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Testing for Unit Roots and Structural Breaks in Malaysia Unanticipated Macroeconomic Variables

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ABSTRACT

The objective of this study is to execute a comprehensive analysis of the unit root test and structural break in Malaysia unanticipated macroeconomic variables from January 2009 to December 2016 using an endogenous structural break. The findings obtained by using conventional regression methods without testing for the unit root in time series data might be misleading. The empirical results from the Zivot-Andrews model, which endogenously identifies the most significant structural breaks in each of the macroeconomic variables, clearly show that the null hypothesis of at least one-unit root could be rejected for some of the variables under investigation. Some of the variables, which contain a unit root based on the conventional unit root test, become stationary after considering the existence of potential structural breaks in the series. The results are statistically significant, and the endogenous structural breaks identified using this methodology also coincides with periods of major economic shocks to the Malaysia economy. The estimated break dates correspond closely with the expected dates associated with the changes in the government economic policy and the effect of the European Debt Crisis as well as the oil price shock in 2011 which resulted in a significant shift in Kuala Lumpur Composite Index (KLCI) from 1389 point (September 2011) to 1492 point (October 2011). An analysis of the structural breakpoint of these variables suggests that the Malaysia stock market has

gone through a structural change after October 2011. The policymakers can use historical information to forecast future movements in macroeconomic time series.

INTRODUCTION

The unit root test has both empirical and theoretical implications for economic modelling and theory. This is one reason for the popularity of unit root tests and a key motivation for methodological innovations. Perron (1989) showed that ignoring a structural break, as is the case with Dickey and Fuller (1979), can lead to the false acceptance of the unit root null hypothesis. It is well known that a break in the deterministic trend affects the outcome of unit root tests. The primary issue involves the long-run response of a trending data series to a current shock to the series. The traditional view holds that current shocks only have a temporary effect and that such shocks unalter the long-run movement in the series. Major arguments concern the dynamic properties of macroeconomic and financial time series (Nelson & Plosser, 1982). Nelson and Plosser (1982) challenged this view and argued, using statistical techniques developed by Dickey and Fuller (1979, 1981), that current shocks have a permanent effect on the long-run level of most macroeconomic and financial aggregates. Conversely, Perron (1989) challenged this result by arguing that the empirical findings of non-stationary may result from the overlooking of the possible structural breakpoints in the economy. Perron (1989) further showed that the power of a standard unit root test tends to decrease if the structural breakpoints are overlooked. Particularly, a unit root test that ignores a structural change when it exists does not reject a null hypothesis of unit root even if an accurate model is of stationary.

In this paper, the study emphasizes the issue in numerous aspects. Firstly, most researches have focused on the unit root test and structural break in developed and developing countries as well as an emerging market. Still, it is rather surprising that there are no serious investigations and no comprehensive studies have been made on Malaysia unanticipated macroeconomic variables. Thus, a thorough investigation of statistical in this subject is required. The second problem is related to the ignorance of structural breaks. Numerous previous empirical researches do not consider structural breaks in the research. One obvious feature is that most of the financial and macroeconomic time series with a long span of historical time is subject to the existence of structural breaks (Basher & Westerlund, 2009).

Numerous important events happened during the period of this study. These events are likely to affect the estimation of the variables and can be used as a possible explanation for the break found in the data series. However, the exact structural break cannot be deduced from logic as events may have both immediate as well as gradual effects, and their timing is of paramount importance in any empirical analysis. The detection of structural breaks within the times series data will present clear evidence of the impact of the critical change in the Malaysia economy. Therefore, the focus will be on the unit root test hypothesis and structural breaks in the Malaysia stock market. Structural breaks are usually ignored when the analysis deal with a long period of time-series data. The series of data will be subjected to structural breaks. If the unit root test conducted does not consider structural breaks that could arise from various economic and political events (Arestis & Mariscal, 1999), it can be wrongly specified, and it will produce inaccurate inference (Chaudhuri & Wu, 2003). Thus, the regression will be bias and spurious.

The time-series data taken from January 2009 to December 2016 has gone through many anomalous events such as the global financial crisis in 2008 and 2009, the crude oil price crisis started at the end of 2014, major fiscal debt reaching almost to 70 per cent of the GDP, political turmoil like BERSIH events and also political scandal. These major shocks were able to contract the macroeconomic condition and create fluctuation. Besides, the value of the MYR exchange rate has been going through major changes that are influencing the price of crude oil. Particularly, almost every year, there have been some radical policy changes or external shocks to the economy resulting in the occurrence of a multitude of structural breaks in systematic risk factors. These major shocks were particularly severe on the macroeconomic condition, and the overall Malaysia economy indicated a sharp decline and instability over these periods. Hence, the behaviour of Malaysia macroeconomic may react differently because of several economic and financial events that happened throughout the study period.

The stock market provided an important channel to raise capital for the economy and to stimulate the economy. The stock market was used as a leading indicator that measures the strength of the economy (Nordin, Nordin & Ismail, 2014). The return of stock markets can measure the performance of the stock market. The increase in stock market return tends to be related to an increase in business investment and vice versa. The theoretical underpinning of the effect between macroeconomic variables and the stock market is explained by the Arbitrage Pricing Theory (APT) model (Ross, 1976). The APT was known as multi factors model which can compare more than one factor to analyse the explanatory power of the variables to stock market returns. APT hypothesizes the relationship between stock market return and macroeconomic variables. APT models clarify how the fluctuations in macroeconomic variables can influence stock market returns. Macroeconomic variables were the primary source of risk known as systematic risk factors. Systematic risk is unpredictable and impossible to avoid completely. Therefore, systematic risk always exists in the markets. Hence, this study starts with the general objective of analysing the unit root hypothesis and structural breaks of various macroeconomic time series in Malaysia from January 2009 to December 2016.

DATA

The macroeconomic variables chosen in these studies should be in line with the transformation policy of the administration of the Malaysia government. Hence, the macroeconomic variables chosen to represent the systematic risk factors was in line with the Economic Transformation Programme (ETP) designed under the New Economic Model (NEM) was interest rate, inflation rate, exchange rate and money supply, preferably known as the monetary variables obtained from the Theory of Monetary Transmission Channel. Besides, financial development, crude oil price and industrial production index also been selected as systematic risk factors to examine their influence on stock market returns within the context of Malaysia.

The research is based on the Kuala Lumpur Composite Index (KLCI) stock market as dependent variables and independent variables the set of systematic risk factors chosen in this paper is based on the macroeconomic variables affected by the Economic Transformation Programme (ETP) during the study period. The economic factors were money supply (MS), interest rate (IR), inflation rate (CPI), exchange rate (EXR), financial development (FD), crude oil price (OP) and industrial production index (IPI). Since the observation is only from January 2009 to December 2016, the study only focuses on the era of the New Economic Model (NEM). The natural logarithm (Ln) of macroeconomic variables for Malaysia as displayed in Table 1. Monthly data covered from January 2009 to December 2016. Moreover, this chosen period allows for the possibility of major structural changes. The sample data are obtained from the Bloomberg Finance L.P.

Table 1 Description of data

Variables	Proxy	Explanation	Units
Stock Market Return	LnKLCI	Monthly composite market index in Bursa Malaysia	Index
Money Supply	LnMS	Monthly money circulation in Malaysia market of category 2 (broad money M2)	MYR
Interest Rate	LnIR	Monthly overnight interest rate in Malaysia	Per cent
Inflation Rate	LnCPI	Monthly consumer price index in Malaysia	Index
Exchange Rate Financial Development	LnEXR LnFD	Monthly currency exchange rate with USD Monthly ratio of M2 over GDP of Malaysia	MYR MYR
Crude Oil Price Industry production Index	LnOP LnIPI	Monthly oil price of one barrel in Malaysia Monthly change in output in Malaysian manufacturing, mining, construction and electricity, gas and water	MYR Index

METHODOLOGY

The factors that create risks are usually macroeconomic factors. Sources of systematic risk can be macroeconomic factors such as inflation rate, interest rates, exchange rate, foreign direct investment, recessions, natural disasters, wars and government regulations (Tripathi & Neerza, 2015; Zahiri, Mehrara & Falahati, 2014). Macroeconomic factors that affect the direction and instability of the whole market will be a systematic risk. Based on the scenario mentioned, the risk of money supply (LnMS), interest rate (LnIR), inflation rate (LnCPI), exchange rate (LnEXR), financial development (LnFD), crude oil price (LnOP) and industrial production index (LnIPI) were suitable variables to represent systematic risk in Malaysia context.

Since in this study, all observe is unanticipated variables. Therefore, all the variables except financial development (LnFD) will be converted into unanticipated variables. Hoffman (1987) and Barro (1977) were used to create the estimation of risk for all the macroeconomic variables used in this study. The two-step estimation method was used to differentiate the variables. The first step is all the anticipated values of the macroeconomic variables were regressed with the lagged two values of its own variable to obtain the residuals. In the second step, the residuals will be powered by two to obtain the variance, which represents the risk of each variable.

Therefore, this study suggested the unanticipated money supply (LnUMS), unanticipated interest rate (LnUIR), unanticipated inflation rate (LnUCPI), an unanticipated exchange rate (LnUEXR), financial development rate (LnFD), unanticipated crude oil price (LnUOP) and unanticipated industrial production index (LnUIPI) as independent variables. Many methodologies have been widely applied to examine the unit root test and structural breaks, in this paper, firstly discuss unit root test without a structural break or Augmented Dickey-Fuller (ADF) tests, and it is then followed by unit root test with endogenous unknown structural or Zivot-Andrews (ZA) tests.

Unit Root Tests without Structural Breaks

The stationary test is another common name for the unit root test. Unit root test is applied to check whether the time series variable is stationary or non-stationary or to determine the data trend from model variables. According to Dickey and Fuller (1979), the findings may be biased if the sample data present non-stationary characteristics. Therefore, the unit root test is important to test the hypothesis of whether the given time series data has trend-stationary or level-stationary. If the stationary process is accompanying by the determinant trend, the facing shock is considered as temporary or transitory. However, if the data has a unit root or stochastic trend, the shock then is said to be permanent. In order to examine the presence of unit root of each variable in this paper, the Augmented Dickey-Fuller (ADF) test will be used.

a. Augmented Dickey-Fuller (ADF) Test

Dickey and Fuller (1979) developed the Augmented Dickey-Fuller (ADF) test to analyze the existence of a unit root (Glynn, Perera & Verma, 2007). Since these variables have well approximated by the time series model as a preliminary analysis, and each series were first checked for unit root using the ADF test that allows for a linear time trend. The ADF model used in this research for the unit root test has the following equation:

$$\Delta Y_t = \mu + \beta t + \alpha Y_{t-1} + \sum_{i=1}^{k} c_i \, \Delta Y_{t-1} + \varepsilon_t \tag{3.1}$$

where:

Y_t = the time series being tested
t = a time trend variable
Δ = the first difference operator
k = the number of lags which are added to the model to ensure that residuals
ε_t = white noise disturbance

The ADF test is primarily concerned with the estimate of in the equation (3.1). The level of integration for the non-stationary time series data can be determined by conducting the unit root test. The hypotheses of unit root test are stated as follow:

H_0: All variables are not stationary.
H_1: All variables are stationary.

If the value of the *t*-statistics is greater than the critical value, H_0 will be rejected, which means that the values series is stationary, and the unit root does not exist. Conversely, if *t*-statistics is less than the critical value, H_0 will not be rejected, means that the values series is non-stationary, and unit root exists.

Unit Root Tests with Structural Breaks

A common problem with the conventional unit root tests is not allowed for the possibility of the structural break. Also, an applied conventional unit root test alone is insufficient and problematic since it is highly possible that can be significant structural breaks in the time-series data. There are two advantages of applying the unit root hypothesis with the possible presence of the structural break. First, it avoids yielding a test result that is biased towards non-rejection (Perron, 1989). Second, since this method can identify when the possible presence of structural break happened, then it would give valuable information for investigating whether a structural break on a certain variable is related to government policy, financial crisis, regime shifts or other factors.

This paper showed that endogenous determining the time of structural breaks and bias in the conventional unit root tests could be reduced. Therefore, this research was motivated to analyze whether the data series used is affected by a structural break by applied the Zivot and Andrews (1992) model, which in turn reflects the response of stock market return in Malaysia.

a. Zivot and Andrews Test

Zivot and Andrews (1992) extended a difference of Perron (1989) original model, which the time of the break is estimated. Zivot and Andrews (1992) included the endogenous break in the model and it was referred to as a sequential trend break model. Perron (1989) is a predetermined break, but Zivot and Andrews (1992) is an estimated break. The alternative hypothesis is that the series is a trend stationary process with any breakpoint. Meanwhile, the null hypothesis in this procedure is that the variable under analysis is not stationary with a drift that excludes any breakpoint. The alternative hypothesis considered in the Zivot-Andrews method was more general and allows for shifts in the level of the series. In this method, TB (breakpoint) was chosen to minimize the one-sided -statistic of . The Zivot-Andrews model endogenous one structural break in a series as the following:

Model A allows a one-time change in the intercept of the series:

$$\boldsymbol{y_t = \mu + \alpha y_{t-1} + \beta_t + \theta DU_t + \sum_{j=1}^{k} c_j \; \square y_{t-j} + e_t} \quad (3.2)$$

where:
DU_t represents the intercept dummy $DU_t = 1$, when t > TB (breakpoint) and zero otherwise.

Model B allows a one-time change in the slope of the series:

$$\square y_t = \mu + \alpha y_{t-1} + \beta_t + \gamma DT_t + \sum_{j=1}^{k} c_j \; \square y_{t-j} + e_t \quad (3.3)$$

where:
DT represents the slope dummy $DT_t = t - TB$, when t > TB (breakpoint) and zero otherwise.

Model C allows a one-time change in both slope and intercept of the trend function of the series:

$$\square y_t = \mu + \alpha y_{t-1} + \beta_t + \theta DU_t + \gamma DT_t + \sum_{j=1}^{k} cj \; \square y_{t-j} + e_t \quad (3.4)$$

Based on the above equations, is indicator dummy variable for a mean shift in the intercept and is another dummy variable representing a shift in the trend occurring at time. The null hypothesis in equations (3.2), (3.3) and (3.4) was that , which indicates that there is a unit root in . The alternative hypothesis is that , which indicates that was breakpoint.

EMPIRICAL RESULTS

It is essential to examine the stationary properties through the unit root test analysis to realize the integration order of variables employed in this study. One of the reasons was to ensure that no incorrect inferences were made due to spurious regression. All the series used were tested using Augmented Dickey-Fuller (ADF) unit root tests. Additionally, the purpose of using different types of unit root tests was to ensure robustness, because the main problem with the unit root test was the decreasing low power or the ability to reject a null hypothesis when it was false.

Results of Unit Root Tests without Structural Breaks

Unit root test was conducted to examine the availability of the unit root in the data in order to confirm the autocorrelation problem. The study subsequently runs the ADF unit root tests on all the variables individually to test stationary and to determine the order of integration of each series (Dickey & Fuller, 1981). In order to check stationarity for every time series in the research, ADF tests considered the inclusion of intercept, trend and intercept and without trend and intercept were conducted to account for the possible trend components in the series. The occurrence of a unit root in each time series was determined by comparing estimated t-statistics with critical values of t provided in Table 4. Regarding the ADF tests, the null hypothesis of a unit root cannot be accepted unless the estimated t-statistic excesses the critical values at 1 per cent, 5 per cent or 10 per cent estimated level of significance. The unit root test results based on the ADF tests were summarized in Table 2 and Table 3 respectively.

The ADF test at the level (Table 2) is based on the Schwarz Information Criteria (SIC) (Schwarz,1978) up to a maximum lag length of 11. The ADF test at 1 per cent (3.501), 5 per cent (2.892) and 10 per cent

(–2.583) significant level under the intercept term has rejected the null hypothesis that tested variables stock market return (LnKLCI) (–4.364), unanticipated money supply (LnUMS) (–9.651), unanticipated inflation rate (LnUCPI) (–6.194), unanticipated exchange rate (LnUEXR) (–10.312), unanticipated oil price (LUOP) (–9.248), unanticipated industrial production index (LnUIPI) (-8.396) and unanticipated interest rate (LnUIR) (–2.964) have unit root except for financial development (LnFD) (–1.171) variable failed to reject the null hypothesis.

Meanwhile, unanticipated money supply (LnUMS) (–9.602), unanticipated interest rate (LnUIR) (–4.153), unanticipated inflation rate (LnUCPI) (–6.723), unanticipated exchange rate (LnUEXR) (–10.327), unanticipated oil price (LnUOP) (–9.473), unanticipated industrial production index (LnUIPI) (–8.372) and financial development (LnFD) (–3.905) have rejected null hypothesis of ADF test at 1 per cent (–4.059), 5 per cent (-3.458) and 10 per cent (–3.155) significant level under the trend and intercept. However, stock market return (LnKLCI) (–2.785) failed to reject the null hypothesis while testing with the trend and intercept at 1 per cent (–4.059), 5 per cent (–3.458) and 10 per cent (–3.155) significant level. Therefore, all the variables need to be converted into first differences for further investigation on the unit root test.

The ADF test at the first differences also rejected the null hypothesis that tested variables have a unit root. Unanticipated money supply (DLnUMS) (–8.462), unanticipated interest rate (DLnUIR) (–8.903), unanticipated inflation rate (DLnUCPI) (–10.841), unanticipated exchange rate (DLnUEXR) (–9.967), unanticipated oil price (DLnUOP) (–9.885), unanticipated industrial production index (DLnUIPI) (–9.748) and financial development (DLnFD) (–3.218) have rejected null hypothesis of ADF test at 1 per cent (–3.501), 5 per cent (–2.892) and 10 per cent (–2.583) significant level with an intercept term.

On the other hand, the ADF test at the first differences under the trend and intercept term has rejected the null hypothesis that the tested variables unanticipated money supply (DLnUMS) (–8.410), unanticipated interest rate (DLnUIR) (–8.886), unanticipated inflation rate (DLnUCPI) (–10.799), unanticipated exchange rate (DLnUEXR) (–9.884), unanticipated oil price (DLnUOP) (–9.887), unanticipated industrial production index (DLnUIPI) (–9.699) have unit root except for financial development (DLnFD) (–2.973) variable failed to reject the null hypothesis while testing with trend and intercept at 1 per cent (–4.059), 5 per cent (–3.458) and 10 per cent (–3.155) significant level. Additionally, dependent variable stock market return (DLnKLCI) has rejected the null hypothesis of ADF at first differences with the trend (–9.509) at 1 per cent (–3.501) significant level and with trend and intercept (–10.608) also at 1 per cent (–4.059) significant level.

Table 2 Augmented Dickey-Fuller test results in levels

ADF Results	Level	
	Intercept	Trend and Intercept
Dependent Variable		
LnKLCI	–4.364***	–2.785
Independent Variables		
LnUMS	–9.651***	–9.602***
LnUIR	–2.964**	–4.153***
LnUCPI	–6.194***	–6.723***
LnUEXR	–10.312***	–10.327***
LnFD	–1.171	–3.905**
LnUOP	–9.248***	–9.473***
LnUIPI	–8.396***	–8.372***

*Note: ***, **, and * indicates 1%, 5% and 10% statistically significance levels, respectively.*
Source: Author's Computation using E-views 10 (2019)

Table 3 Augmented Dickey-Fuller test results in first differences

ADF Results	First Differences	
	Intercept	Trend and Intercept
Dependent Variable		
DLnKLCI	−9.509***	-10.608***
Independent Variables		
DLnUMS	−8.462***	−8.410***
DLnUIR	−8.903***	−8.886***
DLnUCPI	−10.841***	−10.799***
DLnUEXR	−9.967***	−9.884***
DLnFD	−3.218**	−2.973
DLnUOP	−9.885***	−9.887***
DLnUIPI	−9.748***	−9.699***

*Note: ***, **, and * indicates 1%, 5% and 10% statistically significance levels, respectively.*
Source: Author's Computation using E-views 10 (2019)

Table 4 Critical values for unit root tests at a significance level

Level	1%	5%	10%
Intercept	−3.501	−2.892	−2.583
Trend and Intercept	−4.059	−3.458	−3.155

Source: Author's Computation using E-views 10 (2019)

Therefore, based on the result from ADF unit root test, stock market return (LnKLCI), unanticipated money supply (LnUMS), unanticipated interest rate (LnUIR), unanticipated inflation rate (LnUCPI), unanticipated exchange rate (LnUEXR), financial development (LnFD), unanticipated oil price (LnUOP) and unanticipated industrial production index (LnUIPI) were integrated into level and first differences, where there was a mix of stationarity I(1) and I(0) in the data at a level and first difference.

However, the problem with the ADF unit root tests was to provide biased empirical evidence if the series contains a structural break. The results based on the ADF unit root tests were mixed, which could be due to the ignorance of the possible structural break that exists in the series (Ling, Nor, Saud & Ahmad, 2013). By purposely ignoring the structural break in time series can influence the results of tests for unit roots. Therefore, the series used in this study will be tested with unit roots tests that consider the presence of structural break, which include Zivot-Andrews models unit root tests which incorporate one structural break.

Results of Unit Root Tests with Structural Breaks

The structural break can reflect policy, technical or institutional change. Structural breaks may also because of changes in economic policies or large economic shocks. This indicates that the structural break can have a permanent effect on the pattern of the time series. This test makes room for single unknown structural break arising in the series. Break-in intercept for a one time change in the intercept. Meanwhile, break-in trend was applied to test for stationarity of the series around a broken trend and break in both provides the possibility of a change in the intercept as well as a broken trend. The insertion of a structural break in the unit root tests allowed for both intercept and trend shift was important because it could improve the reliability of the econometric tests used and improved the accuracy of statistical inference (Harvie, Pahlavani & Saleh, 2006).

The results from Zivot-Andrews test at level (Table 5) showed that dependent variables stock market return (LnKLCI) and independent variable unanticipated oil price (LnUOP) were non-stationary in the presence of structural break. Therefore, the null hypothesis of a unit root tests for stock market return (LKLCI) and unanticipated oil price (LnUOP) cannot be rejected in Model A, B and C. However, unanticipated money supply (LnUMS), unanticipated interest rate (LnUIR), unanticipated consumer price index (LnUCPI), unanticipated exchange rate (LnUEXR) and unanticipated industrial production index (LnUIPI) were stationary at 1 per cent, 5 per cent and 10 per cent significance in level for Model

A, B and C except for financial development (LnFD) variable were stationary at 10 per cent significant in level for Model A and Model B but Model C was non-stationary either at 1 per cent, 5 per cent and 10 per cent significant level. Hence, at the level, the stationarity of all the variables was mixed.

After converting the data into first differences (Table 6), as expected, all variables were stationary at 1 per cent, 5 per cent and 10 per cent significance level with the presence of a structural break in Model A, B and C. Additionally, dependent variable stock market return (LnKLCI) were non-stationary at a level. At first difference, stock market return (DLnKLCI) the null hypothesis of Zivot-Andrews unit root test with the break-in Model A at October 2011, Model B at March 2010 and Model C at October 2011 were rejected.

Tables 5 and 6 summarized the results of Zivot-Andrews unit root test in the presence of structural break, allowing for a change in Model A, B and C. This result obtained from the Zivot-Andrews test revealed that all the variables examined contain unit root despite capturing one endogenously determine break in the data. This was also consistent with the results obtained by the conventional unit root test (ADF test). This empirical evidence indicated that the series was non-stationary at level except for unanticipated money supply (LnUMS), unanticipated interest rate (LnUIR), unanticipated consumer price index (LnUCPI), unanticipated exchange rate (LnUEXR) and unanticipated industrial production index (LnUIPI) but found all the variables were stationary at first difference. Therefore, it can be concluded that the Zivot-Andrews unit root tests given the corresponding breakpoints do not change the results of the conventional unit root tests and signified that all the series were integrated at I(1).

Table 5 Structural Break – Zivot-Andrews results in levels

ZA Results	Level		
	Model A Break-in Intercept	Model B Break-in Trend	Model C Break-in Both
Dependent Variable			
LnKLCI	−3.825(2015M05)	-3.811(2014M01)	-3.797(2014M07)
Independent Variables			
LnUMS	−8.689***(2012M02)	−8.069***(2011M08)	−8.954***(2012M02)
LnUIR	−6.136***(2011M06)	−5.676***(2012M04)	−6.230***(2011M06)
LnUCPI	−7.936***(2014M10)	−7.119***(2012M10)	−7.893***(2014M10)
LnUEXR	−10.873***(2014M12)	−10.310***(2011M07)	−11.203***(2014M12)
LnFD	−4.904*(2012M11)	−4.262*(2015M10)	−4.684(2011M11)
LnUOP	−3.371(2010M11)	−3.496(2015M08)	−4.141(2014M10)
LnUIPI	−6.630***(2014M02)	−6.372***(2013M07)	−6.637***(2014M02)

*Note: ***, **, and * indicates 1%, 5% and 10% statistically significance levels, respectively. ( ) is the estimated break month.*
Source: Author's Computation using E-views 10 (2019)

Table 6 Structural Break – Zivot-Andrews results in first differences

ZA Results	First Differences		
	Model A Break-in Intercept	Model B Break-in Trend	Model C Break-in Both
Dependent Variable			
DLnKLCI	−11.269***(2011M10)	−11.184***(2010M03)	−11.848***(2011M10)
Independent Variables			
DLnUMS	−9.908***(2012M02)	−9.545***(2015M03)	−10.077***(2012M02)
DLnUIR	−9.084***(2010M08)	−8.863***(2010M10)	−10.862***(2010M06)
DLnUCPI	−7.156***(2015M04)	−6.631***(2015M08)	−7.574***(2015M04)
DLnUEXR	−7.007***(2014M08)	−7.027***(2015M08)	−7.219***(2015M08)
DLnFD	−5.944***(2015M06)	−5.960***(2011M12)	−6.077***(2013M03)
DLnUOP	−5.925***(2015M05)	−5.778***(2014M12)	−6.019***(2014M06)
DLnUIPI	−7.575***(2015M04)	−10.531***(2010M06)	−7.571***(2010M08)

Note: ***, **, and * indicates 1%, 5% and 10% statistically significance levels, respectively. ( ) is the estimated break month.
Source: Author's Computation using E-views 10 (2019)

Table 7 Critical values for Zivot-Andrew tests at a significance level

Level	1%	5%	10%
Model A	−5.34	−4.93	−4.58
Model B	−4.80	−4.42	−4.11
Model C	−5.57	−5.08	−4.82

Source: Author's Computation using E-views 10 (2019)

The empirical results based on the Zivot-Andrews model which identifies structural break at an unknown point. There was a clear presence of a structural break-in data for time series. The model constructed a shift dummy taking the value zero (0) before the breakpoint (0 for 2009 M01 – 2011 M09) and one (1) at the breakpoint and beyond (1 for 2011 M10 – 2016 M12). There was a structural break that occurs over the month of October 2011 to December 2016. The break does not occur at just a single point in time. Instead, there was a change in level and trend of the data that evolved over several periods. Hence, the dummy variable is created as a BREAK. The estimated break dates correspond closely with the expected dates associated with the changes in the government economic policy and also effect of the European Debt Crisis as well as the oil price shock in 2011 which resulted in a significant shift in Kuala Lumpur Composite Index (KLCI) from 1389 point (September 2011) to 1492 point (October 2011).

DISCUSSION

The research applied the ADF analysis as the unit root test without a structural break. The empirical results of the unit root test seem to be inconsistent. The results of ADF unit root test at the level of the series with intercept or with the trend and intercept found that all variables were significant at 1 per cent and 5 per cent except for financial development (LnFD) with intercept and stock market return (LnKLCI) with the trend and intercept which found insignificant. The results of ADF unit root tests with intercept or with trend and intercept showed that all variables were stationary at 1 per cent except financial development (LnFD) with intercept were significant at 5 per cent and with trend and intercept were insignificant.

Based on the findings, the results of conventional unit root tests can be concluded that the data was stationary at a level and first difference with a mix order of stationary which means some of the variables integrated in the order of zero, I(0) and some of the variables integrated in the order of one, I(1), which might due to ignorance of the possible structural break that existed in the series (Ling, Nor, Saud & Ahmad, 2013).

For additional checking on stationary, the study employed Zivot-Andrews as an analysis method for unit root test with a structural break. The results of Zivot-Andrews found that all model has a break in intercept (Model A), break-in trend (Model B) and break in both (Model C) for dependent variable stock market return (LnKLCI) but was insignificant at the level of the series. However, when data converted to first differences, the results showed that the entire models were significant at 1 per cent significant level with Model A significant breakpoint at October 2011, Model B significant breakpoint at March 2010 and Model C significant breakpoint at October 2011 for stock market return (LnKLCI).

There is a clear structural break that exists in the relationship between the systematic risk factor and stock market return (LnKLCI) between the period from January 2009 to December 2016. The normal correlation between systematic risk factors and stock market return has been transformed over the period and the structural break has been detected for stock market returns. Based on the findings showed that structural break occurs over the month of October 2011 to December 2016. The estimated break dates correlation nearly with the expected dates related with the changes in the government economic policy by implementing the Economic Transformation Programme (ETP) and also affected by the European Debt Crisis as well as the crude oil price shock in 2011 where KLCI fall to 1387 point on September 2011 and follow by oil price slump over 50 per cent in 2014 – 2015 where KLCI fall to 1761 point on December 2014. Therefore, it can be concluded that the events have a crucial impact on the interactions between systematic risk factors and stock market return over the long period in Malaysia and also based on the empirical evidence confirms that there is the existence of structural break relationship between systematic risk factors and Malaysia stock market return empirically.

CONCLUSION

This paper has identified the timing, and explanation, of major breaks in key macroeconomic variables for the Malaysia economy, utilizing monthly time series data covering the period January 2009 to 2016. The objective of this study is to carry out a comprehensive analysis of the unit root test and structural break in Malaysia unanticipated macroeconomic variables using an endogenous structural break. An analysis of the structural breakpoint of these variables suggests that the Malaysia stock market has gone through a structural change after October 2011. The estimated break dates correlation nearly with the expected dates related with the changes in the government economic policy by implementing the Economic Transformation Programme (ETP) and also affected by the European Debt Crisis as well as the crude oil price shock in 2011 and follow by oil price slump over 50 per cent in 2014 – 2015. The study has shed some light on the issue of structural breaks in the data and provides complementary evidence and useful results for future studies using macroeconomic variables in Malaysia and elsewhere. The policymakers can use historical information to forecast future movements in macroeconomic time series. Since testing variables for unanticipated with the presence of structural breaks may yield conflicting results to conventional as well as Zivot-Andrews unit root tests, future work could usefully further concentrate on a clearer refinement of this issue.

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