FINANCIAL LIBERALISATION AND STOCK MARKET VOLATILITY IN MALAYSIA: A GARCH APPROACH

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ABSTRACT

This paper examines the contention that stock market volatility increases after market liberalisation for the case of Malaysia. Applying a GARCH model, we find evidence that contradicts this contention. Instead, the return volatility seems to decrease after the opening of the Malaysian market in 1988 to international investors. We also, tentatively, find evidence for the role of portfolio investment inflows in increasing market volatility during the post-liberalisation period.

INTRODUCTION

The widely documented time-varying volatility in international stock markets in recent years has attracted increasing empirical attention to its underlying causes. Probably, for an emerging market such as Malaysia, one explanation that may be often cited to account for high return volatility is the increased financial liberalisation of a country. Generally, financial liberalisation refers to the de-regulation of financial markets. One important facet of liberalisation is the process by which the once administered interest rates and banking activities are relaxed to provide market forces more influence in the determination of interest rates. Moreover, barriers to international capital movements and controls when lifted, can lead to increasing financial innovations and integration between national markets.

While financial liberalisation has encouraged the growth of equity markets and, subsequently, increased the efficiency of capital mobilisation, some have raised concerns that the liberalisation may increase market volatility. In particular, from a Keynesian perspective, the rapid capital movements across markets and the heightened pace of financial transactions that financial liberalisation allows as well as the increased speculation that it induces may lead to increased market volatility (See Grabel, 1995 and references therein). Moreover, Alexakis et al. (1995) noted that the greater flexibility and better responses of the markets to internal and external changes may cause market volatility to rise (see

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also the discussion in Peel at al., 1993). However, contradicting these views, some argue that financial liberalisation can decrease the market volatility. In particular, financial liberalisation tends to increase the number of shares listed, i.e. expand the markets. This will have beneficial effects on portfolio diversification as well as market volatility (De Santis and Imrohoroglu, 1997). Additionally, liberalisation improves the quality of information disseminated in the markets, which leads to better financial deepening (Grabel, 1995, Domowitz et al., 1996).

Empirically, in a recent study, De Santis and Imrohoroglu (1997) examined the stock returns and volatility in 15 emerging markets and 4 developed markets using weekly data series that span from the last week of December 1988 to the second week of May 1996. Consistent with existing studies, they found strong evidence for time-varying volatility in these markets. However, analysing the impact of financial liberalisation on stock market volatility for 5 emerging markets (India, Taiwan, Argentina, Brazil, and Columbia)[1], they found no support for the contention that liberalisation would increase market volatility. Similarly, examining 17 countries that underwent liberalisation, Bekaert and Harvey (1997) documented the reduction in stock return volatility in many countries after liberalisation. However, Ng et al. (1991) found an increase in volatility spillover from the United States to Japan and, to a lesser extent, to Thailand after market liberalisation. The analysis by Kim and Singal (1994) also suggested an increase in volatility. Similarly, Grabel (1995) documented the increase in volatility during financial liberalisation episodes in developing countries. Alexakis et al. (1995) also found the same results for Greece. However, the increase is noted to be insignificant. This latter evidence, thus, tends to favour the Keynesian view on financial liberalisation.

The present analysis extends as well as complements De Santis and Imrohoroglu's study on the relationship between financial liberalisation and stock market volatility by evaluating the issue for the Malaysian market. Malaysia was omitted from their analysis due to insufficient data points prior to liberalisation. However, the availability of daily data series that begins in January 1983 and ends in December 1996 enables us to examine the issue for the Malaysian case. The understanding of the volatility effect of financial liberalisation is highly important. As we have mentioned above, financial liberalisation increases the efficiency of financial markets and, accordingly, contributes to the development of the country. However, if the liberalisation also brings heightened volatility in the markets, the efficiency benefits of the liberalisation may be mitigated. As Alexakis et al. (1995)

[1] *The analysis of the impact of financial liberalisation is restricted to these five countries because of the requirement that there be at least 100 observations for each regime, pre-liberalisation and post-liberalisation.*

noted, volatility in asset prices imposes costs to investments and, accordingly, the long-term growth prospects of the country. The volatility may also erode investors' confidence and, subsequently, result in capital outflows from the markets. Lastly, the volatility may result in misallocation of resources instead as firms may be required to allocate more funds to hedge against uncertainty (Peel et al., 1993).

The analysis employs a generalized autoregressive conditional heteroskedasticity (GARCH) model suggested by Bollerslev (1986). The impact of the market liberalisation on the stock return volatility is evaluated alternatively by (i) incorporation of a dummy variable in the conditional variance equation and (ii) estimating the GARCH model separately for pre-liberalisation and post-liberalisation periods. Since the results may be affected by the number of years after liberalisation included in the sample, we examine the robustness of the liberalisation-volatility linkage using three sample periods that end respectively in (i) December 1992, (ii) December 1994, and (iii) December 1996. Additionally, the October 1987 crash, which occurred before market liberalisation, may unduly suggest high volatility during the pre-liberalisation period and, consequently, indicates a reduction in volatility post-liberalisation. Thus, we also account for the October 1987 crash in the analysis.

Consistent with the finding of De Santis and Imrohoroglu (1997) and Bekaert and Harvey (1997), our results reject the contention that market liberalisation increases stock return volatility. If anything, the volatility seems to decrease after liberalisation. The rest of the paper is structured as follows. In the next section, we present the methodology used. Section 3 describes the data and section 4 presents the results. Lastly, Section 5 concludes.

METHODOLOGY

The methodology employed in the analysis is based on an autoregressive condition heteroskedasticity (ARCH) model introduced by Engle (1982) and generalized (termed GARCH) by Bollerslev (1986). The model is well suited for modelling stock return behaviour as it allows the return volatility to be time varying. The GARCH model also captures the tendency in return series for volatility clustering, which has long been recognized as an important feature of stock return behaviour.

In particular, we use a GARCH (1, 1) model to characterize the variance process of Malaysian stock returns. We restrict our estimation to this simple GARCH model since several empirical studies indicate the adequacy of the specification in fitting time series data (Bollerslev, 1986). Formally, the GARCH

(1,1) is represented as:

$$r_t = a_o + a_1 r_{t-1} + e_t \qquad (1)$$

$$e_t \mid I_{t-1} \sim N(0,h_t)$$

$$h_t = \mu + \alpha e^2_{t-1} + \beta h_{t-1} \qquad (2)$$

where rt is the stock return at a time t and $It-1$ is the available information set. Equation (1) is the conditional mean equation, modelled as an autoregressive process. Equation (2) is the conditional variance equation specified to depend on once-lagged squared errors and once-lagged conditional variances. It is necessary that both α and β are non-negative to ensure positive finite variances of return series. Furthermore, for the variance process to be stationary, the sum of α and β must be less than unity. In the case where the sum $(\alpha+\beta)$ equals unity, the volatility is said to follow an integrated GARCH, or IGARCH, process. In this case, any shock to the conditional variance persists over its entire future path.

In studying the influence of financial liberalisation on volatility, two alternative approaches are employed. The first approach augments the conditional variance equation with a dummy variable, FL_t, taking on the value zero pre-liberalisation, and one post-liberalisation. Thus we have

$$h_t = \mu + \alpha e^2_{t-1} + \beta h_{t-1} + \phi FL_t \qquad (3)$$

Alternatively, to account for the October 1987 crash, we have:

$$h_t = \mu + \alpha e^2_{t-1} + \beta h_{t-1} + \phi FL_t + \gamma OC_t \qquad (4)$$

where OC_t is the October crash dummy variable. In specific, we take December 1988 as tabled by De Santis and Imrohoroglu (1997) as the beginning date for the Malaysian market liberalisation. Thus, FL takes the value zero for the periods prior to December 1988 and one otherwise. The date is based on the information from the International Finance Corporation and it corresponds to the opening date of the equity markets to international investors. Although the process of financial liberalisation starts much earlier[2], we believe that the date is appropriate since it signifies the opening up of the market internationally, whose volatility is being evaluated. The influence of financial liberalisation is assessed based on the sign and statistical significance of the liberalisation dummy variable.

The second approach partitions the sample into two sub-periods, pre-liberalisation and post-

[2] *In particular, the liberalisation started with the liberalisation of the interest rate in 1978. However, the event is not directly linked to the stock market. Levine and Zervos (1998) identify the liberalisation to be November 1986. We believe that taking this date instead will not materially affect the results.*

liberalisation, and estimates the model as specified by (1) and (2) separately for the two periods. The impact of market liberalisation is then evaluated by comparing the implied unconditional volatility for both periods, which is computed as $\mu/(1-\alpha-\beta)$. Namely, if market liberalisation contributes to the increase in return volatility, the unconditional volatility for the second period should be higher. An additional advantage of this approach is that we can also examine the nature of volatility persistence for the two periods. It needs to be noted that, in the estimation of the model for pre-liberalisation period, we account for the October 1987 crash in similar manner by including the crash dummy variable (OC_t) in the conditional variance equation.[3]

One point of departure from existing studies is that we investigate the issue across several estimation ranges. Our prior contention is that the results may be affected by the number of years after liberalisation included in the sample. Accordingly, we examine the robustness of the liberalisation-volatility linkage using three samples that begin in January 1983 and end, alternatively, in (i) December 1992, (ii) December 1994, and (iii) December 1996. The added advantage of this approach is that we may provide indirect evidence in the role of portfolio investment flows to the Malaysian market. Although the Malaysian market was liberalized at the end of 1988, the drastic surge in portfolio investment flows did not occur until 1993.[4] As these flows are characterized by "instant" reversal and high volatility, it is expected that the inclusion of 1993 observations and thereafter may increase the volatility of the stock market. Consequently, the difference in volatility pre- and post-liberalisation may be weakened (strengthened) depending on whether market liberalisation decreases (increases) volatility.

DATA

The analysis is conducted using the Kuala Lumpur Composite Index (KLCI) from January 3, 1983 to December 31, 1996. The index was constructed in 1986 to capture the rapid growth and changes of the Malaysian economy and of the Kuala Lumpur Stock Exchange (KLSE) listed companies. It

[3] Either one of the two approaches or both are normally employed to test the impact of major event occurrences on financial volatility. For instance, De Santis and Imrohoroglu (1997) use the second method to examine the impact of market liberalisation on the stock market volatility for emerging markets. Lastrapes (1989) employed the second to examine the monetary policy - exchange rate volatility linkage. Antoniou and Holmes (1995) use both approaches to evaluate the role of futures tradings in affecting spot market volatility. Lastly, Su and Fleisher (1998) employed both methods to examine the effect of the daily price-change limit removal on volatility in Chinese stock markets.

[4] The ratio of portfolio equity flows to GDP was less than 1% for every year during 1988-1992. However, in 1993 and 1994, this ratio surged drastically to 6.2% and 3.3% respectively. See Welch (1996), Table 1.

is a market value-weighted index of actively traded stocks of companies that contribute substantially to the Malaysian economy. In the selection of the KLCI component stocks, the following stocks are not considered: (1) the stocks that are not traded for more than three consecutive months; (2) the stocks that are traded less than 250 lots (then, starting in 1992, less than 1000 lots) per calendar year; and (3) the stocks of newly-listed companies, subsidiary companies, and companies that experience drastic capital structure changes.[5] These criteria provide the suitability of this index, as it is not likely to suffer from the problem of infrequent trading. Moreover, the inclusion of once-lagged returns in the conditional mean equation can account for the problem (De Santis and Imrohoroglu, 1997).

Daily rates of returns, r_t, are calculated as $r_t = ln(P_t/P_t) \times 100$, where P_t is the closing price index for day t. Table 1 provides descriptive statistics of the return series for the whole sample period, pre-liberalisation and post-liberalisation. For the pre-liberalisation, we also present the statistics for the period that ends September 1987, which excludes the October 1987 crash.

Several observations can be made from the table. The mean daily return for the post-liberalisation period is more than twice the return for pre-liberalisation period, although the October 1987 crash raises the daily return for the pre-liberalisation. The differences between the standard deviations of the return series for the two periods seem to depend on whether post-September 1987 sample is included in the pre-liberalisation sample. A marked difference in the statistics can be observed when post-September 1987 sample is included. Meanwhile, when it is excluded, there seems to be a little difference in the standard deviations between the pre-liberalisation and especially the December 1988 - December 1994 post-liberalisation samples. If anything, the statistics appears to provide a preliminary indication of a reduction in stock return variances after liberalisation.

The skewness statistics indicate that the return distributions for all samples are negatively skewed. Furthermore, the distributions suggest high levels of kurtosis, which mean they have fatter tails than normal distributions. The Ljung-Box-Pierce (Q) statistics suggest serial dependency in the series of Malaysian stock returns. Moreover, the Q statistics for squared returns reject the null hypothesis of conditional homoskedasticity. These characteristics of Malaysian returns, i.e. excess kurtosis and serial dependency in the squared returns, are suggestive of the conditional heteroskedasticity or time-varying volatility.

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[5] *Readers may refer to Kok Kim Lian (1993) for detailed account on the construction of the KLCI.*

ESTIMATION RESULTS

We first report the estimation results of the GARCH model using the first approach for alternative sample periods in Table 2. Regressions (I), (III), and (V) include only the liberalisation dummy variable (FL) while regressions (II), (IV), and (VI) also control for the October 1987 crash. Virtually all estimated coefficients are statistically significant at better than 10% level. We observe that the estimated α and β are non-negative in all regressions. Additionally, their sums are less than unity, ranging from 0.8708 to 0.9232. Our results, thus, indicate stability in the variance process of Malaysian stock returns. However, since the sums are high and close to one, the shocks to volatility seem to persist over a long period. As expected, the crash dummy's coefficient is highly positive and significant at 5% level, indicating high degrees of volatility in the Malaysian market during October 1987.

Turning to our focal theme, the market liberalisation - volatility linkage, we find the coefficients of liberalisation dummy to be negative in all cases except one. The statistical significance of these coefficients, however, depends on the inclusion/exclusion of the crash dummy variable and on estimation ranges. In particular, the incorporation of the crash dummy variable in the conditional variance equation seems to weaken the statistical significance of *FL*. Indeed, for the two shorter sample periods, the impact of market liberalisation turns insignificant once the October 1987 crash is taken into consideration. The significant effect of *FL* is found to be robust only when the whole sample is used.

Examining across estimation ranges, we observe some tentative evidence that the drastic increase in portfolio equity flows in 1993 increases the stock return volatility. The difference between pre-liberalisation and post-liberalisation conditional variances is reduced when the observations from 1993-1994 are included.

Table 3 presents the results from estimating the GARCH model separately for the pre-liberalisation and post-liberalisation periods. Regressions (I) and (II) correspond to the pre-liberalisation sample, January 1983 - December 1988, where the latter incorporates the crash dummy in the equation for conditional variances. Regressions (III) to (V) are based on post-liberalisation observations that end respectively in December 1996, December 1994, and December 1992. Overall, the results are consistent with those reported in Table 2.

Notably, although the implied unconditional volatility for the pre-liberalisation period reduces substantially after the market crash of October 1987 is accounted for, there is a reduction in the volatility post-liberalisation. The biggest reduction can be observed when only the post-liberalisation sample up to 1992 is used. When the observations are extended to include 1993 and 1994, there seems to be an increase in the implied conditional volatility. Yet, it is still less than the pre-liberalisation volatility. If anything, this increase may be due to the influx of portfolio equity flows, which reached 6.2% of GDP in 1993. This explanation, however, is only tentative and requires further investigation. Lastly, when we employ the whole post-liberalisation sample (December 1988 - December 1996), the unconditional volatility decreases but is still higher than that obtained for the December 1988 - December 1992 period.

The degrees of volatility persistence, as measured by the sum $\alpha + \beta$, for the pre-liberalisation period conform well to those from Table 2. The sum of α and β for the two conditional variance specifications, without and with the crash dummy, are 0.9475 and 0.8785 respectively. However, there seems to be a marked difference in the nature of volatility persistence across post-liberalisation estimation ranges. The degree of volatility persistence is the lowest, where the estimated sum $\alpha + \beta$ equals 0.6421, for the four-year sample after liberalisation. Then, this volatility persistence becomes very close to the pre-liberalisation level for the longer sample periods.

In sum, in the Malaysian context, our results do not support the contention that the market liberalisation results in an increase in volatility. To the contrary, there is some evidence for the reduction in volatility post-liberalisation. While the rapid increase in portfolio investment inflows in 1993 seems to push up volatility, it is still lower than that for the pre-liberalisation.

CONCLUSION

This paper examines the impact of December 1988 Malaysian stock market liberalisation on the return volatility using daily returns from January 1983 to December 1996. Applying a generalised autoregressive conditional heteroskedasticity (GARCH) model suggested by Bollerslev (1986), we find evidence for the reduction in conditional volatility after market liberalisation. Additionally, shocks to volatility have less persistent effect post-liberalisation. Lastly, the examination of the post-liberalisation volatility measures and the nature of volatility persistence reveals the increase in volatility and its persistence, when the 1993-1994 observations are included. We argue, tentatively, that this may be due to huge portfolio investments that began to pour into the Malaysian market in 1993.

Thus, our results agree with those of De Santis and Imrohoroglu (1997) and Bekaert and Harvey (1997) that reject the contention of increased volatility after liberalisation. In the context of Malaysian market, the evidence points to the reduction in volatility instead.

TABLE 1: DESCRIPTIVE STATISTICS

Periods	Mean	Std. Deviations	Skewness	Kurtosis	$Q(24)$	$Q^2(24)$
Whole Period:						
Jan 3, 83 - Dec 31, 96	0.0425	1.3676	-1.473	20.771	113.64	2253.81
Pre-Liberalization:						
(a) Jan 3, 83-Nov 30, 88	0.0131	1.5650	-1.984	22.876	83.060	1193.51
(b) Jan 3, 83-Sept 30, 87	0.0314	1.2864	-0.498	7.367	74.390	107.92
Post-Liberalization:						
(a) Dec 1, 88-Dec 31, 96	0.0637	1.2056	-0.539	11.651	85.880	374.01
(b) Dec 1, 88-Dec 31, 94	0.0685	1.2585	-0.716	12.493	76.190	274.54
(c) Dec 1, 88-Dec 31, 92	0.0614	1.1695	-1.378	17.618	59.750	104.93

Note: *Q(24) and Q^2(24)* are Ljung-Box-Pierce statistics for the return and squared return series respectively. The 5% critical value for these statistics, which are distributed as a chi-square distribution with degrees of freedom equal 24, is 36.415.

TABLE 2: GARCH ESTIMATION RESULTS

	Dec 3, 88 - Dec 31, 96			Dec 3, 88 - Dec 31, 94		Dec 3, 88 - Dec 31, 92	
Parameters	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)
$a0$	0.0488*	0.0413**	0.0322***	0.0471**	0.0408**	0.0313	0.0269
	(2.779)	(2.319)	(1.817)	(2.402)	(2.109)	(1.458)	(1.272)
$a1$	0.2106*	0.2117*	0.2140*	0.2276*	0.2284*	0.2349*	0.2373*
	(10.67)	(10.58)	(10.94)	(10.62)	(10.97)	(9.805)	(10.26)
μ	0.1375*	0.2664*	0.1968*	0.1902*	0.1296*	0.2584*	0.1614*
	(8.528)	(8.906)	(8.647)	(7.289)	(6.945)	(7.086)	(6.818)
α	0.1804*	0.2010*	0.1727*	0.1855*	0.1524*	0.2087*	0.1628*
	(10.24)	(10.19)	(10.31)	(9.146)	(9.287)	(8.046)	(8.255)
β	0.7480*	0.6698*	0.7107*	0.7248*	0.7708*	0.6654*	0.7408*
	(37.23)	(28.26)	(35.47)	(29.79)	(39.16)	(20.26)	(30.34)
ϕ	---	-0.0745*	-0.0295***	-0.0312***	0.0003	-0.0528**	-0.0069
		(-3.545)	(-1.781)	(-1.797)	(0.0205)	(-2.263)	(-0.4203)
γ	---	---	4.8695**	---	3.3564**	---	3.6941**
			(2.366)		(2.291)		(2.291)
Log Likelihood	-5331.31	-5352.45	-5311.71	-4645.90	-4600.00	-3846.16	-3802.64

Note: Numbers in parentheses are asymptotic t-ratios. *, **, *** denote significance at 1%, 5%, and 10% respectively.

TABLE 3: GARCH ESTIMATION RESULTS FOR PRE- AND POST-LIBERALIZATION

Parameters	Pre-Liberalization (I)	(II)	Post-Liberalization: From Dec 1, 88 to (III) Dec 96	(IV) Dec 94	(V) Dec 92
a_0	0.0788*	0.0188	0.0442**	0.0449***	0.0084
	(2.667)	(0.6386)	(2.014)	(1.722)	(0.2767)
a_1	0.2104*	0.2011*	0.2268*	0.2601*	0.2809*
	(6.947)	(6.796)	(8.698)	(8.607)	(7.235)
μ	0.1459*	0.2083*	0.1750*	0.2007*	0.4590*
	(5.218)	(7.205)	(6.584)	(5.952)	(5.831)
α	0.1965*	0.1834*	0.1721*	0.1793*	0.2700*
	(6.887)	(7.136)	(7.086)	(6.149)	(4.817)
β	0.7510*	0.6951*	0.7017*	0.6860*	0.3721*
	(25.55)	(25.47)	(20.41)	(16.86)	(4.230)
γ	---	7.0430**	---	---	---
		(2.438)			
Implied Unconditional Volatility	2.7799	1.7145	1.3863	1.4898	1.2826
Log Likelihood	-2382.99	-2368.86	-2942.17	-2259.03	-1449.47

Note: Numbers in parentheses are asymptotic t-ratios. *, **, *** denote significance at 1%, 5%, and 10% respectively.

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