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Structural Break and Cointegration in Malaysian Stock Market

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Abstract. This study explores the empirical influence of domestic and foreign factors on equity pricing in Malaysia for the period 1990-2013. This research seeks to determine if the dynamics have changed over time with the period of study spanning across major episodes of crisis such as the Asian Financial Crisis, the Global Financial Crisis and the European Debt crisis. Advanced econometric techniques namely unit root test with structural breaks, multivariate cointegration analysis, error correction model and innovation accounting technique are employed in the analysis. The findings show that share prices and macroeconomic variables (inflation rate, industrial production, money supply and US share price) are cointegrated in Malaysia for the period 1990-2013. In the long-run, consumer price index and US share prices contribute positively to share price movement while industrial production and money supply have a negative relations with KLCI. As for short-run dynamic interaction, Malaysia share prices are not significantly affected by lagged information from macroeconomic variables. Macroeconomic activities have weak explanatory power on stock market movements in short-run. Structural change has occurred after the Asian Financial Crisis.

Keywords: Stock Market, Malaysia, Structural Break, Macroeconomic Variables, Cointegration

1. Introduction

A variety of developments – domestic and international – can influence movement in share prices. Stock prices are also commonly associated with expectations about economic activity. This research explores the empirical influence of domestic and foreign factors on equity pricing in Malaysia. The central question is: what are the major factors driving share prices in Malaysia over time? In particular, this study explores whether the determinants of share price and their influence have been altered by a series of major developments in the past 20 years such as financial crises, capital control, low interest rate environment, international development etc. That is, how have the influence of these factors evolved over the past two decades?

The main contribution of this research lies mainly in using a larger set of variables by bringing external influence into the equation. As a longer sample period is studied, the analysis covers major crises such the Asian financial crisis, US subprime crisis and European debt crisis. In addition, the analysis seeks to explain why share prices behave differently over time by considering structural change. By structural change, the values of the parameters of the model do not remain the same through the entire time period. Such analysis enables the identification of influential factors driving the local share prices over different periods.

Generally, understanding the determinants of share price is of great importance to economists, portfolio managers, financial analysts, investors, regulators, policy makers and academic researchers. This study has practical implication for investment management decision.

Malaysia has been chosen as a case study in this dissertation mainly due to the distinctive features of the country. Malaysia is an emerging stock market with a relatively smaller market capitalization. It is likely to be more susceptible to speculative activities. The country has shown tremendous growth over the past two decades. During the period 1991-95, the economy grew at an average rate of 8.7% per annum, followed by a

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slower growth rate of 4.6% per annum in 1996-2000. GDP growth averaged to 4.4% for the period 2001-2005 and 4.5% for the period 2006-2010. The economic growth was disrupted by the 1997/1998 Asian financial crisis as well as 2007/2008 global financial crisis. The capital control measures implemented in September 1998 has also created an ideal condition for investigating the behaviour of stock market in Malaysia. After the Asian Financial crisis, Malaysia has built its capacity to cope with such challenges. The interest in this topic is motivated by the fact that after the Asian financial crisis, Malaysia is supported by sound macroeconomic fundamentals, continued access to financing in an environment of ample liquidity and a resilient financial sector (International Monetary Fund, 2009) and would in fact, could insulate its stock market from adverse external shocks.

2. Theoretical Background

Since the late 1960s, numerous empirical studies have focused on the stock market and determinants of asset pricing. Researchers have provided various theoretical explanations. Theoretically, the determinants of share price has been developed and modeled with the Discounted Cash Flow Model, the Capital Asset Pricing Model [(Sharpe, 1964); (Lintner, 1965)] and the Arbitrage Pricing Theory (Ross, 1976). These models provide a basis for the study of the dynamic interaction among macroeconomic variables and stock prices. In early studies, the systematic risk or beta with respect to market portfolio has been hypothesized as the factor explaining the determinants of share price. Over time, new factors such as inflation, money supply, industrial production have been added to explain the determinants of equity pricing.

From literature review, a few major conclusions are derived. First, the various theories do not provide a unique concept or measure of share price movement. A standardized set of macroeconomic variables is not found. The variables selected by researchers tend to differ slightly across studies, depending on the researchers' judgment, experimentation and data availability.

Second, inconsistent results are obtained with regards to which variables significantly affects the stock market. The results have been mixed with some studies finding strong evidence of predictive ability for a given variable, while others find no evidence for the same variable. It can be conjectured that the use of different methods and sample period could have accounted for the fragmented empirical findings.

Third, the predictive ability of certain macroeconomic variables with respect to stock returns is unstable over time, subject to structural changes in the economy and stock market or the impact of financial crises. The absence of a systematic relationship among the variables since the early 1990s could mean that the economy's structure or fundamentals have change (such as the shift from manufacturing into financial services and the rapid advances in technology). The upswings and downswing in stock prices since the mid-1990s may come from non-fundamental factors or irrational exuberance. Alternatively, the macroeconomic policies may have no noticeable impact on the equity market because the market has learned to anticipate future policy moves.

Fourth, although there is no theoretical consensus on the interaction between macroeconomic variables and share price, variables such as exchange rates, industrial production, interest rates play a vital role in establishing the linkage between them. Little was discussed in the previous empirical study on which variables have been more influential in predicting share prices.

The cointegration approach has been used by many researchers to analyze the relationships between economic variables and stock markets. Since its introduction in the 1980s, there has been a noticeable tendency to shift from the classic regression testing approach to cointegration technique as the method is useful in investigating both the long-run and short-run dynamic relationship. The usefulness of Johansen's framework is also widely recognized for analyzing stock market and macroeconomic activity as it incorporates dynamic co-movements or simultaneous interactions, allowing the researchers to study the channels through which macroeconomic variables affect asset pricing.

Considering the conflicting theoretical perspective on the relationship between macroeconomic variables and share prices, a few notable research gaps are identified for this study. First, a wider range of macroeconomic variables can be incorporated in the study to have a more comprehensive coverage. Second, the change in economic structure, external environment as well as numerous stock market crashes and

financial crises over the last two decades may have altered the relationship between macroeconomic variables and share price. Therefore, it is crucial to reexamine the relationship using more recent data and across different sub-periods.

The theoretical models used to explain the behaviour of share prices in Malaysia is presented in Figure 1. This study draws on asset pricing, economic theory and empirical evidence from the literature. The model builds on and extends the work of Chen, Roll and Ross (1986), Mukherjee and Naka (1995), Habibullah and Baharumshah (1996), Abdul Rahman et al. (2009) to examine the influence of macroeconomic variables on share prices. This study identifies a broader set of variables that are hypothesized to jointly affect share prices. The model constructed captures the impact of domestic macroeconomic variables and global factors on share prices in Malaysia.

The macroeconomic variables included in this model were selected based upon the present value model and arbitrage pricing theory. All the essential factors that may directly or indirectly affect the expected returns and subsequently affect the stock prices are analyzed. These variables have also been commonly used in previous empirical studies to examine the theoretical links between share prices and economic activity. This research draws upon theory and existing empirical studies to choose a number of macroeconomic variables that are expected to be strongly related to the stock market index. The rationale for the selection of variables is essentially based on financial theory and investor's intuition as asset pricing theories do not specify the underlying economic forces or systematic risk factors that drive securities prices [see (Chen, Roll, & Ross, 1986); (McMillan, 2005); (Mukherjee & Naka, 1995)].

It is impossible for a theoretical model to capture all fundamentals that will potentially influence share prices. Therefore, it is unavoidable that a model will provide only a limited scope for dealing with the subject matter. In addition, empirical analysis depends on the availability of data. There is a limitation in long-run macroeconomic data availability, mainly due to changes in the reporting format by statistical database provider. This restricts considerably the data that can be used.

Fig. 1: Conceptual Model

As the economic environment often varies considerably over time, it is not prudent to assume that the parameters of a model are constant. It is important to consider structural break, which can be defined as a change in the level or the slope of a time series. Such a change may happen through relatively infrequent but important events such as oil shocks, wars, and changes in fiscal and other policy regimes, etc. (Wilson, Okunev, & Webb, 1998). These events may affect the economic environment of a country and change the nature of its relationships with various variables.

Structural change is pervasive in economic time series relationships. It can be quite perilous to ignore structural change as inferences about economic relationship can go astray, forecast can be inaccurate, and policy recommendations can be misleading (Hansen, 2001). Identification of structural breaks in the data is essential to avoid model misspecification and coefficient bias.

The inclusion of structural change in the unit root test allowing for both the intercept and trend shift is important. Such inclusion can improve the reliability of econometrics tests and consequently, improve the accuracy of statistical inference [(Cheong, 2008), (Harvie & Saleh, 2006)]. Also, the test can identify the timing of major structural breaks in the variables by determining endogenously the more likely time of structural breaks. A review of the literature suggests that no other studies have been conducted taking the trend breaks into account in cointegration analysis of stock market.

3. Data Analysis

This study uses monthly time series data spanning from January 1990 to December 2013, totaling 288 observations for each variable. This study extends the previous literature by using the latest data and examining a time frame across two major financial crisis periods (1997 and 2007). As there is no study done during the period concerned, it is not documented whether the established relationships remain unchanged during the last two decades. Therefore, this research is of great interest as the findings may provide a new perspective on the analysis of the Malaysian stock market.

Over a decade or more, the long-run relationships may be affected by structural shifts emanating from changes in the policy regime and the general economic development (Dhal, 2009) (Chou, Ng, & Pi, 1994). To determine for possible structural changes in the dynamic linkages between variables over time, unit root tests with single as well as multiple structural breaks are used.

The data is collected from International Financial Statistics (IFS), Bloomberg and various issues of the Bank Negara Annual Report. The information on stock prices, exchange rates, interest rates, oil prices is available on a continuous basis without informational lag. On the other hand, monthly macroeconomic data, such as the consumer price index, the industrial production index and money supply is available two months after the period covered. To ensure comparability of all series and to place all variables on an equal footing, observations that are available at the end of a given month are assigned to the sample month. The detail of each variable is described in Table 1.

Table 1: Symbol of Variables, Source and Definition

	Symbol	Variable	Source	Definition
1.	klci	Kuala Lumpur Composite Index	Bloomberg	A capitalization-weighted index comprising of the 30 largest companies by market size.
2.	cp	Consumer Price Index	IFS series code: 54864...ZF…	A measurement of the general price level.
3.	ex	Exchange rate	IFS series code: 548..AE.ZF...	US Dollar per Ringgit, official rate, end of period.
4.	ip	Industrial production	IFS series code: 54866...ZF...	An economic indicator that measures real production output, which includes manufacturing, mining and utilities. The index number has a base year of 2005.
5.	lr	Average lending rate	IFS series code: 54860..ZF…	The average lending rate of commercial banks, measured as percent per annum.
6.	ms	Money supply M3	IFS series code: 54859MC.ZF...	Broad money supply M3.
7.	op	Oil price	IFS series code: 11276AAZZF….	Petroleum price in US dollar per barrel based on UK Brent

				Average.
8.	djia	Dow Jones Industrial Average	Bloomberg	A price-weighted index that consists of 30 major US companies.

This research hypothesizes a negative relationship between share prices and consumer price indices, average lending rates and oil prices. For the exchange rates, industrial production, money supply and the US stock market index, we hypothesize a positive relationship with share prices.

The series are computed as natural logarithm. The variables must be positive in order to undergo logarithm transformation. Thus, the model can be expressed as:

$$Y = (\ln klci, \ln cp, \ln ex, \ln ip, \ln lr, \ln ms, \ln op, \ln djia)$$

(Equation 1)

Where, Y is a 8 x 1 vector of variables.

Based on standard time series econometric techniques, the data analysis is conducted in steps. Correlations, unit roots and cointegration tests are employed in the preliminary analyses of data to ensure proper specification of models. This is then followed by the analyses of error correction model, impulse response function and variance decomposition.

As a starting point, a graphic illustration of all the variables of study is presented in Figure 2. A brief review of their long-term trend is also provided. The Malaysia share prices experienced significant uptrend in 1993, 1999, 2007 and 2009. However, the stock market went through four major downturns, which were the 1994 capital outflow, 1997 Asian Financial Crisis, 2000 Dot-com bubble and 2008 subprime mortgage crisis. For the year 1993, the stock market experienced a remarkable bull run in the history of Malaysia with KLCI appreciating by 98% annually. This was followed by a major correction in 1994 following the unprecedented 1993 bull-run. KLCI dropped by 36% in 1994. The market experienced the most severe loss of nearly 80% of its value between March 1997 and August 1998 during the Asian financial crisis. An uptrend resumed in 1999 with the imposition of capital controls on September 2, 1998 and corresponded with the recovery from Asian Financial Crisis. The bursting of the information technology bubble in 2001 affected the share prices in Malaysia. Between February 2000 and January 2001, KLCI declined by 40%, in tandem with the global downturn. The stock market boom from April 2006 to December 2007 corresponded with a period of rising commodity prices. The KLCI experienced a severe downturn with the onset of the subprime mortgage crisis that began in August 2007 in the US. In 2008, KLCI declined by 45% due to the contagion effect from the US subprime crisis and the unwinding of foreign funds from various markets. The Malaysian stock market started to recover from the Global Financial Crisis in October 2008 with the KLCI experiencing a sharp recovery of 83% increase over a period of 21 months.

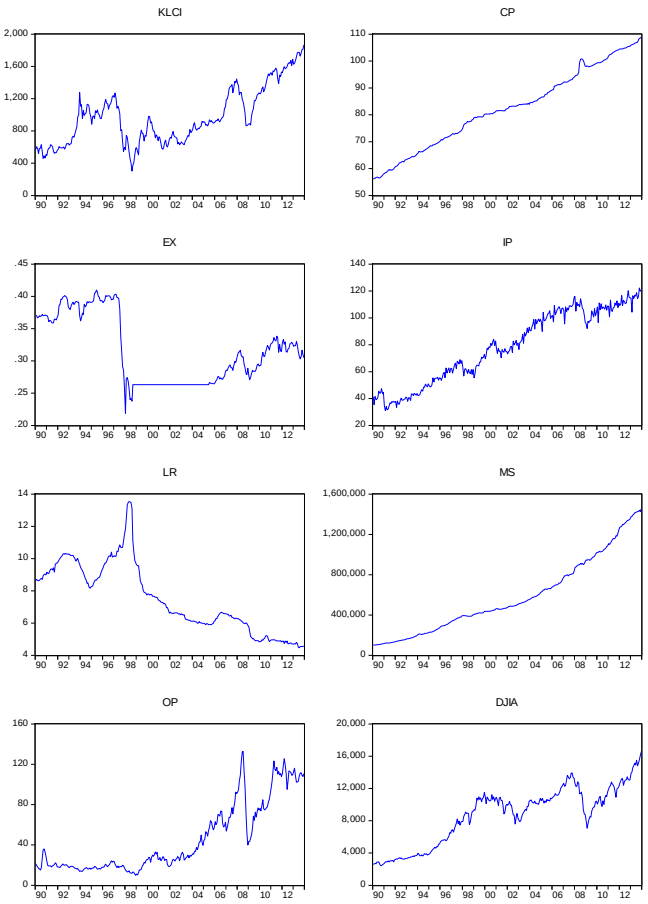

Fig. 1: Key Variables of the Study

3.1. Unit Root Tests

To test for stationary and to determine the order of integration of each series, both Augmented Dickey-Fuller and Phillips-Perron unit root test are employed. [(Dickey & Fuller, 1981); (Phillips & Perron, 1988)]. Three variations of unit root tests (no trend or intercept; an intercept; and an intercept and a linear time trend) are conducted to account for the possible trend components in the series. The ADF test is based on the Schwarz Information Criteria (SIC) (Schwarz, 1978) up to a maximum lag length of 15. The results suggest that all variables of study are non-stationary at level and stationary at first difference. The only exception is money supply M3, which is stationary at level and first difference. The t-statistics of Augmented Dickey Fuller test at level and first difference are -4.03 and -9.59 respectively. As money supply M3 is stationary at level and first difference, M3 cannot be considered as the variable in the cointegration test due to its different order of integration.

It is worth mentioning here that Ibrahim and Aziz (2003) who have studied the Malaysian market for the period January 1977 - August 1998 suggest a broader monetary such as M3, but monthly data on M3 are available only from 1986 onwards. Since they required sufficiently long span of data sample to evaluate changing relations among variables, they use M2 for their purpose. Abdul Rahman et al. (2009) use money supply M2 and find it to be integrated of order 1. M2 comprises private sector holdings of currency and deposits with the commercial banks and the Central Bank including net negotiable certificates of deposit (NCDs) issued and Repos. The broader monetary aggregate, M3 is defined as M2 plus all private sector deposits (including Repos) placed with finance companies, merchant banks, discount houses and Bank Islam, but excluding placement of fund among these institutions (BNM, 1993). This study is therefore different from previous studies as M3 is used. Furthermore, M3 cannot be included in cointegration modelling due to its different order of integration.

As structural change is pervasive in economic time series relationships, it is important to test for possible structural breaks. Conventional unit root tests have low power and will likely find the series to be non-

stationary when in actual fact the series is trend stationary when the breaks are considered. This study uses the Zivot-Andrews (1992) and Perron (1997) unit root tests with structural break.

The results from ZA test (Table 2) show that all variables, except KLCI and the exchange rate are non-stationary. KLCI and the exchange rate, which contain a unit root based on conventional unit root test, become stationary after taking into account the existence of potential structural breaks in the series. The null hypothesis that the series contain a unit root without any structural break is rejected at 1% level. The results imply that both KLCI and exchange rate are trend-stationary process with a one-time break. The endogenously determined breakpoints occur on July 1997 and August 1997 for KLCI and the exchange rates respectively. The two break dates are very close and coincide with the Asian Financial Crisis.

Table 2: Zivot-Andrews (1992) Unit Root Tests

Indices	**T statistics**	**Break Point**	**Lag Length**
ln(klci)	-5.87***	1997M07	11
ln(cp)	-4.17	2001M01	1
ln(ex)	-8.92***	1997M08	0
ln(ip)	-4.29	2008M02	12
ln(lr)	-5.14	1998M09	2
ln(ms)	-4.65	1995M04	12
ln(op)	-5.05*	1999M03	1
ln(djia)	-3.44	1995M02	0

Note:

- The critical values are -5.57, -5.08 and -4.82 for 1%, 5% and 10% level of significance respectively.
- The symbol ***, ** and * denote significant at 1%, 5% and 10% respectively.

The results of Perron (1997) unit root test with structural break (Table 3) show that exchange rates are stationary with structural break on July 1997. The t-statistic of -8.89 is significant at 1% level. The null hypothesis of unit root with a structural break in both intercept and trend is rejected.

Table 3: Perron (1997) Unit Root Tests

	t-statistic	Chosen lag length	Chosen break point
ln(klci)	-5.91	11	1997M06
ln(cp)	-3.93	7	1999M12
ln(ex)	-8.89***	5	1997M07
ln(ip)	-4.38	12	2005M02
ln(lr)	-5.15	11	1998M08
ln(ms)	-4.67	12	1995M03
ln(op)	-4.45	10	1999M02
ln(djia)	-3.43	0	1995M01
1% critical value	-6.32		
5% critical value	-5.59		
10% critical value	-5.29		
Null Hypothesis: The series has a unit root with a structural break in both intercept and trend			

The Zivot and Andrew (1992) and Perron (1997) unit root tests with structural break show contradicting results. One important commonality is exchange rate is stationary with a structural break. In view of this finding, the exchange rates are removed from the cointegration equation.

Unit root tests with one structural break will lead to unreliable results if there are two structural breaks. It is important to conduct higher order test that account for two structural breaks to compare the findings. To accomplish this, the Lumsdaine and Papell (1997) unit root test with two structural breaks is conducted (Table 4).

Table 4: Lumsdaine and Papell Unit Root Tests

Description	TB1	TB2	t-statistic for α	p-value
ln(klci)	1998M09	2001M05	0.5556	0.5789
ln(cp)	2004M01	2008M08	-0.4828	0.6296
ln(ex)	1998M02	2007M05	4.8156***	0.0000
ln(ip)	2011M03	2011M05	-1.7005	0.0902
ln(lr)	2009M04	2010M12	-2.8656***	-0.0045
ln(ms)	2001M01	2005M04	0.8008	0.4239
ln(op)	1993M03	2008M10	-4.7658***	0.0000
ln(djia)	2002M10	2009M03	1.5521	0.1218

The results suggest that a unit root cannot be rejected for all ln(klci), ln(cp), ln(ip), ln(ms) and ln(djia). Exchange rates, average lending rates and oil prices are stationary as the t-statistics for α are statistically significant at 1% level. The corresponding time of the endogenously determined structural breaks for exchange rates are February 1998 and May 2007. The breakpoint in February 1998 occurs at the height of the Asian Financial Crisis and May 2007 corresponds to the refloating of ringgit.

To conclude, the results from conventional unit root tests and unit root tests with structural break are compared. The Augmented Dickey-Fuller and Phillips-Perron unit root tests allowing for no structural break cannot reject the non-stationary hypothesis for all variables except money supply at the 5% level of significance. The conventional unit root tests are biased in favour of acceptance of stationarity if structural breaks are ignored in long-run time series. When the Zivot and Andrews (1992) and Perron (1997) unit root tests which allows a one-time structural shift in the series is employed, both the results shows that exchange rates stationary. The endogenously determined structural break in exchange rates corresponds with the Asian Financial Crisis in 1997. This result is used as the basis for sub-period analysis. When allowance is made for multiple structural breaks, more variables, i.e. exchange rates, average lending rates and oil prices are found to be stationary.

3.2. Estimation of Lag Length

The estimation of the Johansen and Juselius (1990) VECM requires the specification of a common lag length. In practice, the unrestricted VAR model is first estimated and the lag length is ascertained from the Swartz Information Criteria (SIC) or the Akaike Information Criteria (AIC) (Raj & Dhal, 2009). Empirical studies generally prefer lower order lags, keeping in view the informational efficiency of stock markets [(Raj & Dhal, 2009); (Eun & Shim, 1989); (Hassan & Naka, 1996)].

Based on the unrestricted VAR model (Table 5), the SIC shows lower order lag length of one month. The AIC determines a somewhat higher lag length of three months. Thus, our subsequent empirical analyses are based on lower order lag length of one month. As most economic data is reported with a lag and share prices tend to be forward looking, the low lag order of one month is deemed appropriate.

Table 5: Lag Length Selection

	Number of Lags Based on Unrestricted VAR				
	1	2	3	4	5
Akaike information criterion	-24.1632	-24.4220	--24.4926*	-24.4242	-24.4531
Schwarz information criterion	-23.7807*	-23.7189	-23.4673	-23.0751	-22.7785
*denotes the lowest value Note: Variables included are ln(klci), ln(cp), ln(ip), ln(ms) and ln(djia)					

3.3. Testing for Long-Run Cointegrating Relation

The multivariate cointegration test of Johansen (1988) and Johansen-Juselius (1990) is used to test if a long-run equilibrium relationship exists among the variables. Johansen cointegration test can be used to determine the number of vectors, which are called the cointegrating ranks. The variables considered for cointegration test are ln(klci), ln(cp), ln(ip), ln(ms) and ln(djia), which are determined based on unit root test with structural break. Exchange rates, average lending rates and oil prices are excluded as the variable are stationary with structural break.

The model is as follows:

$$Y = (\ln klci, \ln cp, \ln ip, \ln djia)$$

With reference to the model of Engle and Granger (1987), Johansen (1991) and Johansen and Juselius (1992), the model in this study can be expressed as:

$$\Delta Y_t = \alpha + \beta_e ECT_{t-1} + \sum_{i=1}^{p} \beta_y \Delta Y_{t-i} + \sum_{i=1}^{p} \beta_1 \Delta X_{1_{t-i}} + \sum_{i=1}^{p} \beta_2 \Delta X_{2_{t-i}} + ... \sum_{i=1}^{p} \beta_k \Delta X_{k_{t-i}} + \varepsilon_t$$

(Equation 2)

Where,

Y represents share prices as the dependent variable

$X_{1,2,...n}$ represent macroeconomic variables that are integrated of order one

Δ denotes the first-difference operator.

ECT_{t-1} is error correction term lagged one period obtained from the underlying cointegrating regression. The error correction term captures the long-run equilibrium relationship.

$$ECT = Y - b_1 X_1 - b_2 X_2 - ... - b_k X_k$$

α is a constant term or intercept.

β is parameter to be estimated.

β_e denotes the speeds of adjustment of any disequilibrium towards a long-run equilibrium state (Engle & Granger, 1987). The series are cointegrated and exhibit long-run comovement when the β coefficient of error correction term is different from zero.

$\beta_{1,2,...k}$ are coefficients and expected to capture the short-run dynamics of the model. These coefficients show short-run causality when at least one of the coefficients is different from zero.

p is the lag length.

ε is the white-noise disturbance term with mean zero and constant variance.

When conducting the Johansen cointegration test, this study has allowed for a linear deterministic trend in the data. To avoid the risk of over-parameterization, lag length of 1 is used. The results for the trace

statistic and max-eigenvalue statistic are summarized in Table 6. At the 5% level of significance, both the Trace test and Maximum Eigenvalue test indicate 2 cointegrating vectors. Therefore, there is evidence that cointegration exists among stock prices and macroeconomic variables as the null hypothesis of no cointegration vector (r=0) is rejected at 5% significance level.

The results suggest that all variables are in the cointegration space, which means each variable moves along together in the long run and short run deviations will be corrected towards equilibrium. There is a common force that brings the variables together in the long run.

Table 6: Johansen Cointegration Test

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	P-value
None *	0.153320	103.9878	69.81889	0.0000
At most 1 *	0.092796	56.38813	47.85613	0.0065
At most 2	0.064571	28.53514	29.79707	0.0694

Trace test indicates 2 cointegrating equations at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	P-value
None *	0.153320	47.59968	33.87687	0.0007
At most 1 *	0.092796	27.85299	27.58434	0.0462
At most 2	0.064571	19.09041	21.13162	0.0942

Max-eigenvalue test indicates 2 cointegrating equations at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level

The evidence of cointegration carries several important implications. First, the market efficiency hypothesis is violated in a multivariate context. Second, it guarantees some significant Granger-causality in the system, at least in one direction. Third, the evidence of cointegration implies that possible arbitrage profits can be made, which is to say future fluctuations of the stock prices can be forecasted to some extent, using an information set provided by the macroeconomic variables (Ratanapakorn & Sharma, 2007).

These findings are consistent with the findings of Mukherjee and Naka (1995), Barus (1997), Lee (1997), Kwon and Shin (1999), Nasseh and Strauss (2000) and McMillan (2005), Alkhudairy (2008), Guttler et al. (2008), Hasan (2008), Liu and Shrestha (2008), Rahman and Mustafa (2008), Abdul Rahman et al. (2009) who find that stock returns and various macroeconomic variables are, to varying degrees, cointegrated, using either US or other international data. Nevertheless, these findings contradict the results of Habibullah and Baharumshah (1996), who report that stock indexes and macroeconomic variables, in particular money supply and national output are not cointegrated in Malaysia using monthly data from 1978 to 1992. As the sample period (1991-2012) in this research is subsequent in timing, it is not surprising to find different results as various changes have taken place over time. In addition, the inclusion of a structural breaks and dummy variables has resulted in different findings.

The normalized cointegrating equation can be expressed as:

$$\ln(klci) = \underset{(3.13)}{13.61}\ln(cp) - \underset{(-0.81)}{0.54}\,n(ip) - \underset{(-2.27)}{2.67}\ln(ms) + \underset{(1.11)}{0.38}\ln(djia)$$

Note: t statistics in parentheses ( ).

(Equation 3)

The cointegrating equation indicates that consumer price indexes and US share prices are positively related to overall share prices. In contrast, industrial production and money supply are negatively related to share prices. The corresponding coefficients are 13.61, -0.54, -2.67 and 0.38 for ln(cp), ln(ip), ln(ms) and ln(djia) respectively. The relationships are theoretically grounded. Since a double logarithmic functional form is used here, the coefficients can be interpreted as long-term elasticity. Based on t statistics, only consumer price index and money supply are statistically significant at 5% significant level.

The result shows that consumer price index influences share prices positively. The results can be interpreted as share price serves as a hedge against inflation in Malaysia. Malaysia has a long tradition of price stability and historically enjoyed a benign inflation environment due to its stable exchange-rate regime and macroeconomic policies. A key feature affecting the transmission of inflation in Malaysia is the administered price mechanism. The prices of some essential goods are administered by the Government. Price administered items constitute about 30% of the CPI basket. In general, there are two types of price administered items. The first group comprises of items listed under the Price Control Act (1946), where the Government determines the retail prices for these goods. Examples of these items would be fuel and sugar. The second group are items that require Government approval for changes to be made on their prices. For example, electricity tariff and public transport fares (BNM, 2010). With the administered price mechanism in place, the impact of supply shocks and external price developments on domestic prices is less direct and less immediate.

Share prices in Malaysia are negatively related to the level of real economic activity. This results contradict with the findings of Fama (1990), Geske and Roll (1983), Chen et al. (1986), Lee (1992), Mukherjee and Naka (1995), McMillan (2005), Ratanapokorn & Sharma (2007), Agrawalla & Tuteja (2008), Abdul Rahman et al. (2009). Theoretically, the level of aggregate economic activity may influence stock prices through its impact on cash flows and corporate profitability. An increase in outputs may increase cash flows and hence raise stock prices. However, this is not the case in Malaysian stock market. The Malaysian stock market does not seem to makes rational forecast of the real sector. A possible explanation is Industrial production index is reported with a time lag and share price may be a leading indicator of real economic activities and productivity.

A negative relationship exists between money supply and share prices in the long run in Malaysia. Money supply fluctuations can affect the stock market through their effect on inflation uncertainty, and through a policy anticipation mechanism. The findings of this research contradict with Mukherjee and Naka (1995), who find a positive long-run relation in Japan, and Maysamin and Koh (2000) in Singapore. The results support the findings of Ibrahim and Aziz (2003), who find a negative long-run association between stock prices and M2 money supply in Malaysia.

US share price is positively related to KLCI. The results support the notion that US stock market, as a major stock market in the world, can affect smaller and less-developed markets. US stock market index is one of the most widely tracked index by investors worldwide. The results support the findings of Maysami & Koh (2000), Baharumshah, Sarmidi & Tan (2003), Kurihara and Nezu (2006), Chen, Wang & Shaki (2009).

The cointegration relationship of the variables is further investigated on a sub-period basis to capture the evolving relations during the past two decades. The methodology employed in this study considers the data frequency and availability. As monthly data is used, the sample data is divided into 5-year sub-periods, which consist of 60 series in each variable of study. This method allows for the examination of the evolving pattern of dynamic interactions among stock prices and macroeconomic variables under changing financial condition in Malaysia (Ibrahim and Aziz, 2003). Although the exact start and finish dates of the underlying structural points of change are not easily identified, the split choice should ensure a clean separation of effects (Brailsford, Penn, & Terrell, 2006).

The results of sub-period analysis are presented in Table 7. The result indicates that long-run cointegrating relationships are not consistent over the 5 sub-periods.

Table 7: Cointegration Test by Sub-period

	Sub-periods			
	1991-1995	1996-2000	2001-2005	2006-2010
Number of Cointegrating Vector based on:				
Trace Test	1	0	1	2
Maximum Eigen Test	1	0	1	2
Normalized Cointegrating Relation:				
ln(cp)	-29.24* (-2.34)	9.36* (2.63)	6.15* (2.81)	1.19 (0.44)
ln(ip)	8.69* (6.81)	3.75* (6.64)	1.48* (4.65)	5.41* (4.42)
ln((ms)	4.62 (1.60)	-6.75* (-4.60)	-1.88* (-3.20)	0.34 (0.54)
ln(djia)	-4.47* (-2.47)	3.53* (3.75)	0.67* (5.85)	0.15 (0.37)
Note: t statistics in ( ), * denotes significant at 5% level.				

For sub-period 1991-1995, the number of cointegrating vectors is found to be 1 based on both Trace Test and Maximum Eigen Test. Macroeconomic variables are cointegrated with share prices. In early 1990s, Malaysia, as an emerging market experienced high economic expansion averaged 8.7%. Malaysia stock market had attracted the interest of international investors seeking an expansion of their investment portfolio, as evidenced by the record bullish market in 1993. Based on the normalized cointegrating equation, US share prices are negatively related to Malaysian stock prices. The results could be interpreted as Malaysian stock market exhibited different characteristics and offered diversification benefits from those in developed stock markets.

The markets may have experienced structural change after the Asian Financial Crisis. The trace test statistics show that the number of cointegrating vectors reduced to 0 for sub-period 1996-2000. The strength of the cointegration between macroeconomic variables and share price appears to have disappeared. The result suggests that the Asian Financial Crisis seems to create irregularity in the cointegration between share prices and macroeconomic variables. The results suggest that share prices are not affected by macroeconomic variables and the spreading of the Asian financial crisis can be attributed to contagion effect.

After year 2000, the cointegrating relations strengthened over time. The number of cointegrating vector increased from 1 in sub-period 2001-2005 to 2 in sub-period 2006-2010.

Comparison of the sub-periods reveal that the impact of the Global Financial Crisis is was not as severe as compared to the Asian Financial Crisis. The stability of the cointegrating relation had increased. This finding is sufficient to conclude that macroeconomic variables could have supported Malaysia stock market during the sub-period 2006-2010, despite the occurrence of Global Financial Crisis. Clear evidence points to decoupling hypothesis.

Industrial production is found to have a consistent positive impact on share prices throughout all sub-periods. The beta coefficient of 8.69 indicates that the magnitude of influence was the strongest for sub-period 1991-1995. During the period 1991-95, the economy grew strongly at 8.7% per annum, driven by private investment in the manufacturing sector. Provision of various incentives to the private sector, especially since the late 1980s, had contributed to rapid economic growth.

The Consumer Price Index has a negative impact on share prices for sub-period 1991-1995. The beta coefficient in the cointegrating equation for sub-period 1991-1995 is -29.24. The early 1990s was characterized by high inflation above 3% in the wake of several years of buoyant economic expansion. The result indicates that high inflation rate has a negative impact on share price. However, after 1996, the consumer price index has a positive impact on share prices. Stock investment serves as a good hedge against inflation. It is noteworthy to mention that after the Asian Financial Crisis, Malaysia has enjoyed a benign inflation environment. In the early 2000s, inflation rate moderated to very low levels below 2% as the demand and supply pressures that characterised the 1990s dissipated. Inflation began rising in 2005, reaching a peak of 8.5% in July 2008 driven mainly by higher global commodity and food prices. A key feature affecting the transmission of inflation in Malaysia is the administered price mechanism. The prices of some essential goods are administered by the Government According to BNM (2010), with price administered items constituting 29.3% of the CPI basket. With the administered price mechanism in place, the impact of supply shocks and external price developments on domestic prices is lesser. For sub-period 2006-2010, the beta coefficient of CPI weakened to 1.19 and not significant at 5% level.

Money supply has a positive impact on share prices for sub-period 1991-1995. The role of money supply in influencing stock prices has become negative after 1996. Money supply grew rapidly at 15%-20% in the early 1990s following the strong growth in economic activity, increased lending to private sector, as well as high domestic interest rates amidst low rates abroad. The money supply growth in 1993 which was accelerated by unprecedented influx of foreign fund on a large scale, as well as the subsequent response to the short-term capital controls introduced by the Bank Negara Malaysia in the first quarter of 1994 have a destabilizing impact on the stock market. After the Asian financial crisis, the major trust of monetary policy was directed at strengthening economic recovery and maintaining financial stability. The accommodative monetary policy was able to provide the foundation for the strengthening of economic fundamentals. In mid-2000s, monetary policy focused on managing liquidity situation and maintaining orderly condition in the financial markets. Most of the surplus liquidity was sterilised through the conventional money market, which accounted for 79.6% of the total operations (BNM, 2006). As a result, the impact of shock in money supply on share price weakened.

US share prices were negatively related to Malaysian share prices during 1991-1995. After 1996, the relationship changed to positive and US factor has become significant in influencing the movement of KLCI. Domestic investors have become more aware of the economic interdependencies of international markets and therefore react to the developments in US markets. For sub-period 2006-2010, the influence of US on Malaysian stock market weakened, as shown by the beta coefficient of 0.15 which is not statistically significant at 5% level. The results can be inferred as a sign of decoupling. The impact of the slowdown in the US and the continual strength of growth in Asia could have help to weather the adverse consequences of a US slowdown and eased the impact of stock market downturn in Malaysia. As a consequence, it can be argued that local macroeconomic factors, rather than global stock market of US are the primary source of share prices variation in Malaysia. This may suggest that the impact of the global financial crisis of 2008 on the Malaysia stock market would have been much more severe if it were not for the macroeconomic strength built up after the Asian financial crisis.

3.4. Testing for Short-Run Dynamic Interaction

As a cointegrating relationship among stock prices and macroeconomic variables has been determined, the causal relationship between these variables can be investigated in the context of an error correction model. In this model, the first differences capture the short-run dynamics movement of share prices while the error correction term captures the partial adjustment that macroeconomic variables exert on share prices. The

error correction term can be interpreted as a measure of the deviation from long run relationships. It shows the speed at which adjustment occurs in long-run equilibrium.

The error correction model with one lag is constructed to explore whether lag changes in macroeconomic variables can Granger-cause stock prices. The lag length is selected using the Schwarz Information Criterion based on unrestricted vector autoregression.

The model of this study reveals that Malaysia share prices are efficient in terms of its auto correction in the short-run over the entire sample period. The coefficient of error correction term on dln(klci) of -0.06 is negative and statistically significant at 5% level (Table 8), which further substantiate the presence of cointegration among macroeconomic variables and KLCI. The result indicates that current KLCI adjusts to previous equilibrium errors. Based on the speed of adjustment, 6% of variation is adjusted in the following month. The results suggest that the disequilibrium in the short run is only partially corrected in subsequent month.

Table 8: Vector Error Correction Model

Dependent Variable: DLN(KLCI)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.0011	0.0060	-0.1839	0.8543
RESID01(-1)	-0.0605	0.0190	-3.1757	0.0017
D(LN(KLCI(-1)))	0.0975	0.0654	1.4906	0.1372
D(LN(CP(-1)))	1.0208	1.1103	0.9194	0.3587
D(LN(IP(-1)))	-0.0983	0.0795	-1.2362	0.2174
D(LN(MS(-1)))	0.1891	0.4153	0.4552	0.6493
D(LN(DJIA(-1)))	0.1298	0.1080	1.2013	0.2306

Although the linear combination of all variables is cointegrated, none of the macroeconomic variables are influential in the short-term in terms of causality. Most of the macroeconomic variables (consumer price index, industrial production, money supply and US share prices) do not lead changes in share prices in the short-run, despite a cointegrated long-run relationship. There is no evidence of causality running from macroeconomic variables to share prices. This finding carries important implication as investors cannot make use of the lead and lag relationship between macroeconomic data and share prices to predict stock returns in the short-term.

This finding concurs well with the findings of Lee (1997) and Ratanapakorn and Sharma (2007). Lee (1997), in his study of the stock markets of the Pacific Basin countries, notes that even if there is a long-run equilibrium relationship between macroeconomic policies and stock prices, stock prices do not necessarily adjust quickly and fully to the changes in either monetary or fiscal policy in the short run. Ratanapahorn and Sharma (2007) report that macroeconomic variables in US Granger-cause stock prices in the long-run but not in the short-run.

To conclude, macroeconomic activities have weak explanatory power on stock market movements in the short-run as stock prices are not affected by the lag information from such variables. There is hardly any significant short-term interaction between macroeconomic variables and share prices.

There are a few possible explanations to such phenomenon. First, macroeconomic variables could have affected the share prices contemporaneously where market participants promptly react to the release of new information. Investors could have formed their expectation based on future forecast, rather than past information. An important factor is the time lag in the reporting of macroeconomic data, where data are available one or two months after the period covered. Only share prices, oil prices, exchange rates and interest rates are available on a continuous basis. Empirical evidence shows that changes in share prices precede movement in macroeconomic variables. For example, during the Global Financial Crisis, KLCI

started to fall in December 1997 and hit a trough of 835 point on 9 December 2008. The weakness in the economy and the contraction in real GDP were only shown in 2009. The first, second and third quarter of 2009 registered contraction in real GDP of -5.8%, -3.7% and -1.1% respectively.

Second, stock prices may follow a random walk in the short-term (Ratanapakorn & Sharma, 2007). Share price movement can be triggered by reasons unexplained by macroeconomics, perhaps being due to a shift in market sentiment, the contagion effect, herding behaviour, and a change in the risk tolerance of investors or even changes in the perception and interpretation of certain information. Share price movement may also be triggered by local and neighbouring country news. The results may suggest that the influence of macroeconomic fundamentals in the short run may be overshadowed by non-fundamental issues.

Lastly, stock market booms and busts in emerging economies like Malaysia can be related to capital flows. Such information is not captured by macroeconomic variables in the short-term.

3.5. Generalized Impulse Response Function

Next, the generalized impulse response function (GIRF) from the VECM is constructed to simulate how KLCI reacts to its own shocks and shocks from macroeconomic variables. In this study, the directional responses of KLCI to a one standard deviation shock of macroeconomic variables are traced up to 60 months, which are equivalent to 5 years. The results are shown in Figure 3.

The results show that a shock to macroeconomic variables leads to a permanent long run impact on KLCI. Macroeconomic influences on share prices are not transitory but persist permanently into the long run.

The effect of a shock to DJIA, money supply and the consumer price index are positive throughout the next 60-month time horizon. On the other hand, a shock on industrial production has a negative impact on KLCI. IRF illustrates greater influence of DJIA on Malaysian stock index, indicating external factor is more important than domestic economic indicators. The results also show that the impact of consumer price index is stronger over time.

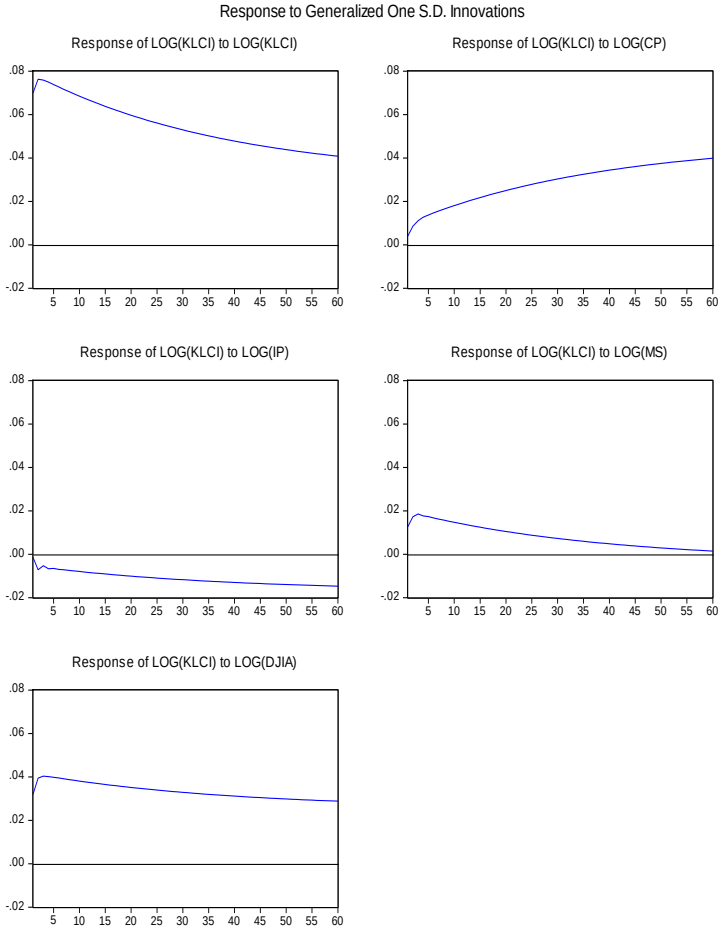

Fig. 2: Generalized Impulse Response Function

3.6. Variance Decomposition Analysis

Lastly, a variance decomposition analysis (VDC) is used to evaluate the relative influence of random innovations of each macroeconomic variable on share prices. VDC procedure involves the decomposition of forecast error variance of each variable into components attributable to its own innovations as well as to shocks of other variables in the system. The variable that is explained mostly by its own shocks (and not by others) is deemed to be exogenous. The results for 1 month to 60 months are reported to identify the relative importance of each innovation in affecting share prices over the short-term and long-term.

The variance decomposition based on the Cholesky factor can change dramatically the ordering of the variables in the VECM is altered. In this study, the ordering of the variables is determined by Generalized Impulses as described by Pesaran and Shin (1998). In this way, an orthogonal set of innovations that does not depend on the ordering can be constructed.

The results are reported in Table 9. The result shows the 77% of the error forecast variance of KLCI is attributable to its own variations up to 1 month. Share prices are relatively exogenous because very little of KLCI is explained by other macroeconomic variables in the short-term. A main conclusion is that share prices in Malaysia are more dependent on themselves than macroeconomic variables. Macroeconomic variables are not a significant source of volatility in equity market in short periods, especially those below 3 months. Shocks in the short-term may not be related to real economic activity. These finding is consistent with the empirical evidence found by vector error correction model.

Nevertheless, the results indicate an increasing percentage of the explanatory component of the variance of macroeconomic variables towards KLCI for periods up to 12 months. After 12 months, 65% of the error forecast variance in KLCI is explained by its own shock. For a one year period, stock prices are explained by macroeconomic fundamentals as the underlying volatility inherent in share prices related to macroeconomic movements. Share price movement is difficult to predict in the short-term but macroeconomic fundamentals will reveal the economic fundamentals over the long-run.

Table 9: Variance Decomposition Analysis

Period	LN(KLCI)	LN(CP)	LN(IP)	LN(MS)	LN(DJIA)
1	76.87497	0.311434	0.076509	1.916735	20.82036
2	72.25743	0.789873	0.541445	2.573385	23.83787
3	70.09312	1.225036	0.516221	2.980961	25.18466
4	68.86788	1.609828	0.565932	3.071153	25.88520
5	67.99505	1.946179	0.585819	3.116979	26.35598
6	67.32012	2.261473	0.613966	3.112706	26.69174
7	66.74904	2.566020	0.638559	3.091133	26.95525
8	66.24229	2.867896	0.664318	3.055718	27.16978
9	65.77513	3.170837	0.689644	3.013073	27.35132
10	65.33403	3.477301	0.715232	2.965345	27.50809
11	64.91021	3.788570	0.740846	2.914556	27.64582
12	64.49812	4.105409	0.766591	2.861785	27.76809
24	59.79325	8.347772	1.079902	2.232476	28.54660
36	55.17136	13.09097	1.385551	1.738551	28.61357
48	50.77846	17.86787	1.666398	1.391406	28.29587
60	46.77575	22.37476	1.914859	1.159405	27.77522
Cholesky Ordering: LN(DJIA) LN(MS) LN(CP) LN(IP) LN(KLCI)					

The results indicate that innovations in US share prices have the largest impact (20.8%) on the error forecast variance in KLCI up to a 1-month period. Among the monthly variables studied, DJIA is the most influential variable on share prices in Malaysia, followed by money supply. For a one month period, money

supply contributes 2% to the error forecast variance in KLCI. The results show that macroeconomic variables can explain a small percentage of the variance in share prices and the predictive power is higher for longer time periods.

4. Conclusion

The findings show that KLCI and macroeconomic variables (consumer price index, industrial production, money supply and US share price) are cointegrated in Malaysia for the period 1990-2013. The presence of cointegration means these variables share common trends or long-run equilibrium relationships and do not drift too far apart from each other over time. In addition, cointegration provides firm evidence that macroeconomic variables are significant factors in explaining long-run equity price movement. As stock prices are affected by macroeconomic variables, informational inefficiency of the stock market exists. Thus, potential investors can use macroeconomic information as an indicator of share price movement over long run. The cointegrating equation indicates that consumer price indexes and US share prices are positively related to overall share prices. On the other hand, industrial production and money supply are negatively related to KLCI. The long-term impact of macroeconomic variables on share prices is supported by generalized impulse response functions, which show that a shock to macroeconomic variables leads to a permanent long run impact on KLCI. Macroeconomic influence on share price is not transitory but persists permanently.

As for short-run dynamic interaction, macroeconomic variables have weak explanatory power on stock market movement. None of the macroeconomic variables are influential in short-term causality. This finding carries important implication as investors cannot make use of the lead and lag relationship between macroeconomic data and share prices to predict stock return in the short-term. Malaysia share prices are not significantly affected by lagged information from macroeconomic variables. A possible explanation for this is that macroeconomic variables might have affected the share prices contemporaneously where market participants react promptly to the release of new information or form their expectation based on forecasts. These results are supported by the Variance Decomposition Analysis, which shows that KLCI is exogenous in 3 months but there is a higher explanatory component of the variances of macroeconomic variables towards KLCI for periods of 12 months. Among the macroeconomic variables, the US stock market index is the most consistent and reliable predictors of stock returns in Malaysia.

The nature of the relationship between macroeconomic variables and share prices has changed over time. Structural breaks have been detected for KLCI and exchange rate. The break dates coincide with the Asian Financial Crisis. The results show that the Asian Financial Crisis had a major impact on the interactions between macroeconomic variables and share price over the long run in Malaysia. Comparison of sub-periods shows that the number of cointegrating vectors has strengthened in recent years.

The nature of the relationships between macroeconomic variables and share prices change over time. Industrial production is found to have a consistent positive impact on share prices. The Consumer Price Index has a negative impact on share prices in early 1990s but the influence is positive after 1996. Money supply has a positive impact on share prices in early 1990s but the influenced of money supply on share prices has weakened over time. US share prices were negatively related to Malaysian share prices during 1991-1995. After 1996, the relationship changed to positive and US factor has become more significant in influencing the movement of KLCI.

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