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Modeling the Relationship between KLCI and Monetary Policy after the 1997 Asian Financial Crisis

Model Hubungan antara KLCI dan Polisi Kewangan selepas Krisis Kewangan Asia 1997

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ABSTRACT

Using Johansen multivariate cointegration test with structural break and Granger-causality based on vector error correction model, the interactions between stock prices (KLCI) and monetary policy variables (M1, M2 and interest rate) are examined in the Malaysian setting using monthly data for the post 1997 Asian financial crisis period from January 2000 to May 2008. Four major conclusions can be drawn from the results. First, evidence of significant cointegration relationships prevails only when structural break is considered in the models. Second, among the monetary variables, only interest rate (money market rate, MM) has a direct short-run relationship with stock prices whereas the relationships between monetary aggregates and stock prices are indirect through MM. Third, all three monetary variables consistently show long-run impacts on stock prices. Fourth, between the two monetary aggregates, M2 consistently prevails as an effective monetary policy tool whereas M1 fails to assume such function. The policy implication of this study is that Bank Negara Malaysia can rely on interest rate rather than money supply as short-term measure to manage the stock market more effectively. However, in the long-run, both interest rate and money supply (specifically M2) can be relied upon to monitor the stock market condition. Investors in the meantime may interpret results of this study as supporting evidence that the stock market in Malaysia is still inefficient. Accordingly, they should exploit new information triggered by changes in monetary policy stance to formulate their future investment strategy.

ABSTRAK

Menggunakan ujian kointegrasi multivariat Johansen dengan selaan struktur dan sebab-akibat Granger berdasarkan model pembetulan ralat vektor, interaksi antara harga saham (KLCI) dengan pemboleh ubah dasar monetari (M1, M2 dan kadar pasaran wang (MM)) dikaji di Malaysia menggunakan data bulanan bagi tempoh selepas krisis kewangan Asia 1997 antara Januari 2000 hingga Mei 2008. Empat rumusan utama diperoleh daripada hasil kajian. Pertama, bukti mengenai hubungan kointegrasi dikesan hanya apabila selaan struktur diambil kira dalam model. Kedua, di kalangan pemboleh ubah monetari, hanya kadar faedah (MM) mempunyai hubungan jangka pendek secara langsung dengan harga saham manakala hubungan antara agregat monetari dengan harga saham adalah secara tidak langsung melalui MM. Ketiga, ketiga-tiga pemboleh ubah monetari secara konsisten menunjukkan kesan jangka panjang ke atas harga saham. Keempat, antara dua agregat monetari, M2 secara konsisten menyerlah sebagai mekanisme dasar monetari yang efektif manakala M1 gagal melaksanakan fungsi tersebut. Implikasi dasar dari kajian ini adalah Bank Negara Malaysia boleh bergantung kepada kadar faedah berbanding penawaran wang sebagai mekanisme jangka pendek untuk menguruskan pasaran saham secara efektif. Walau bagaimanapun, dalam jangka panjang, kedua-dua kadar faedah dan penawaran wang boleh diharapkan untuk mengawal selia kedudukan pasaran saham. Para pelabur sementara itu boleh mentafsirkan hasil kajian ini sebagai bukti sokongan bahawa pasaran saham di Malaysia masih belum cekap. Sehubungan itu, mereka harus mengeksploitasi maklumat baru yang tercetus daripada perubahan dasar monetari untuk merangka strategi pelaburan masa depan.

INTRODUCTION

In attempt to establish evidence about the effectiveness of monetary policy in stabilizing the condition of stock market in developing economies, this study models the relationship between monetary policy variable and stock prices in Malaysia. The proposition that monetary policy can be an effective tool to monitor stock market condition is in essence constructed based on the underlying formulation of share prices. That is, embedded in monetary policy are its major tools which are interest rate and money supply. Standard stock valuation models such as the

dividend growth model (Gordon 1959) posits that the intrinsic value of common stocks be determined by rate of return and expected cash flows. So does the arbitrage pricing theory (Ross 1976) which argues that macroeconomic variables such as interest rate, inflation and output drive changes in share prices. Based on similar theories, previous studies generally argue that macroeconomic variables which have influence on future cash flows and required returns would therefore have impact on share prices. The importance of monetary policy in determining prices of stocks becomes a focal point in recent studies particular after recent discoveries (eg. Cassola & Morana 2004; Ioannidis & Kontonikas 2008; Sourial 2002) which suggest that stock market has also been playing an important role in transmitting monetary policy separate from the traditional balance sheet and bank lending channels.

This study is motivated to re-visit the monetary policy-stock prices relationship in the aftermath of the infamous 1997 Asian financial crisis because of several reasons. First, the 1997 Asian financial crisis has unveiled the fact that Malaysian economy is exposed to global factors as much as it is exposed to local factors. Thus, it raises a question on whether the current monetary policy which claimed to have been adjusted to address such changes is effective in playing its role. This includes the capital control measures in 1998 which involves pegging the Ringgit to the U.S. dollar in order to minimise the impact of external shocks on domestic economy. Another example is the package of broad-based pro-growth measures in 2003 which was introduced to battle against the adverse global environment and concerns over further weakening of the already sluggish global economy as well providing immediate relief for the SARS-affected sectors. Second, the results of this study will verify the finding by a recent study in Singapore which associates the same crisis with the missing link between monetary policy variable and stock prices (Wong, Khan & Du 2005). Similarly in Malaysia the same crisis has been suspected to cause irregularities in the interactions between the two variables (Ibrahim and Aziz 2003). Third, this period also witnesses a series of external shocks which to a great extent present a threat to Malaysian economy in its recovery progress. These shocks include the Iraq war, political changes in the U.S, September 11 terrorism attack, Afghanistan war, Tsunami, and pandemics. To a greater extent, there is also a notable shock to the world economy when oil prices rose sharply to USD69.91 per barrel on 30 August 2005. Fuel prices continued to rally in the days ahead that until the of this study period, the price was as high as USD132.99 per barrel on May 21, 2008 (U.S. Energy Information Administration 2008).

During this period of weak external environment, the Malaysian monetary policy was set in ways such that it continues to remain accommodative to support domestic growth while at the same time mitigate the adverse impact from the global economic slowdown on the Malaysian economy. Money supply (M1) has been allowed to expand during this period and at a faster pace after 2007 (Bank Negara Malaysia 2008). The low inflationary environment as well as global easing of interest rates has enabled the government to ease monetary policy to support its larger fiscal stimulus without putting pressures on prices and wages. Interest rates remain low while ample liquidity continues to prevail in the financial system, reflecting the easier monetary stance.

Fourth, the external shocks that had adversely affected the Malaysian economy had to a great extent caused the stock market to sail on rough surfaces. As depicted in Figure 1, the performance of Bursa Malaysia (as indicated by Kuala Lumpur Composite Index (KLCI)) had indicated a good sign of a recovery process. However, the KLCI was quickly plummeting as soon as it reached 969.96 points in March 2000, apparently in tandem with the developments in major world and regional bourses. The declining performance of the Bursa Malaysia in the first three quarters of 2001 could be clearly attributed to the weaker investor sentiment due to concerns over the global economic slowdown as well as the September eleven attack on the U.S. Over the next five years from 2003 to 2007, the KLCI had been rather steadily growing at a compound annual growth rate (CAGR) of 16.2 percent. Somewhat consistent with the expansionary monetary policy in place, 2007 was an exceptionally great year for the Malaysian stock market as it achieved an all time high of 1,447 points in December (the previous high of 1,315 points was recorded in 1994). The stock market rallies however were disrupted by the beginning of 2008 as the Malaysian stock market witnessed bouts of volatility due to unstable global financial market which owed a lot to the U.S recession due to sub-prime crisis.

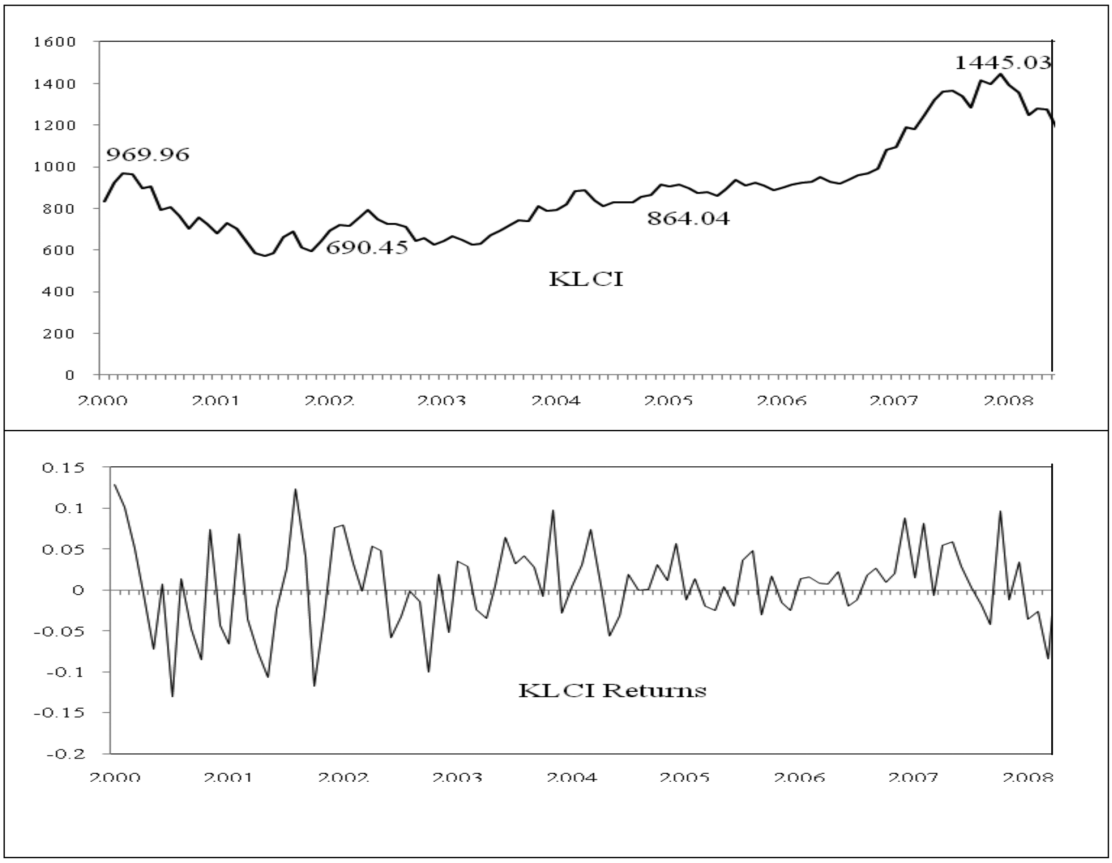

FIGURE 1. Plots of stock prices (KLCI) and movements (KLCI returns) in the aftermath of the 1997 Asian financial crisis

In this study, we use M1, M2 and money market rates to represent the monetary policy stance and examine its relationship with stock prices (KLCI) within the Johansen multivariate cointegration and Granger-causality based the vector error correction model (VECM) frameworks. In addition to bringing evidence from the more recent period (January 2000 to May 2008), it deviates from the previous studies on Malaysian setting (Abdul Rahman, Mohd Sidek & Tafri 2009; Habibullah & Baharumshah 1996; Ibrahim & Yusoff 2001; Ibrahim & Aziz 2003; Yusof, Majid & Razali 2006; Wongbangpo & Sharma 2002) by incorporating structural breaks in its analyses. The results of this study can be summarised as follows. First, evidence of significant cointegration relationships which initially failed to be detected prevails in the sub-sample and whole sample periods when structural break is considered in the models. Second, among the monetary variables, only interest rate (money market rate or MM) has a direct short-run relationship with stock prices whereas the relationships between monetary aggregates and stock prices are indirect through MM. Third, all three monetary variables consistently have long-run relationships with stock prices. Fourth, between the two monetary aggregates, M2 consistently prevails as the more effective monetary policy tool than M1 given its significant relationship with stock prices.

The remainder of this paper is structured as follows. Section 2 reviews the existing theories and literature on the issue. Section 3 presents the data and methodology, section 4 reports and discusses the results and section 5 concludes and discusses the implications.

LITERATURE REVIEW

The real tests on the effectiveness of a certain monetary policy should ideally be judged based on its impact on macroeconomic variables such as inflation, real output and employment (Ioannidis & Kontonikas 2006). However, probably because the impacts on these variables are at best indirect, a large volume of past studies tend to examine the effectiveness of monetary policy through its impact on stock market for several valid reasons.

Ioannidis and Kontonikas (2006) attribute it to the efficiency of stock market in reflecting new information and to the close monitoring of stock prices. Their arguments support that of Sourial (2002) who conjecture that stock market reflects the macroeconomic condition. Casolla and Morana (2004) and Bennaceur, Boughrara and Ghazouani (2007) in the meantime suggest that it is because the changes in stock prices may have destabilising effects on economy, whether or not such changes are induced by fundamentals.

In most studies that model the relationships between monetary policy and stock prices, monetary policy variables are normally tested along with other major macroeconomic variables including output, inflation rate and exchange rates. As almost naturally the case on any issue, most evidence that has been established in the literature is the result from investigations in developed countries (e.g. Chen, Roll and Ross (1986), Darrat (1990), Fama (1981)), French, Schwert and Stambaugh (1987), Mukherjee and Naka (1995), Geske and Roll (1983), Lee (1992), Leigh (1997) and Bulmash and Trivoli (1991)). However, some recent studies have extended the analysis to the cases of developing economies. The list includes studies by Fung and Lie (1990), Kwon and Shin (1999), Gjerde and Seattem (1999), Achsani and Strohe (2002), Gan, Lee, Yong and Zhang (2006) and Abugri (2008).

Theoretically, there should be a negative relationship between money supply and stock prices because as money growth rate increases, the inflation rate is expected to increase. Increases in price level raises firm's production costs which in turn reduces its future cash flows which consequently reduces the value of its stocks. However, there are equally strong arguments for a positive relationship which are supported by an explanation that an increase in the money supply stimulates the economy, the main part of which is contributed by the increases in corporate earnings. This explanation is consistent with the argument which relates interest rate as the price of money. That is, increases in the supply of money reduce its price (interest rate) which subsequently increases firms' ability to afford new capital. Both explanations lead to an increase in firms' future cash flows, present value of which should be reflected in higher stock prices.

In general, the empirical evidence seems to be more inclined toward the latter argument. That is, the positive relationship between money supply and stock returns have been documented in Fama (1981), Mukherjee and Naka (1995), Maysami and Koh (2000), Kwon and Shin (1999) and Bulmash and Trivoli (1991). Other evidence suggests money supply-stock prices relationship in a more general manner. Masih and Masih (1996) for instance find that being the most exogenous of all, money supply (particularly M1) appears to have played the leading role of a policy variable. Meanwhile, the other macroeconomic variables (output, rate of interest, exchange rate, and prices) appear to have borne most of the brunt of short-run adjustment endogenously in different proportions in order to re-establish the long-run equilibrium. Similarly, Kwon and Shin (1999) find the Korean stock markets are cointegrated with the money supply, in addition to production index, exchange rate, and trade balance. So does the study by Mookerjee and Yu (1997) which discovers significant interactions between money supply (M2), foreign exchange reserves and stock prices.

Unlike money supply, the opinions on the predicted relationship between interest rate and asset prices are more in consensus. An increase in interest rate which would commonly increase the required rate of return would decrease the share price. A common explanation is that an increase in interest rate would raise the opportunity costs of holding cash, and the trades off to holding other interest-bearing securities would lead to a decrease in share price (Rigobon & Sack 2002). Empirically, French *et al.* (1987) document that stock returns respond negatively to both the long term and short term interest rates. So do Achsani and Strohe (2002) who examine the relationship in the Indonesian setting and find that stock returns respond negatively to changes in interest rate. Without denying the relationship, Allen and Jagtianti (1997) indicate that the interest rate sensitivity to stock returns has decreased dramatically since the late 1980's and the early 1990's because of the invention of interest rate derivative contracts used for hedging purposes. In a more inconclusive manner, Bulmash and Trivoli (1991) find that the U.S. current stock price is positively correlated with the federal rate (in addition to the previous month's stock price, recent federal debt, recent tax-exempt government debt and long-term unemployment rate) but negatively correlated with the Treasury bill rate and the intermediate lagged Treasury bond rate. Maysami and Koh (2000) indicate significant contribution of interest rate and exchange rate in the long-run relationship between Singapore's stock prices and various macroeconomic variables.

A large bulk of the past studies includes both money supply and interest rates to represent monetary policy stance. This includes a study by Gan *et al.* (2006) which finds that stock prices in New Zealand is consistently determined by the interest rate and money supply as well as real GDP. Similarly is a study by Wongbangpo and Sharma (2002) which investigates the role of selected macroeconomic variables (GNP, the consumer price index, the money supply, the interest rate, and the exchange rate) on the stock prices in five ASEAN countries. The study finds a negative long run relationship between stock prices and interest rates in Philippines, Singapore, and Thailand but, a positive relationship in Indonesia and Malaysia. It argues that the high inflation rate in Indonesia and Philippines influences the long run negative relationship between stock prices and the money supply, while the money growth in Malaysia, Singapore and Thailand provokes the positive effect for their stock markets.

In the Malaysian context, there are a few notable studies including those by Habibullah and Baharumshah (1996), Ibrahim and Yusoff (2001), Wongbangpo and Sharma (2002), Ibrahim and Aziz (2003), Yusof et al. (2006) and and Abdul Rahman *et al*. (2009). In a study which objective is to examine the informational efficiency of the stock market (measured by both market and sectoral indexes) in Malaysia, Habibullah and Baharumshah (1996) employ cointegration analyses which incorporate real output and money supply (M1 and M2). The results indicate that for the period of January 1978 to September 1992, there is no evidence of cointegration relationships among the variables. Because cointegration indicates predictability of the stock prices, its absence is interpreted as evidence for an efficient market, in the long run. Ibrahim and Yusoff (2001) take a slightly broader approach in that they analyze dynamic interactions among four macroeconomic variables (real output, price level, money supply and exchange rate) and equity prices. Their results show that money supply exerts a positive effect on the stock prices in the short run but negatively in the long-run. When used to address the issue of market efficiency put forth by Habibullah and Baharumshah (1996), this evidence is a good indication that Malaysian stock market is still inefficient. This inference is somewhat supported by the evidence found in the more recent studies in Malaysia either those from the pre-crisis period (Wongbangpo & Sharma 2002; Ibrahim & Aziz 2003) or those from the post-crisis period (Yusof *et al*. 2006; Abdul Rahman *et al*. 2009).

Wongbangpo and Sharma (2002) study the relationships between stock prices and a set of selected macroeconomic variables (GNP, consumer price, money supply (M1), interest rate (money market rate) and exchange rate) for the period from 1985 to 1996 for the ASEAN-5 countries (Malaysia, Thailand, Indonesia, Singapore and Philippines). With regard to Malaysia, the results of their Johansen cointegration analyses indicate the stock prices are positively related to interest rates both in the short and long run. Meanwhile, the positive relationship between money supply and stock prices are explained by the expansionary policy adopted during the study period. These findings are further supported by the VECM results which show that variances in stock prices are accounted by innovations in interest rate and money supply. Ibrahim and Aziz (2003), whose study covers the pre-crisis period from January 1977 to August 1998, use cointegration and vector autoregression (VAR) approaches to examine the dynamic linkages between Malaysian stock prices and four macroeconomic variables (industrial production index, money supply (M2), bilateral exchange rate of MYR/USD and price level (CPI)). Their results suggest the presence of a long-run relationship between these variables and the stock prices and substantial short-run interactions among them. In particular, their study documents positive short-run and long-run relationships between the stock prices and two macroeconomic variables (M2 and CPI). With regard to the monetary policy variable, there appears to be immediate positive liquidity effects and negative long-run effects of money supply expansion on the stock prices. The former effects however fade away over time.

The remaining two studies cover the period after or including the 1997 crisis. The first by Yusof *et al*. (2006) investigates the extent to which macroeconomic variables affect the behavior of Malaysian stock market after the 1997 financial crisis period. By employing the autoregressive distributed lag (ARDL) model, they find results which suggest that in addition to real effective exchange rate and industrial production index, federal funds rate and money supply (M3) are effective monetary policy instruments to stabilize the stock market and to encourage more capital flows into the capital market. This finding is supported by the second study by Abdul Rahman *et al*. (2009) which spans the period of January 1986 until March 2008. Specifically, they find results from Johansen and VECM analyses which show that stock prices (KLCI)

is positively associated with price levels, reserves and interest rate (T-Bills rate).

DATA AND METHODOLOGY

This study employs monthly data of Kuala Lumpur Composite Index (KLCI), two monetary aggregates (M1 and M2) and money market interest rate (MM) for the period that spans from January 31, 2000 until May 30, 2008. The data of KLCI is obtained from Datastream, M1 and M2 are obtained from Bank Negara Malaysia while MM is obtained from International Financial Statistics. All data are transformed to natural logarithms prior to analysis. In investigating the short and long run relationships between stock prices and the monetary policy variables, two k-variable models are considered;

Four-variable model: $X_t = (KLCI_t, M1_t, M2_t, MM_t)'$

Three-variable models: $X_t = (KLCI_t, M1_t, MM_t)'$

$X_t = (KLCI_t, M2_t, MM_t)'$.

In our three- and four-variable models we apply the standard tests and then introduce structural breaks in the series in order to find out their possible impacts on the interaction between KLCI and selected monetary policy variables. In doing so, unit root with structural breaks, multivariate cointegration and cointegration with structural breaks model are used.

First, stationary tests which are Augmented Dickey–Fuller (ADF) (Dickey & Fuller 1981), Phillips-Perron (PP) (Phillips & Perron 1988) and unit root test with structural breaks are applied to determine the order of integration. This is because if a shift is detected in time series, then it should be taken into account in testing for a unit root. This is important because the ADF test may be distorted if the shift is simply ignored. Saikkonen and Lutkepohl (2002) and Lanne et al. (2002) have proposed the model in which a shift function, which is, $f_t(\theta)'\gamma$ is added in the equation;

$$y_t = \mu_0 + \mu_1 t + f_t(\theta)'\gamma + e_t, \quad (1)$$

where θ and γ are unknown parameters or parameter vectors and the errors e_t are generated by an AR(p) process. The shift function is defined as;

$$f_t^{(1)} = d_{1t} = \begin{cases} 0, & t \pi T_B \\ 1, & T \geq T_B . \end{cases} \quad (2)$$

The shift function, ft (θ)γ is a simple shift dummy variable with shift data T_B. Saikkonen and Lutkepohl (2002) and Lanne et al. (2002) have proposed unit root tests based on estimating the deterministic term by the generalised least squares (GLS) procedure and subtracting it from the original series. Thereafter an ADF-type test is performed on the adjusted series.

Second, Johansen multivariate cointegration (Johansen 1988, 1995; Johansen & Juselius 1990) and Vector Error Correction Model (VECM) are employed on our three-variable models ($X_t = (KLCI_t, M1_t, MM_t)'$ and $X_t = (KLCI_t, M2_t, MM_t)'$) and four-variable model ($X_t = (KLCI_t, M1_t, M2_t, MM_t)'$) to investigate the impact of structural breaks on the interactions between KLCI and the monetary policy variables. In Johansen's (1995) notation, a p-dimensional VECM can be written as;

$$\Delta y_t = \Pi^* \begin{bmatrix} y_{t-1} \\ 1 \end{bmatrix} + \sum_{j=1}^{p-1} \Gamma_j \Delta y_{t-j} + e_t, \quad (3)$$

where $[\prod: v_0^*)$ is $(K \times (K+1))$. The intercept can be absorbed into the cointegrating relations; thus $\prod^* = \alpha\beta^{*\prime}$ has rank r. The trace test is of the form:

$$LR(r_0) = -T \sum_{j=r_0+1}^{K} \log(1 - \lambda_j) \quad (4)$$

where the λ_j are the eigenvalues obtained by applying reduced rank regression techniques. If the presence of cointegration is confirmed, the Granger-causality test based on VECM is applied to examine the temporal causalities and long run adjustments of our variables.

EMPIRICAL RESULTS

To begin with, we perform stationary tests on all series using ADF, PP and unit root with structural break (UR_{SB}) test specifications, which include an intercept. Lag selection is based on Akaike Information Criterion. The results as reported in Table 1 indicate that all series are nonstationary in log levels but stationary in log first differences. Accordingly, all series are I(1) as they are stationary in first difference particularly according to PP and unit root with structural break test (UR_{SB}).

We proceed next to the Johansen multivariate cointegration analysis which we apply in three stages as follows (i) whole sample which ignores the existence of structural breaks, (ii) sub-sample period which is determined according to the structural breaks, and (iii) whole sample period

which incorporates the structural breaks. Applying the Johansen multivariate cointegration procedure in the last two stages seems necessary to draw a strong proposition about the significance of structural breaks in addressing similar issues on stock market. In this study, two structural breaks have been identified based on the patterns of KLCI (ln KLCI), namely July 2000 and December 2005. As depicted in Figure 2, KLCI had been slipping since the April 2000 but July 2000 marked the turning point of a series of significant declines in stock prices. This incident is consistent with the global and regional market slowdown which clearly spillovers to stock market in Malaysia. The structural break in December 2005 in the meantime marked another turning point, this time for the stock market rallies which went exceptionally well throughout 2007. The most apparent reason is the government decision to shift from a pegged to a managed float exchange rate regime. Accordingly, the sub-sample period in (ii) above runs from July 2000 until December 2005.

The results from Johansen multivariate cointegration analysis performed on three- and four-variables models for the whole sample period, the sub-sample period which is free from structural breaks as well as the whole sample period with structural breaks are presented in Table 2. The results indicate that in all three models, evidence of cointegration relationship between stock prices (KLCI) and monetary policy variables fails to be detected in the whole sample period. This result is consistent with that found in Habibullah and Baharumshah (1996) for the pre-crisis period. However, the remaining evidence is more consistent with the rest of the other studies done in Malaysia (Ibrahim & Yusoff 2001; Wongbangpo & Sharma 2002; Ibrahim & Aziz 2003; Yusof *et al*. 2006; Abdul Rahman *et al*. 2009). Specifically, when tested in the sub-sample period (2000M07 – 2005M12), the results consistently suggest that there is one cointegration relationship between the variables. The tests are repeated in the whole sample which

TABLE 1. Results of unit root tests

Variables	Levels			First Difference		
	ADF	PP	UR_{SB}	ADF	PP	UR_{SB}
KLCI	-0.511(2)	-0.379(0)	-1.791(1)	-6.912(1)*	-8.518(1)*	-6.591(0)*
M1	2.213(12)	1.028(6)	-0.042(2)	-2.318(1)	-9.325(6)*	-4.246(9)*
M2	1.942(1)	2.198(2)	-0.947(2)	-7.980(0)*	-8.133(4)*	-7.922(0)*
MM	-1.167(3)	-0.629(5)	-1.066(2)	-1.843(3)	-10.297(5)*	-4.161(2)*

Notes: Critical values for ADF with intercept for 1%, 5%, 10% are -3.503, -2.893 and -2.583. Critical values for Unit Root with Structural Break (UR_{SB}) and with intercept for 1%, 5%, 10% are -3.48, -2.88 and -2.58.

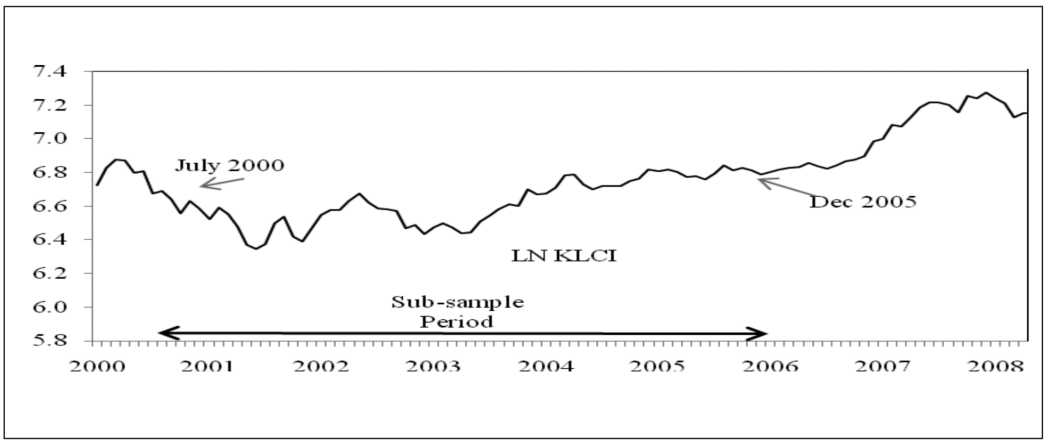

FIGURE 2. Plots of LN KLCI from January 2000 to May 2008

TABLE 2. Johansen cointegration test results

K-Variable Models	Lag	Trace	λ_{max}
4-Variable Model, $X_t = (KLCI_t, M1_t, M2_t, MM_t)'$			
Whole sample period: 2000M01 – 2008M05	4	No Coint.	No Coint.
Sub-sample period: 2000M07 – 2005M12	4	1 Coint. Vector*	1 Coint. Vector*
2000M01 – 2008M05 with structural break	2	1 Coint. Vector **	
3-Variable Model ($X_t = (KLCI_t, M1_t, MM_t)$			
Whole sample period: 2000M01 – 2008M05	4	No Coint.	No Coint.
Sub-sample period: 2000M07 – 2005M12	4	1 Coint. Vector*	1 Coint. Vector*
2000M01 – 2008M05 with structural break	2	No Coint.	
3-Variable Model $X_t = (KLCI_t, M2_t, MM_t)$			
Whole sample period: 2000M01 – 2008M05	4	1 Coint. Vector	No Coint.
Sub-sample period: 2000M07 – 2005M12	4	1 Coint. Vector*	1 Coint. Vector*
2000M01 – 2008M05 with structural break	2	1 Coint. Vector **	

Notes: Trace and Max-eigenvalue test indicates 1 cointegrating equation at the 0.05 level. Symbol ** LR test indicates 1 cointegrating vector at the 0.01 level. The structural break on July 2000 is based on the movement in KLCI.

includes the structural break. In general, the results confirm that found from the sub-sample period which suggests the existence of cointegration relationship between monetary variables and KLCI. Specifically, the significant cointegration relationship is detected in the four-variable model models ($X_t = (KLCI_t, M1_t, M2_t, MM_t)'$) and the three-variable model which includes M2 but omits M1 ($X_t = (KLCI_t, M2_t, MM_t)'$). In some sense, the results from the alternative three-variable models can be interpreted as suggesting that M2 is the better money supply variable for examining the relationship between monetary policy and stock prices (KLCI).

Once evidence of cointegration relationship is confirmed in our model, the Granger-causality test based on VECM is applied to examine the temporal causalities of our variables. The existence of a cointegrating relationship suggests that there must be Granger causality in at least one direction. Granger-causaility test in much sense compliments finding from cointegration tests because the cointegration relationship does not indicate the direction of temporal causality between the variables. In the remaining of this study, the VECM test is focused on the four-variable model. Table 3 provides results from examining the short run Granger causality within the error correction mechanism (ECM).

Prior to discussing the main results, it is worth noting that the diagnostic tests (reported at the bottom of Table 3) that are performed on the residuals of the VECM equations generally confirmed that the error terms are normally distributed, homoscedastic and not autocorrelated. So do the results of the CUSUM tests (Panel A in the Appendix) which verify the stability of the specified models. The results of CUSUM of squares (Panel B in the Appendix) which appear to run outside of the 5 percent bounds is somewhat expected due to the volatility of financial data.

The main body of Table 3 reports the χ^2 statistics on the explanatory variables in the equation which indicate the statistical significance of the short-run causal effects. The results indicate that there is no short-run relationship between monetary variables and stock prices (KLCI) except in the case of money market rate (MM). On the other hand, the significant χ^2 statistics for M1 and M2 in the MM equation suggest that M1 and M2 influence KLCI through MM in the short run. This finding to a certain extent is consistent with the t-value from the Error Correction Term (ECT) which indicates that all the three monetary policy variables have long-term relationship with stock prices.

TABLE 3. Granger causality based on VECM

Dep. Var.	Independent Variable								ECT	
	KLCI		M1		M2		MM			
	χ^2	Prob.	χ^2	Prob.	χ^2	Prob.	χ^2	Prob.	Coeff.	t
KLCI			2.587	0.274	4.503	0.105	13.42	0.001**	-0.0162	-1.540*
M1	0.094	0.953			0.645	0.724	0.216	0.898	-0.0003	-0.005
M2	0.016	0.991	0.578	0.748			0.223	0.894	0.0002	0.074
MM	1.370	0.503	9.461	0.008**	6.364	0.041*			0.0184	5.238**

Diagnostic statistics
Normality of distribution (Jarque-Bera) 1.427, Heteroscedasticity: ARCH 0.0712, White 0.473, Breusch-Pagan-Godfrey 1.367, Serial correlation (Breusch-Godfey) 0.866.

Normalised equation
Ln(KLCI) = -6.099ln(M1) + 1.767ln(M2) – 178.82ln(MM)
(11.44) (11.54) (29.78)

Notes: Asterisk (*) and (**) denote 5% and 1% significance level, respectively. Chi-square (χ^2) tests the joint-significance of the lagged values of the independent variables while t-statistics tests the significance of the error correction term (ECT).

The results from the ECT is also consistent with the long-run relationship between the monetary policy variables and stock price (KLCI) which is provided by the normalized equation reported at the very bottom of Table 3. The normalized equation which indicates the impact of explanatory variables on the dependent variables in the long-run shows that all the three variables have significant impact on stock prices in the long run. However, the signs of the coefficients indicate that only the impacts of M2 and money market rate (MM) are consistent with the theoretical intuition while that of M1 is counterintuitive. That is, the positive coefficient (1.767) of M2 correctly suggests that an increase in money supply (M2) is most likely to increase the market value of stocks. This finding is also consistent with that found by Ibrahim and Aziz (2003) but contradicts that found by Ibrahim and Yusof (2001), both of which are done for the pre-crisis period. Similarly, the negative coefficient on MM suggests that a reduction in interest rate (MM) is most likely to lead to an increase in stock market value. Earlier study by Abdul Rahman *et al.* (2009) found that the relationship is negative.

Consistent with our earlier finding from the Granger causality tests, the contradicting result between M1 and M2 again suggests that M2 is the better indicator of money supply compared to M1. This finding is further supported with the results from the Likelihood Ratio exclusion tests of Johansen (1991) on the four-variable model as reported in Table 4. The exclusion test examines the null hypothesis that each coefficient is statistically equivalent to zero in single cointegrating vector or that relevant variable does not belong to the cointegration relationship. The results confirm that M2 and MM belong to the cointegration relationship between monetary policy variables and stock prices but M1 does not.

CONCLUSION

This study models the relationship between monetary policy (M1, M2 and money market rates) and asset prices (KLCI) in the Malaysian setting for the post 1997 Asian financial crisis period from January 2000 to May 2008 by applying the Johansen multivariate cointegration test with structural breaks and Granger-

TABLE 4. Exclusion test (LR) results

Variables	M1	M2	MM
KLCI-M1-M2-MM	0.287	11.399**	7.485**

Notes: The exclusion test is a likelihood ratio test (Johansen 1991).

causality test based on vector error correction model (VECM). In order to eliminate the impact of structural breaks in our standard cointegration analyses, we define a sub-sample period which exclude period of structural breaks in addition to testing on a whole sample period which incorporates structural break. The results in general support the importance of introducing structural breaks in the analysis. That is, the results from the standard cointegration analyses (which do not incorporate structural break) indicate no evidence of cointegration relationships between the variables in both the four-variable (X_t = ($KLCI_t$, $M1_t$, $M2_t$, MM_t)′) and three-variable models (X_t = ($KLCI_t$, $M1_t$, MM_t)′ and X_t = ($KLCI_t$, $M2_t$, MM_t)′). This finding may be interpreted to suggest that no long run relationship exists between stock prices and monetary policy variables, within the four- and three-variable systems. However, these findings almost completely change when structural breaks are incorporated in the cointegration analyses as strong cointegration relationships prevail in the four-variable models. Similar evidence is also detected in the three-variable model which includes M2 but not in one that includes M1. Thus, it may be surmised that cointegration analyses with structural breaks give more robust result than the standard cointegration and consistent with the conjecture that ignoring structural breaks may give spurious results.

Next, the results of running Granger-causality tests based on the VECM frameworks on the four-variable system indicate that there is a positive long

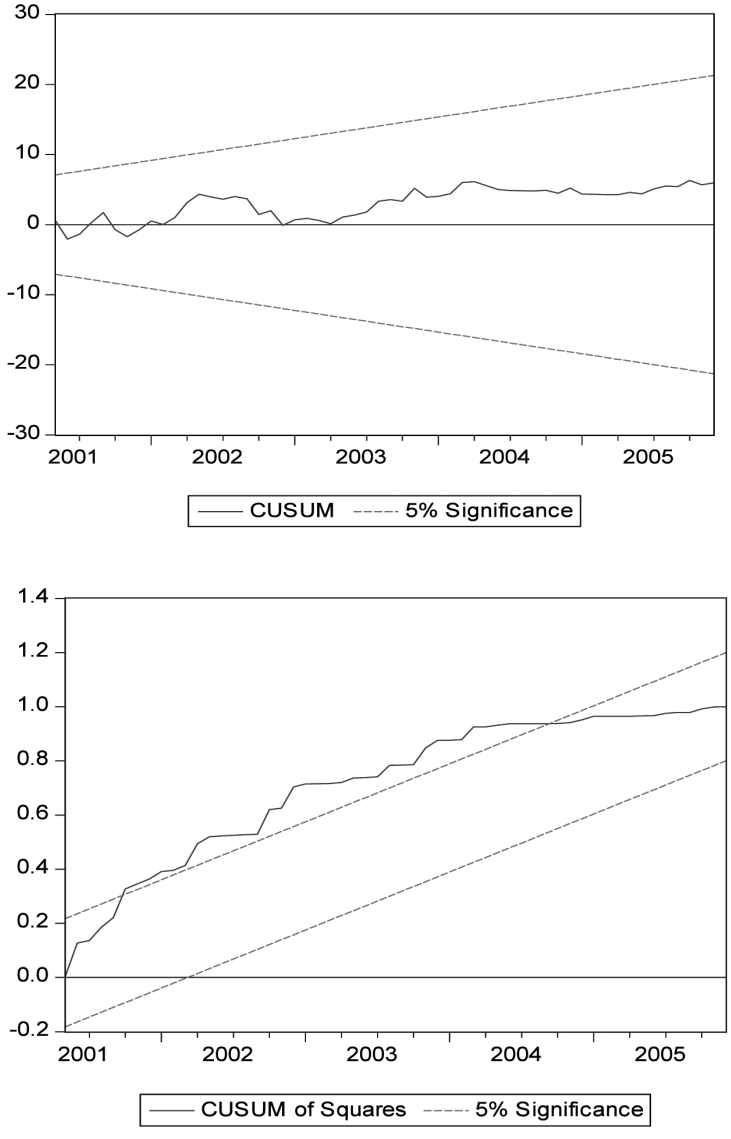

FIGURE 3. Plots of CUSUM and CUSUM of squares from 2001 to 2005

run relationship between KLCI and monetary policy variables. In the short run, the results show that money market interest rate (MM) Granger-causes KLCI. Meanwhile, the other monetary variables (M1 and M2) influence KLCI indirectly through money market interest rate (MM). Hence, there is sufficient empirical evidence to show that KLCI responds to changes in monetary policy in the short run and particularly in the long run. The latter conjecture is further supported by the normalized equation and also the LR exclusion tests.

In short, the results of this study can be summarized to draw the following major conclusions. First, evidence of significant cointegration relationships prevails only when structural break is considered in the models. Second, among the monetary variables, only interest rate (money market rate, MM) has a direct short-run relationship with stock prices whereas the relationships between monetary aggregates (M1 and M2) and stock prices are indirect through MM. Third, all three monetary variables consistently show long-run impacts on stock prices. Fourth, between the two monetary aggregates, M2 consistently prevails as an effective monetary policy tool whereas M1 fails to assume such function.

The policy implication of this study is that the central bank of Malaysia should rely more on interest rate rather than money supply as short-term measure to manage the stock market more effectively. However, in the long-run, both interest rate and money supply (specifically M2) can be relied upon to monitor the stock market condition. As far as investors are concerned, the cointegration relationship found in this study is another good indication as it confirms most previous studies which are very much lenient toward suggesting that the stock market in Malaysia is still informationally inefficient. Therefore, new information triggered by changes in monetary policy variables, specifically money market rate should be exploited to formulate their future investment strategy.

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