysia (RM) is uncertainly with the global issues and domestic issue. For example, the declining of oil price made the depreciation of the Ringgit (The Star, 2019). Moreover, the Coronavirus (2019-nCov) gave the impact to Ringgit Malaysia and make the Ringgit Malaysia continues slide down. The depreciation of the Ringgit Malaysia over US Dollar become more serious when Malaysia faces the politic crisis since 24 February 2020 (The Star, 2020). The fluctuation of Ringgit against the US Dollar will influence the price of imported good and create the inflation in Malaysia.

Hence, this study will investigate the relationship between the inflation with the interest rate, money supply and the exchange rate by using VAR approach in Malaysia. Besides that, this study will identify the impact of the interest rate, money supply and the exchange rate to the inflation in Malaysia by using the Granger causality test.

2.0 LITERATURE REVIEW

Engsted and Tanggaard (2002) analysed the relationships between expected stock and bond returns and expected inflation at short and long run by using VAR model. The IS and Danish stock and bond data are adopted. The result revealed that the expected US bond returns and expected Danish stock returns move closely with expected inflation at long horizons but not at short horizons. Besides that, the relationship between expected returns and inflation is quite weak at all horizons. Mishra and Mishra (2010) used the VAR approach to model the reaction function of the central bank and structure of the economy. This model with the objective to identify monetary policy shocks. The hypothetical case of inflation targeting where the monetary policy instrument is set with the current values of inflation, output and exchange rate is build. Kanchan and Chandan (2011) in their study to investigate the inflation and economic growth in Malaysia by using VAR model. The empirical result from their study demonstrated that there is existing for the short-run causality between the variables. Meanwhile, the direction of causality is from inflation to economic growth but in the long-run economic growth Granger Causes inflation.

Olurunfemi and Adeleke (2013) examined the money supply and inflation rate in Nigeria which used the data from 1970 to 2008. The VAR is used to model the data. The results of causality test portrayed that a unidirectional causality between money supply and inflation rate is exists. Meanwhile, the interest rate and inflation also gave a unidirectional causality between each other. Moreover, Mishra, Mishra and Mishra (2010) studied about the causality test for India between money, price and output. The result revealed that there is an existence of long-run bidirectional causality between money supply and output. Furthermore, the unidirectional causality also existed between money supply and output. However, the bidirectional causality only exists between money supply and price level and from output to price level. Lee (1992) used a multivariate vector autoregression (VAR) model to determine causal relations and dynamic interactions among asset returns, real activity and inflation in the post-war United Stated. The results shown that the stock returns appear Granger-causally prior and help to explain real activity. Secondly, the stick returns explain little variation in inflation with interest rates in the VAR model. Thirdly, the inflation explained little variation in real activity.

Moreover, Amoah, Nyarko and Asare (2015) modelled the Gross Domestic Product (GDP) with Foreign Direct Investment (FDI), inflation and real exchange rate from period of 1980 to 2013 in Ghana by using the co-integrated analysis and Granger causality test. There is co-integration between the selected macroeconomic variables and GDP in Ghana which shown the long run relationship. Exchange rate and FDI have a negative long run effect on GDP while the inflation has a positive long run effect on GDP. The causality result revealed that a unidirectional causality between GDP growth rate and exchange rate. The bidirectional causality is shown between inflation and exchange rate and between inflation and GDP. However, FDI does not granger cause inflation. Gillman and Nakov (2004) examine the model which exogenous money supply causes changes in the inflation rate and the output growth rate in Hungary and Poland. The VAR model is adopted and the result portrayed that the Granger causality positively from money to inflation and negatively from inflation to output growth for both countries.

3.0 RESEARCH METHODOLOGY

3.1 Data

The data of the consumer price index is used as a proxy to the inflation in Malaysia while other economic indicators such as the interest rate, the money supply (MS3) and the exchange rate (RM/USD) are adopted from the central bank Malaysia which is the Bank Negara Malaysia. The data is monthly data within the period of January 2010 to December 2019.

3.2 Model

A multiple regression model is used with the inflation (INF) as the dependent variable while the interest rate (IR), money supply (MS) and exchange rate (EX) as the independent variables. The structural form of the model is:

$INF = f(IR, MS, EX)$……(1)

Meanwhile, the stochastic form of the model is

$INF = \beta_0 + \beta_1 IR + \beta_2 MS + \beta_3 EX + m$……(2)

Hence, the linear regression model is represented as follows:

$LogINF_t = \beta_0 + \beta_1 IR_t + \beta_2 LogMS_t + \beta_3 LogEX_t + m_t$……(3)

Where,

INF = Inflation
IR = Interest rate
MS = Money supply
EX = Exchange rate

3.3 Empirical Methodology

3.3.1 Unit root test

The unit root is run to verify the stationary of the model. This is very important to ensure that the model is stationary because the data will unstable in the long run and the spurious regressions will be exist. Hence, the Augmented Dickey-Fuller (ADF) test will be used for this study to test the existence of the 'unit root' problem in the model.

3.3.2 Cointegration test

After the unit root test, the level of co-integration between the variables is examined. The unrestricted cointegration rank test either the trace or the maximum eigenvalue is used to test whether the between of variables are cointegrated or not (Johansen, 1995). If the P value is lower than 0.05, then the null hypothesis which stated the variables are cointegrated is fail to be rejected.

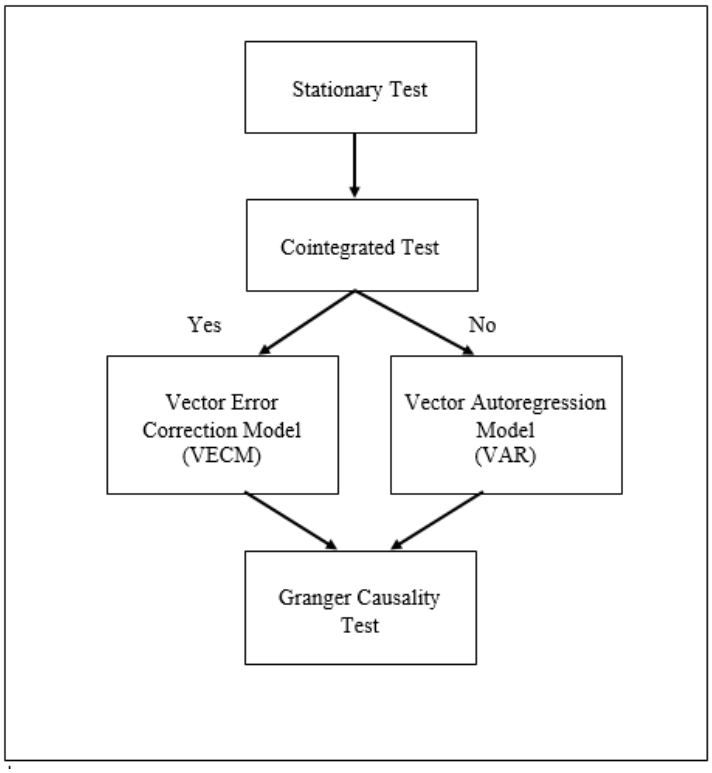

Figure 1: The empirical methodology in this study

3.3.3 Vector Autoregression (VAR) Model

When the model is stationary and not cointegrated, the Vector Autoregression (VAR) model is being adopted. Olurunfemi and Adeleke (2012) stated that VAR model is adopted as follows:

$at = \sum_{i=1}^{k} A_i a_{t-i} + e_t$ …… (1)

where,

at = is column vector of observations at time "t" on all the variables in the model.

$\sum$ = summation of exogenous variables at time "t".

a_{t-I} = lag of endogenous variables.

e_t = v_1-v_6 impluses or innovations or shocks

A_i = $\chi_1 - \chi_3$, $\Omega_1 - \Omega_3$, $\psi_1 - \psi_3$, $\lambda_1 - \lambda_3$ are numbers of parameters to be estimated in equations (2) to (5).

In a VAR linear form, equation (2) to (5) is given as follows:

$INF_t = \chi_1 IR_{t-1} + \chi_2 MS_{t-1} + \chi_3 EX_{t-1} + v_1$…… (2)

$IR_t = \Omega_1 INF_{t-1} + \Omega_2 MS_{t-1} + \Omega_3 EX_{t-1} + v_2$…… (3)

$MS_t = \psi_1 INF_{t-1} + \psi_2 IR_{t-1} + \psi_3 EX_{t-1} + v_3$…… (4)

$EX_t = \lambda_1 INF_{t-1} + \lambda_2 IR_{t-1} + \lambda_3 MS_{t-1} + v_4$ …… (5)

3.3.4 Granger Causality

After applying the VAR model, there is a causal effect occur between the variable. The null hypothesis is formed which the INF, IR, MS, EX do not Granger cause to each other (Granger, 1988). The null hypothesis will be rejected when the p-value is larger than 0.05. If the null hypothesis is rejected due to the significant of the p-value, the variables will have the granger cause between each other.

4.0 RESULTS AND DISCUSSION

4.1 Unit Root Test

The Augmented Dickey-Fuller test will be used to figure out the existence of the 'unit root' problem in the model. The null hypothesis which the model has the 'unit root' problem is rejected when the p-value is exceed 0.05.

Table 1: The results of Augmented Dickey-Fuller test

Variables	Level	First difference
Log Inflation (LogINF)	-1.0704	-8.7963***
Interest Rate (IR)	-3.3574***	-11.0454***
Log Money Supply (LogMS)	-1.3995	-10.7661***
Log Exchange rate (LogEX)	-0.7489	-10.3317***

(***), (**), dan (*) show the significance level at 1%, 5%, and 10%.

From the Table 1, the unit root test in the constant form either the data of the level or the first difference is examined. The results show that the LogINF, IR, LogMS and LogEX is significant at the 1% level for the first difference. This means that the model does not have unit root problem when the data is in the first difference. Hence, the study will obtain the data in the first difference.

4.2 Cointegration Test

The cointegration test for this study is done by the Johansen Cointegration Test to detect the cointegration relationship between the variables in the long run.

Table 2: Johansen Test for Cointegration

Hypothesized	Trace			Hypothesized	Maximum Eigenvalue		
No. of CE(s)	Statistic	Critical value	Prob.	No. of CE(s)	Statistic	Critical value	Prob.
None	46.8266	47.8561	0.0623	None	23.2013	27.5843	0.1650
At most 1	23.6253	29.7970	0.2167	At most 1	17.7468	21.1316	0.1396
At most 2	5.8784	15.4947	0.7098	At most 2	4.6215	14.2646	0.7886
At most 3	1.2569	3.8414	0.2622	At most 3	1.2569	3.8414	0.2622

Table 2 shows that the Johansen Test for Cointegration which the result reveal that there is a long run relationship exists among the variables. Both trace and Maximum Eigenvalues with the P-value more than 0.05 means that it is not significant. The null hypothesis is fail to be rejected as the series are not co-integrated and have not a long run relationship between the variables.

4.3 Relationship between the Variables by Using VAR

Table 3 show the result for the Vector Autoregression (VAR) estimation. From the result, the interest rate has a negative relationship with the inflation which the inflation tends to be reduced by 0.55% at average when the interest rate increased by 1%. Besides that,

it is not significant due to the T-statistic (-1.7269) is bigger than the T-critical (-1.980). However, it is significant at 10% of the confidence intervals because the T-statistic (-1.7269) is bigger than the T-critical (-1.658).

Table 3: Vector Autoregression (VAR)

Variables	Coefficient	Standard Error	T-statistics
IR_{t-1}	-0.0055	0.0032	-1.7269
$LogMS_{t-1}$	0.0334	0.0127	2.6271
$LogEX_{t-1}$	0.0102	0.0052	1.9647
C	-0.0070	0.0507	-0.1380
R-squared	0.9973	Log likelihood	509.4066
Adj. R-squared	0.9972	Akaike AIC	-8.4774
Sum sq. resids	0.0013	Schwarz SC	-8.3606
S.E. equation	0.0034	Mean dependent	4.7131
F-statistic	10827.54	S.D. dependent	0.0656

The money supply and exchange rate have a positive relationship with the inflation. When the increased of money supply by 1%, the inflation tends to be increased by 0.0334% at average. Meanwhile, the inflation tends to be increased by 0.0102% when the exchange rate increased by 1%. The positive relationship of the money supply to inflation is significant because T-statistic (2.627) is bigger than the T-critical (1.980) at the 5% of confidence intervals. However, the exchange rate to the inflation is not significant at 5% of the confidence intervals level but is significant at 10% of the confidence intervals because the T-statistic (1.9647) is larger than the T-critical (1.658).

4.4 Granger Causality

Table 4 portrayed the result for the Granger Causality test. The null hypothesis will be rejected when the p-value less than 0.05. From the result, the inflation have a unidirectional causality to exchange rate. Besides that, interest rate have a unidirectional causality to exchange rate. Moreover, a unidirectional causality have been shown by the money supply to the exchange rate.

Table 4: Granger Causality Result

Null hypothesis	Obs	F-statistic	Prob.
LogIR does not Granger Cause LogCPI	119	1.22525	0.2706
LogCPI does not Granger Cause LogIR		0.00116	0.9729
LogEX does not Granger Cause LogCPI	119	1.36316	0.2454
LogCPI does not Granger Cause LogEX		5.85266	0.0171
LogMS does not Granger Cause LogCPI	119	2.22962	0.1381
LogCPI does not Granger Cause LogMS		3.18284	0.0770
LogEX does not Granger Cause LogIR	119	0.32483	0.5698
LogIR does not Granger Cause LogEX		4.09337	0.0454
LogMS does not Granger Cause LogIR	119	0.01480	0.9034
LogIR does not Granger Cause LogMS		0.01164	0.9143
LogMS does not Granger Cause LogEX	119	5.58118	0.0198
LogEX does not Granger Cause LogMS		0.02715	0.8694

5.0 CONCLUSION

In conclusion, inflation is a fundamental of economic indicator in Malaysia. This paper is to examine the relationship between the inflation with the interest rate, money supply and the exchange rate by using VAR approach in Malaysia. Moreover, this study identifies the impact of the interest rate, money supply and the exchange rate to the inflation in Malaysia. The monthly data from January 2010 to December 2019 is adopted from the Bank Negara Malaysia website. The ADF test, Johansen cointegrated test and the VAR model is applied in this study. The ADF test show that the model is stationary at the first difference. After that, the data undergoes the Johansen cointegrated test. The result shown that the model does not be cointegrated which the model does not have long run relationship. Hence, the VAR model is built to suit the data. After the estimation, the interest rate has a negative relationship to the inflation in Malaysia while the money supply and the exchange rate have a positive relationship to the inflation in Malaysia. However, the relationship of the interest rate and exchange rate is significant at 10% of the confidence intervals and the relationship of the money supply is significant at 5% of the confidence intervals. The Granger causality test revealed that there are three unidirectional causality which are inflation to exchange rate, interest rate to exchange rate and money supply to exchange rate. The inflation rate should be stabilized by the government policy to enable the economic continued to be stimulated and the cost of living will not be affected at the same time.

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