**A Homoscedastic Co-integration Analysis of the Malaysian Equity Market**

**Dr. Mohamed Ibrahim Mugableh\***

\*Department of Financial and Banking Sciences,College of Administrative and Financial Sciences, Irbid National University, P.O Box: 2600−Zip Code: 21110, Jordan. Tel: +962790956497, email addresses: mugableh83@yahoo.com, mugableh83@gmail.com

**Abstract**

This article examined long-term relationships and dynamic links between Malaysian equity market and macroeconomic forces, including inflation rates, interest rates, money supply, and real economic activity. It employed the vector error correction model and annual time series for the 1977−2015 period. The empirical results show the existence of six co-integrating vectors, implying a long-term relationship between the selected variables. In addition, inflation rates and interest rates were shown to be negatively associated with Malaysian capital market. Money supply and real economic activity were found to be positively related to Malaysian capital market. However, the sample resulted in several observations during the economic and financial crises periods which influence the findings obtained from the regression.

**Keywords**

Equity market; Macroeconomics; Malaysia; Market Efficiency.

**JEL classification**

C32; E44; GI4; N95

**1. Introduction**

During the past decades, several studies have examined the relationships between macroeconomic variables and stock prices. For example, some studies examined the influences of individual factors such as inflation rate, interest rate, money supply, and real economic activity (See, *inter alia*, Fama, 1981; Fama and Gibbons, 1982; Fama and Schwert, 1977; Freidman and Schwart, 1975; Geske and Roll, 1983; Mundell, 1963; Tobin, 1969). Other studies have examined the relationship between stock prices and a wider variety of macroeconomic variables (e.g., Bekhet and Mugableh, 2012; Bjornald and Leitemo, 2009; Kizys and Pierdzioch, 2009; Laopodis, 2006; Nasseh and Strauss, 2000; Ratanapakorn and Sharma, 2007). Such studies focused on analysing the relationships between macroeconomic variables and capital markets in developed countries. However, less attention has been focused on examining these relationships in emerging countries. The current paper analyses the interactions between macroeconomic variables and stock prices in Malaysia. By employing the vector error correction model (VECM), this paper examines the long-term relationships and dynamic linkages between Malaysian capital market and macroeconomic variables − namely, inflation rates, interest rates, money supply, and real economic activity.

The development of the stock market is a milestone in Malaysia’s economic reform course. In 1977, the Kuala Lumpur Stock Exchange (KLSE) was formed and officially started operations. The capital market in Malaysia has been growing rapidly ever since. For example, in 1981, the domestic market capitalization was MYR343 million for KLSE; in comparison, the domestic market capitalization for KLSE in 2015 was MYR1.927 billion (World Federation of Exchange, 2015), indicating an approximately four-fold increase of domestic market capitalization in KLSE. In addition, the total number of listed companies (i.e., domestic and foreign companies) in 1981 was 253; this number increased dramatically to 980 in 2015 (World Federation of Exchange, 2015), again showing a four-fold increase.

In recent years, Malaysia has been attracting an increasing amount of international portfolio capital and foreign direct investment. For instance, in 1977, foreign direct investment flows into Malaysia totalled US$406 million; by 2015 they totalled US$410 million (World Bank, 2015). Nevertheless, not much is known about the behaviour of the Malaysian capital market.

Given the core differences and arguments in Malaysia’s stock market and economy, it would be of interest to examine the relationships between macroeconomic variables and the Malaysian capital market. Such a study could help Malaysian policy makers, investors, and academics to better understand the behaviour of investors in the Malaysian stock market while shedding light on market efficiency.

Utilizing VECM, this paper found a long-term relationship between the Malaysian capital market and selected macroeconomic variables − namely, inflation rates, interest rates, money supply, and real economic activity. In addition, inflation and interest rates were found to be negatively associated with the Malaysian capital market while money supply and real economic activity are positively related to the Malaysian capital market. These results suggest that investors must hold for the long run in order to benefit from portfolio diversification in the Malaysian capital market.

The rest of the paper is organized as follows. Section (2) reviews the literature on the relationships between macroeconomic variables and stock prices. Section (3) describes the data and methodology used in the paper. Section (4) reports the results and discussions. Finally, concluding remarks and some discussion of the results are provided in Section (5).

**2. Review of Literature**

The relationships between macroeconomic variables and stock prices are important to policy makers and investors. The efficient market hypothesis theory, developed by Fama (1970) suggested that current stock prices should reflect all publicly available information and the expectations about future corporate performance. Corporations’ profits generally depend on the level of economic activities. Real economic activities’ fundamentals, (i.e., gross domestic product, industrial production index, and gross national product) are the main components of macroeconomic variables and, influence stock prices positively. Fama (1981) concluded that the changes in macroeconomic variables − namely, interest rates, inflation rates, money supply, and industrial production index − are fully reflected in current stock prices. He only tackled the goods market variables (industrial production index and inflation rates) and the money market variables (money supply and interest rates), which are the most important variables in macroeconomic aspects.

Fama (1981) hypothesized a negative relationship between stock prices and interest rates. Fama and Schwert (1977) found a negative relationship between inflation rates and the U.S stock prices from 1953 to 1971. Fama and Gibbons (1982) and Geske and Roll (1983) confirmed Mundell’s (1963) and Tobin’s (1969) hypotheses that inflation rates are negatively related to stock prices. Freidman and Schwart (1963) argued that money supply positively influences economic cycles. The expansion of money supply stimulates the economy and increases the cash flow in public hands, thereby increasing the demand of stocks and their prices in the market (Wong et al. 2006, p. 32). In contrast to Freidman and Schwart’s (1975) study, Fama (1981) hypothesized a negative relationship between money supply and stock prices. An increase in money supply leads to increase interest rates which in turn decrease stock prices through inflation pressures. Fama (1981) hypothesized a positive relationship between stock prices and the industrial production index. In addition, Geske and Roll (1983) found a positive relationship between US stock prices and the industrial production index. The increase of output produced by corporations boosts the future cash flow and profits of corporations, thereby increasing corporations’ stock prices.

Several studies have examined the relationships between macroeconomic variables and stock prices using various dynamic time series models. Abugri (2008) employed the vector autoregressive (VAR) model to examine the impact of domestic and global macroeconomic variables on stock market indices of four Latin American countries: Argentina, Brazil, Chile, and Mexico. Using the same time series model, Bjornald and Leitemo (2009), Black et al. (2003), Kizys and Pierdzioch (2009), and Ratanapakorn and Sharma (2007) investigated the impact of macroeconomic variables on the US stock market index, (i.e., S&P500). By implementing VECM, Laopodis (2006) in the US, Maysami and Koh (2000) in Singapore, Muradoglu et al. (2001) in Turkey, Nasseh and Strauss (2000) in six European countries, (i.e., France, Germany, Italy, the Netherlands, Switzerland, and the UK), and Pal and Mittal (2011) in India examined the equilibrium relationships between various macroeconomic variables and stock market indices. The overall results showed that stock market indices were significantly influenced by various macroeconomic variables. By utilizing the generalized autoregressive conditional heteroscedasticity (GARCH) model, Rangel (2011) in the US and Vrugt (2009) in the US, Japan, Hong Kong, South Korea, and Australia investigated the impact of the conditional volatilities of macroeconomic variables on stock market indices’ volatilities, revealing that the conditional volatilities of macroeconomic variables explained the volatilities of stock market indices.

**3. Data and Methodology**

The current paper analyses the long-term relationships and dynamic linkages between Malaysian capital market and four macroeconomic variables: inflation rates, interest rates, money supply, and real economic activity. The time series data are based on annual figured from 1977 to 2015, establishing a small sample size of 36 observations. The analysis begins with 1977 due to the availability of time series data on the stock price index. The analysis ends in 2012 to obtain a long span of time series data. In addition, the sample includes several observations during the 1984−1985 commodity crisis, the 1997−1998 Asian financial crisis, and the 2008−2009 global financial crisis. These crises will influence the results obtained from the regression.

The present paper uses the Kuala Lumpur composite index (KLCI) to measure the performance of the Malaysian capital market. KLCI contains stocks for 30 of the largest companies from the main board through full market capitalization. Inflation rates (IFR) refer to consumer prices in terms of annual percentages. Interest rates are measured by the deposit interest rates (IR). The money supply is measured by the broadest monetary aggregate (M3). The M3 is the broadest type of money supply and is used as a proxy of the total monetary aggregates available in the Malaysian economy. The real economic activity is measured by the gross domestic product (GDP). Data on macroeconomic variables were obtained from (Bank Negara Malaysia, 2013) while the data on KLCI were obtained from (Bursa Malaysia, 2013). All variables were transformed into a natural logarithmic form, (i.e., LKLCI, LIFR, LIR, LM3, and LGDP).

Methodologically speaking, the regression results are likely to be spurious if the variables are non-stationary. The solution to the spurious phenomenon is to differentiate the variables and to use the co-integration mechanism. Nowadays, there are three models for implementing the co-integration mechanism: Engle and Granger’s (1987) two-step process, henceforth referred to as the vector autoregressive (VAR) model; Johansen and Juselius’s (1990) maximum likelihood process, hereafter referred to as the vector error correction model (VECM); and Pesaran, Shin, and Smith’s (2001) ordinary least square bounds F-statistics, henceforth referred to as the autoregressive distributed lag model.

The VAR model involves the estimation of one co-integrating vector rather than the VECM, which implies more than one co-integrating vector in the regression (See Eq. (1)).

zt = α + X1zt-1 + …. + Xi zt-h + εt, Xi (i= 1,… 9) (1)

Where, zt is the 5 × 1 vector of the selected variables, (i.e., LKLCI, LIFR, LIR, LM3, and LGDP). The series zt is stationary at level (i.e., *I(0)*) and is said to be co-integrated if the series εt is stationary at *I(0)*. α and εt are the 5 × 1 vector of intercepts and error terms, respectively. The Xi is a 5 × 5 matrix of parameters for the lag length (h). The h is obtained by using the Ackaike information criterion (AIC). However, Hamdi, Sbia, and Shahbaz (2014) argued that the AIC is superior and improves performance over the Schwartz information and Hannan−Quinn information Criteria in a small sample size. The VECM is applied if the co-integrating relationship in Eq. (1) is homoscedastic under the assumption that the series zt is stationary at the first differences, (i.e., *I(1)*). Thus, Eq. (1) can be turned as in Eq. (2).

 Xi (i= 1,… 9) (2)

Where, ∆ denotes the first difference operator; ∏zt denotes the full rank that is used to test the *H0* of no co-integration among variables. However, to test whether the co-integrating relationship in Eq. (1) is homoscedastic or heteroscedastic, the Lagrange Multiplier (LM) test proposed by Engle (1982) is employed on the residuals from Eq. (1). If the LM test implies the existence of a homoscedastic (equal variance (σ2) of (εt)s) co-integrating relationship, VECM can be employed (See Eq. (3)).

 (3)

Where, ∆ is the first difference operator; αit [i= 1,…. 5] represents the intercept terms; βij [i,j= 1,…., 5] denotes the F-statistics coefficients to evaluate the causality directions in the short-run; ζit [i= 1,…. 5] signifies the t-statistics coefficients of equilibrium error terms (EETt-1)s that are used to evaluate the causality directions in the long-run; and εit [i= 1,…. 5] are the disturbance terms.

In contrast, if the LM test indicates the existence of a Heteroscedasticity (unequal (σ2) of (εt)s) co-integrating relationship, the GARCH (1,1) model can be employed (See Eq. (4) and (5)).

zt = α + X1zt-1 + …. + Xpzt-p + εt, εt|Ωt-1 ~ ND (0, ht) (4)

ht = ϛ0 + ϛ1ht-1 + ϛ2ε2t-p, (5)

**4. Results and Discussions**

*4.1. Lagrange multiplier test*

Table 1 demonstrates that the null hypothesis (*H0*) of heteroscedastic co-integrating relationship for the residuals in Eq. (1) is rejected as the F-statistics probability value (i.e., 0.1378) and the chi-square (χ2) probability value (i.e., 0.1171) are greater than 10 per cent. Thus, based on Engle’s (1982) argument with regard to either accepting or rejecting the *H0* of the Heteroscedasticity co-integrating relationship, Brooks (2008) argued that, if the F-statistics and the χ2 probabilities values are greater than 10 per cent, the *H0* of the Heteroscedasticity co-integrating relationship would be rejected.

**Table 1**

Langrage multiplier test results.

|  |  |  |  |
| --- | --- | --- | --- |
| F-statistics | 1.96*\** | Probability. F-Statistics (q = 3,36) | 0.1378 |
| T × R2 | 5.89*\** | Probability. χ2(q = 3) | 0.1171 |

**Notes:** (1) T is the number of observations. (2) R2 is the squared residuals. (3) The LM statistic test is asymptotically distributed F-statistics (q = 3) and chi-Square ((χ2 (q = 3)) with the freedom degrees q equal to the number of lags in the regression. As such, the LM statistic test is calculated using 3 lags. (4) The LM statistic test was performed using E-views econometric software package version 7.2.

*4.2. Unit root test*

The previous step confirmed the existence of the homoscedastic co-integrating relationship, (i.e., the usage of VECM), but the unit root test was still performed to determine if the variables are stationary at *I(1)*. The results of Elliott, Rothenberg, and Stock’s (1996) test showed that all the variables are stationary at *I(1)* (See, Table 2). Specifically, the variables LKLCI and LGDP are stationary at the 10 per cent level of significance. The variables LIFR and LM3 are stationary at the 5 per cent significance level. The variable LIR is stationary at the 1 per cent significance level.

**Table 2**

Unit root test results.

|  |  |  |  |
| --- | --- | --- | --- |
| Stationarity | Variables | ERS P-test statistics | ERS asymptotic critical values |
| 1% | 5% | 10% |
|  | LKLCI | 2.81 |  |  |  |
|  | LIFR | 3.31 |  |  |  |
| I(0) | LIR | 3.65 |  |  |  |
|  | LM3 | 3.85 |  |  |  |
|  | LGDP | 4.10 | 4.22 | 5.72 | 6.77 |
|  | LKLCI | 10.39*\*\*\** |  |  |  |
|  | LIFR | 5.82*\*\** |  |  |  |
| I(1) | LIR | 4.25*\** |  |  |  |
|  | LM3 | 5.77*\*\** |  |  |  |
|  | LGDP | 6.80*\*\*\** |  |  |  |

**Notes:** (1) \*, \*\*, \*\*\* denote the significance at the 1%, 5%, and 10% levels, respectively. (2) Four bandwidths employed using Parzen Kernel. (3) The analysis conducted using intercept and linear time trend. (4) The output of Elliot, Rothenberg, and Stock’s (ERS) test extracted from E-views econometric software package version 7.2.

*4.3. Co-integration test*

The earlier step checked the variables’ stationarity levels and found that all the variables are stationary at *I(1)*. Therefore, VECM will be employed to test the long-term equilibrium relationships among the selected variables. Table 3 shows that three lags were selected using Schwartz, LR, and Akaike information criteria. The number of lags should equal the degrees of freedom in the LM statistic test (Engle 1982, p. 998).

**Table**

Lag length selection tests results.

|  |  |  |  |
| --- | --- | --- | --- |
| Lag length | LR | Schwartz information criterion  | Akaike information criterion  |
| 0 | n.a. | 20.10 | 20.87 |
| 1 | 179.13 | 17.25 | 16.08 |
| 2 | 19.73 | 16.82 | 15.96 |
| 3 | 11.90*\** | 16.59*\**  | 15.91*\** |

**Notes:** (1) n.a. = not available. (2) LR = likelihood ratio. (3) \* denotes the optimal lag length. (4) The lag length selection tests were conducted using Micro-fit econometric software package version 4.1.

Table 4 demonstrates the existence of a long-term equilibrium relationship among the variables− namely, LKLCI, LIFR, LIR, LM3, and LGDP. The trace statistics indicate six numbers of co-integrating vectors exist at the 5 per cent significance level. The trace statistics values are greater than their 5 per cent critical values. These results are consistent with the results obtained for Malaysia (Ibrahim, 1999; Ibrahim and Aziz, 2003). However, the next step is to analyse the coefficients of the selected variables (See, Table 5).

**Table 4**

Co-integration test statistics for LKLCI.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| No. of co-integrating vectors | Trace statistics | λ max | 5% Critical values | P-values*\*\** |
| None, r = 0 | 80.40*\** | 0.80 | 77.22 | 0.00 |
| At most 1, r ≤ 1  | 71.22*\** | 0.77 | 66.53 | 0.00 |
| At most 2, r ≤ 2 | 60.55*\** | 0.66 | 55.44 | 0.00 |
| At most 3, r ≤ 3 | 55.89*\** | 0.51 | 51.22 | 0.00 |
| At most 4, r ≤ 4 | 48.22*\** | 0.45 | 40.35 | 0.00 |
| At most 5, r ≤ 5 | 33.51*\** | 0.33 | 22.10 | 0.01 |

**Notes:** (1)r is the number of co-integrating vectors. (2) \* represents the significance at the 5% level. (3) \*\* (Mackinnon et al. 1999, p. 570). The output of co-integration test statistics extracted from E-views econometric software package version 7.2.

*4.4. VECM analysis*

Table 5 indicates that the coefficient of the error-correction term (ecmt-1) is -0.84, with an accurate sign and high significance at the 1 per cent level. However, the ecmt-1 coefficient implies that any disequilibrium in the LKLCI of 2012’s shock would shortly be adjusted back to the long-run equilibrium in the current year (i.e., 2013).

**Table 5**

VECM results for LKLCI (dependent variable).

|  |  |  |  |
| --- | --- | --- | --- |
| Independent variables | Coefficients | t-ratios | P-values |
| ∆LIFR | -1.82*\** | -11.87 | 0.01 |
| ∆LIR | -2.33*\** | -15.89 | 0.00 |
| ∆LM3 |  3.10*\*\** | 6.78 | 0.03 |
| ∆LGDP |  2.87*\*\** | 7.86 | 0.04 |
| ecmt-1 | -0.84*\** | -3.60 | 0.00 |
|  | Diagnostic tests |  |  |
| R2 | 0.81 |  |  |
| F-statistics | 12.79*\** |  | 0.00 |

**Notes:** (1) \*, \*\* denote the significance at the 1% and 5% levels, respectively. The output of VECM results extracted from Micro-fit econometric software package version 4.1.

Table 5 implies that ∆LIFR is negatively associated with LKLCI. The increase of inflation rates leads to decreased purchasing power, which in turn decreases stock prices and vice versa. These results are similar to the results obtained for the US (Fama and Gibbons, 1982; Fama and Schwert, 1977; Geske and Roll, 1983). In addition, the results are confirmed with Mundell (1963) and Tobin (1969) hypotheses that inflation rates are negatively related to stock prices. Yet the results contradict the results obtained for Malaysia (Ibrahim and Aziz, 2003; Khil and Lee, 2000). ∆LIR is negatively related to LKLCI. The increase of deposit interest rates decreases money supply, which in turn decreases stock prices and vice versa. These results confirmed Fama’s (1981) hypothesis, which implied a negative relationship between stock prices and interest rates.

In addition, Table 5 shows that ∆LM3 is positively associated with LKLCI. Money supply has a double-edged effect on stock prices. The increase of money supply leads to increased purchasing power that in turn increases stock prices. Moreover, Cheung and Ng (1998) and Dhakal et al. (1993) argued that the acceleration of money supply in the economy increases share prices through portfolio adjustments. However, if the increase in money supply is uncertain, then it might generate high inflation rates, which in turn decrease stock prices. The results are consistent with Freidman and Schwart’s (1963) argument that money supply positively influences economic cycles, which in turn increases share prices. Furthermore, the paper results are consistent with results obtained for Japan (Mukherjee and Naka, 1995), and Singapore (Maysami and Koh, 2000). In contrast, the paper findings are not similar to the results obtained for the US (Fama, 1981), or Malaysia (Ibrahim and Aziz, 2003). ∆LGDP is positively related to LKLCI. These findings are similar to the findings obtained for the US (Fama, 1990; Geske and Roll, 1983), South Korea (Kwon and Shin, 1999), and Malaysia (Ibrahim and Aziz, 2003). The increase of output produced by the firms induces their cash flows, profits, and share prices.

**5. Concluding Remarks**

The current paper investigated the long-term relationships and dynamic interactions between the Malaysian capital market and four macroeconomic variables: inflation rates, interest rates, money supply, and GDP. The analysis focused on testing the homoscedastic co-integration relationships on the residuals from the selected variables regression. In addition, this paper employed Elliott, Rothenberg, and Stock’s stationarity test to determine if the variables are stationary at *I(1)*. Using VECM, long-term relationships and dynamic associations between the Malaysian capital market and macroeconomic variables were computed.

The paper’s findings suggest several implications related to monetary transmissions, market efficiency, and the dynamic interactions between macroeconomic variables and the Malaysian capital market. The presence of six co-integrating vectors indicates long-term predictability of the Malaysian capital market in relation to the macroeconomic variables. Thus, the Malaysian stock market is connected with its economic indicators. The selected macroeconomic variables are positively and negatively associated with the Malaysian stock market. Inflation and interest rates are negatively related to the Malaysian capital market while M3 and GDP are positively associated with the Malaysian stock market. The responses of the Malaysian capital market to the changes in macroeconomic variables imply evidence of the weak form of market efficiency. The Malaysian capital market index has a one unit root (i.e., stationary at *I(1)*), which implies that KLCI changes randomly. This result is consistent with the weak form of market efficiency (See, Chaudhuri and Smiles, 2004; Hatemi-J and Morgan, 2009).

The associations between the Malaysian capital market and macroeconomic variables provide several policy implications. The paper’s findings raise some questions on the implementations of monetary policies to achieve the stability of the financial system in Malaysia. Stock prices in Malaysia seem to increase over time as interest and inflation rates decreases while M3 and GDP increases. Malaysia’s central bank has to balance the amount of M3 in the Malaysian economy, which increases inflation rates. The increases of inflation rates lead to the instability of the financial system in Malaysia.

Using the VECM analysis, three dummy variables were included to capture the effects of the 1997−1998 Asian financial, 2008−2009 global financial, and the 1984−1985 commodities crises. It is worth mentioning that these crises exerted short-term irregularities in the associations between macroeconomic variables and the Malaysian stock market. Thus, a large sample of time series data is needed to avoid short-term irregularity in future research.

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