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## Financial Liberalisation and Stock Market Volatility: The Case of Indonesia

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# Financial Liberalisation and Stock Market Volatility: The Case of Indonesia*

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**Abstract**

This paper examines the relationship between financial liberalisation and stock market volatility in Indonesia. By looking at the time series properties of the Jakarta Composite Index (JCI) we identify breaks in stock market volatility which coincide with the timing of major policy events. Our main findings are (i) a significant decrease in volatility after the "official" opening of the stock market to foreign participation; (ii) a significant increase in volatility in the year before market opening following reforms that eased entry requirements and the issuance of brokerage licenses; and (iii) a significant increase in volatility at the time of the Asian crisis followed by a significant decrease in the second and sixth years after the crisis.

JEL classification: G14; G15

Keywords: Financial liberalisation; Stock market volatility; Indonesia; Asian Crisis

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# 1 Introduction

One of the controversial issues in the economic-development literature concerns the merits of stock market liberalisation on emerging market economies. Several empirical studies have shown that liberalisation has had positive effect on these economies via the decreased cost of equity, incresed returns, and increased private physical investment (see Bekaert and Harvey, 2000; Bekaert *et al.*, 2005). However, liberalisation may also expose the economy to speculation and economic or political turmoil abroad making domestic markets more volatile (see Singh, 1997; Arestis and Demetriades, 1999).

The effect of financial liberalisation on stock market volatility is a key issue that policymakers in emerging market economies must face before they decide whether or not to proceed with such a reform. This is because *excessive* volatility, which may reflect independence of stock-market-asset values from underlying fundamentals (Shiller 1981 and 1989) has adverse implications for the effective allocation of resources and, thus, for investment (see Bekaert and Harvey, 1997; Singh, 1997).[1]

Why should financial liberalisation affect stock market volatility? On the one hand, liberalisation may reduce stock market volatility if it attracts a new set of traders from already developed markets having previously been denied access, whose decisions and strategies are based more on rational invetsment analysis and fundamental valuation factors (Tauchen and Pitts, 1983). On the other hand, liberalisation may also attract speculators and investors with short-term horizons and expose the country to uncertainties abroad, resulting in increased stock market volatility, asset price bubbles and financial instability (see Allen and Gale, 2000; Arestis and Demetriades, 1999; Singh, 2003). Another possibility is that competing effects may offset each other with liber-

[1]For instance excess volatility makes investors more averse to holding stocks due to uncertainty, which leads to a higher risk premium and upwards pressures on interest rates, hampering both the volume and the productivity of investment and, therefore, reducing growth (Federer, 1993; DeLong *et al.* 1989). Excessive volatility may also increase the value of the "option to wait" thereby delaying investment (Bekaert and Harvey, 1997).

alisation not having much of an impact on volatility. Empirical evidence on the subject is mixed, depending on the countries and periods that are studied (for a survey, see Jayasurya, 2005).

In this paper, the issue of liberalisation and stock market volatility is examined in relation to Indonesia. The Indonesian experience is particularly relevant for two reasons. Firstly, Indonesia was widely regarded well into the year of the Asian crisis as the textbook example of the merits and benefits of having an active liberalised stock market (Hadiz and Robinson, 2005).[2] Secondly, the economy's heavy reliance on the stock market for its investment funds also made the country extremely vulnerable to international capital flight. With an estimated contraction of 15% in output in 1998, Indonesia suffered one of the most dramatic economic collapses recorded since the US Great Depression of the 1930s and emerged as the most serious casualty of the Asian crisis.[3]

While there are some individual country studies of stock market volatility for Asia-Pacific countries such as Korea, Malaysia, Philippines, Taiwan, Thailand and India (see Jayasurya, 2005; Huang and Yang, 2000; Levine and Zervos, 1998; Kwan and Reyes, 1997; De Santis and Imrohoroglu, 1997), it is somehow surprising that no study to date has focused on Indonesia.[4] This paper fills the gap. Instead of identifying *a priori* a liberalisation date and measure stock market volatility for some years before and after this date, we employ the '*Nominating-Awarding*' methodology of Karoglou (2007), which is

[2]Hadiz and Robinson (2005) note that "*there are few developing economies where the influence of market-oriented technocrats and international agencies such as the World Bank has been so embedded in the policy process as in Indonesia and where relationships between the government and western economists have been so close.*"

[3]A World Bank study grimly observed that "*Indonesia is in deep crisis. A country that achieved decades of rapid growth, stability, and poverty reduction is now near economic collapse... no country in recent history, let alone the size of Indonesia, has ever suffered such a dramatic reversal of fortune*" (World Bank, 1998).

[4]Kim and Singal (2000) examined changes in the level and volatility of stock returns, inflation and exchange rates around market openings for 18 emerging economies including Indonesia. However, they excluded Indonesia from their analysis of stock return volatility around market openings due to insufficient data. Chang *et al.* (1995) analyze the intraday price volatility of Indonesian stocks (i.e. they examine the first-order serial dependence between overnight returns and following daytime returns and between overnight returns and preceding daytime returns).

data-driven and identifies non-parametrically both the number and timing of volatility breaks in the returns of the benchmark stock market index. Our main findings are (i) a significant decrease in volatility after the "official" opening of the stock market to foreign participation; (ii) a significant increase in volatility in the year before market opening following reforms that eased entry requirements and the issuance of brokerage licenses; and (iii) a significant increase in volatility at the time of the Asian crisis followed by a significant decrease in the second and sixth years after the crisis.

The remainder of this paper is organised as follows. In Section 2, we present an overview of the Indonesian stock market liberalisation. Section 3 outlines the statistical procedure for obtaining robust estimates of stock market volatility when multiple breaks may be present. Section 4 discusses the empirical results. Section 5 contains a summary and conclusion.

# 2 Indonesia's Stock Market Liberalisation

When Indonesia launched a five-year development plan in 1969, it was one of the poorest countries in the world. Its per capita income was only US$50, about half that of India, Bangladesh and Nigeria. However, within three decades, the economy grew at historically unprecedented rates, almost 7% per year. In per capita terms average Indonesian GDP growth over this period was 5% per year. In 1997, Indonesia's per capita GDP was over four times the 1969 level. In a World Bank report (World Bank, 1993) the economies of Indonesia, Malaysia, Singapore and Thailand were compared with Japan, Hong Kong, Taiwan, and South Korea, and the term "East Asian Miracle" was coined. Indonesia's financial system grew commensurably with its economy turning into one of the most developed systems among developing economies.

Liberalisation of the financial sector has proceeded gradually. Interest rates were liberalised in 1983. Foreign banks were allowed to set up joint ventures with domestic banks in October 1988, but not permitted to have more than

six offices each in only six major cities (McLeod, 1999). Controls on banks' "offshore" borrowing were removed in March 1989. In February 1992, foreign investors were allowed to acquire shares in domestic banks listed on the stock market, albeit with some restrictions: they were not permitted to own more that 49% of the bank's total shares, and the government was required to have majority shareholding in any state bank whose shares were offered to the public (McLeod, 1992).

Liberalisation of the stock market was planned by the Ministry of Finance (MOF) to proceed in three phases.[5] In December 1987, the MOF issued the first reform package (Pakdes I). The package freed the market from direct price controls by eliminating limitations on daily price movements on the stock exchange. Foreign investors were allowed in, though under tight restrictions. One notable restriction was that they could only purchase shares up to the amount allowed by the provisions of the Investment Coordination Board (*Badan Koordinasi Penanaman Modal*, or BKPM) on foreign capital participation (Cole and Slade, 1996). That constituted Phase I of the liberalisation.

Phase II comprises the introduction of a second reform package (Pakdes II) in December 1988 easing listing requirements. More brokerage licenses were issued and partial listing of large well-established companies was also authorised. MOF decree 1055 issued on September 14, 1989 allowed foreigners to purchase up to 49% of the shares in a new issue and hold up to 49% of outstanding listed shares excluding bank shares. The International Finance Corporation (1996,p. 53) considers the market open from September 16, 1989. At end-1989, there were 67 firms listed compared with about 268 in 1996. Capitalisation improved from Rupiah 449 billion in 1988 to Rupiah 215 trillion

[5]The stock market in Indonesia is made of three Stock Exchanges: the Jakarta Stock Exchange, originally opened in 1912 under the Dutch colonial government and re-opened in 1977, as well as two smaller ones, the Surabaya Stock Exchange (SSX) established in 1989, and an over-the-counter market known as Bursa Paralel (created in 1988 and merged with the SSX in 1994). The SSX (and Bursa Paralel) is facilitating three markets: stock trading for small and medium scale companies, bond trading/reporting for corporate and government bonds, and derivatives trading for stock index futures.

in 1996! This brought in foreign capital inflow. Volume improved, prices surged and more compnaies sought listing on the market.

A third package (Pakdes III) was introduced in December 1990 constituting the final phase of the liberalisation. The package provided for the privatisation of the Jakarta Stock Exchange (JSX) when the government ceased control of it, vesting it as a private limited company self-regulated by member companies. Privatisation took place on July 13, 1992. The trading system was automated in line with the regional practice of neighbouring countries. The JSX significantly improved its attraction as Indonesia's major market. After privatisation, traded value increased from about Rupiah 25 billion to about Rupiah 69 billion. Prior to the Asian crisis, the market was capitalised at 45% of GDP compared with 3% in the 1970s.

# 3 Methodology

The most commonly employed method in studies examining the issue of liberalisation and volatility in the stock market is to identify a single liberalisation date and measure volatility for some years before this date (the pre-liberalisation period) and some years after this date (the post-liberalisation period). The liberalisation date is usually the date when the policy was implemented although some studies have used the announcement date of the policy based on the notion that stock markets respond immediately to the arrival of new information. Demetriades *et al.* (2007) argue that such an approach may lead to misleading volatility estimates either because the liberalisation date is not properly identified (market participants could easily adjust their trading strategies well before or after the announcement dates or the implementation dates depending, for example, on information leakages and changes in the degree of credibility of the policy makers) or because there are other irrelevant or non-directly relevant breaks in the pre/post-liberalisation period. Consequently, they argue that this literature needs to be revisited using data-driven

techniques and made robust to the existence of multiple breaks.

The remainder of this section outlines the method to obtain volatility estimates that are robust in the presence of breaks without resorting to estimating Regime Switching models. Drawing from the *Nominating-Awarding* methodology of Karoglou (2007) first we identify the number and timing of existing breaks and then we estimate volatility in each defined segment or period. Specifically, Section 3.1 describes the procedure that '*nominates*' breakdates and Section 3.2 describes the procedure that '*awards*' the breakdate property to some of the nominations. Section 3.3 refers to the volatility measures that we employ.

## 3.1 Breakdate *Nominations*

The techniques that are employed to detect the number and identify the timing of structural breaks draw on the literature that aims at detecting a single break in the volatility dynamics. Specifically, we use the Inclan and Tiao (1994) test (I&T) and the second test of Sanso *et al.* (2003), joined with the Bartlett kernel ($\text{SAC}_{BT}$).

Karoglou (2006) shows that the relative performance of each of the above tests depends on the underlying data generating process (DGP). For example, the I&T is found to be the most sensitive to the existence of volatility breaks for independent and identically distributed data but suffers severe size distortions for strongly dependent data. In contrast, the $\text{SAC}_{BT}$ does not exhibit size distortions but its power is smaller. As a result, when the DGP is not known, it is preferable to use them both and to select the breakdate according to an appropriate rule, depending on the specific objective of the exercise. Here we accept a breakdate nomination either when the $\text{SAC}_{BT}$ detects it at 5% level of significance or when the I&T detects it at 1% level of significance.

For the detection of multiple breaks it is necessary to incorporate these tests in an iterative scheme (algorithm) and to apply them to sub-samples of

the series, defined by the detected breakpoints. Inclan and Tiao (1994) propose a version of such an algorithm, which they name Iterative Cumulative Sums of Squares (ICSS). However, Karoglou (2007) shows that ICSS may not be robust to the presence of transitional periods between volatility periods. Such periods are likely to exist when the response of market participants to new information is a gradual one, which may be particularly relevant in emerging market economies. For this reason, this paper employs an algorithm that is more robust to the existence of transitional periods introduced by Karoglou (2007). When there are no transitional periods, Karoglou's algorithm produces identical results as ICSS, assuming the underlying tests detect the true breakdate. This algorithm involves the following six steps:

1. Calculate the test statistic under consideration.
2. If the statistic is above the critical value split the particular data segment into two parts at the corresponding point.
3. Repeat steps 1 and 2 for the first segment until no more (earlier) change-points are found.
4. Mark this point as an estimated change-point of the whole series.
5. Remove the observations that precede this point (i.e. those that constitute the first segment).
6. Consider the remaining observations as the new sample and repeat steps 1 to 5 until no more change-points are found.

The above algorithm is implemented with both of the (single breakdate CUSUM type) test statistics described above, i.e. I&T and $\text{SAC}_{BT}$.

## 3.2 Breakdate *Awards*

After detecting the potential breakdates and corresponding volatility periods using the Karoglou algorithm, we use a battery of robustness tests in order to

confirm that neighboring regimes have different variances. These robustness tests involve a different approach to the CUSUM-type tests in that they test for the homogeneity of variances of distinct samples (in our case these samples are two successive segments) without considering the time-series dimension of the data. In this paper we use (1) the standard F-test; (2) the Siegel-Tukey test with continuity correction (Siegel and Tukey, 1960, and Sheskin, 1997); (3) the adjusted Bartlett test (see Sokal and Rohlf, 1995, and Judge *et al.*, 1985); (4) the Levene (1960) test; and (5) the Brown-Forsythe (1974) test. The F-test requires equal sample sizes and is sensitive to departures from normality. The Siegel-Tukey test does not require neither equal samples nor normality; however it assumes that the samples are independent and have equal median. The Bartlett test is also robust when the sample sizes are not equal, however it is still sensitive to departures from normality. Its adjusted version considers a correction factor for the critical values and the arcsine-square root transformation of the data in order to conform with the normality assumption. The Levene test is an alternative to the Bartlett test albeit less sensitive to departures from normality. Finally, the Brown-Forsythe test is a modified Levene test (substituting the group mean by the group median) and appears to be superior in terms of robustness (when scores are highly skewed or samples are relatively small) and power.

## 3.3 Volatility Estimators

The magnitude and direction of the change in volatility is proxied by comparing the unconditional variance of each segment with its neighboring segments. The measures of unconditional variance that we use are: (i) the sample standard deviation; (ii) a Heteroskedasticity and Autocorrelation Consistent (HAC) estimator of the standard deviation - we use the VARHAC estimator of den Haan (1997) that bypasses the problem of selecting an appropriate bandwidth; (iii) the square root of the unconditional variance of the most elaborate GARCH

model that could fit the data.[6]

# 4 Empirical Results

The data employed in this study are weekly stock returns on the Jakarta Composite Index (JCI) calculated from weekly closing prices. The price data series begins on April 11, 1983 and ends on January 23, 2006. Figure 1 plots the JCI weekly stock returns over the sample period. Figure 2 shows the corresponding volatility as modelled by the procedure described in the previous section. Six volatility breaks, that is seven segments or periods are identified. They are depicted on each figure using horizontal lines.

Table 1 contains descriptive statistics of the stock returns for each of the segments identified. The magnitude and direction of the change in volatility is proxied by comparing the unconditional variance of each segment with its neighboring segments using the simple standard deviation and the VARHAC estimator as discussed above. The distribution of return is positively skewed in the first five segments and negatively skewed in the last two segments, and is leptokurtic in each segment. The Jarque-Bera statistic indicates rejection of the normal distribution hypothesis. These results are consistent with those obtained by De Santis and Imrohoroglu (1997), who find that in both developed and emerging markets the skewness and excess kurtosis statistics are not equal to zero. Moreover, Bekaert and Harvey (2000) find that skewness and excess kurtosis in 20 emerging stock markets are significantly different from zero. Further test results indicate that the null of hypothesis of unconditional normality can be rejected at the 5% level in 15 of the countries. Koutmos (1999) also rejects normality using Kolmogorov–Smirnov statistics at the 5% level for Korea, Malaysia, Philippines, Singapore, Taiwan and Thailand, for the period January 2, 1986–December 1, 1995. Other recent papers, which

[6]The most elaborate GARCH model refers to the model that has the highest number of statistically significant lagged parameters.

reject the null hypothesis for normal distribution, include Fraser and Power (1997) for Hong Kong, Japan, Singapore, Malaysia and Australia for the period January 1, 1988–October 14, 1994. Fraser and Power (1997) find that the skewness statistic is significantly different from zero for all sample countries except Australia, while the excess kurtosis statistic is significantly different from zero for all the markets.

Table 2 reports the results of the robustness checks discussed above. These results confirm that the neighboring regimes have statistically different variances. Table 3 reports the timing of the breaks and relevant policy events. The first segment exhibits a conditionally heteroskedastic behaviour with volatility nevertheless at its lowest level for the whole sample.[7,8] This is hardly suprising since for the period between 1983 and 1987, the Indonesian stock market was at its early stages of development with few quoted companies, small capitalisation, high concentration, low liquidity and a rudimentary institutional set-up. Indeed, there was no clear need, nor incentive, for eligible government-owned companies to raise capital through the capital market. Subsidised credit by the central bank and easy availability of finance from abroad under the open capital account seemed to meet the financing needs of state enterprises and larger private enterprises which would have qualified to list on a stock exchange. As Cole and Slade (1996, p.154) stated: "The modest official goal of 10 new listings a year was not achieved in any of the years from 1977 to 1988." The number of listed companies only increased from 23 to 24 between 1983-87. At the end of 1987, the total value of equity public offerings listed at the JSE

[7]The corresponding conditionally heteroskedastic structure is given by

$$y_t = \underset{(0.053)}{-0.178\sigma_t} + \varepsilon_t$$

where $\varepsilon_t = \sqrt{h_t} \times u_t$, $u_t$ is $iid\ N(0,1)$, and

$$h_t = \underset{(0.009)}{0.086} + \underset{(0.123)}{0.452\varepsilon_{t-1}^2} .$$

[8]Note that this is the only segment in which we have identified some very small deviations from risk neutrality.

was Rupiah 111 million, a mere Rupiah 1 million increase from 1983. Market capitalisation was Rupiah 100 billion.

The following two segments are short and can be regarded as transitional periods. Each of the two segments exhibits homoskedastic behaviour. In the second segment volatility remains low. This segment starts with a break which coincides with the release in February 1988 of a publication from Indonesia's Capital Market Supervisory Agency (Bapepam) clarifying the provisions of Pakdes I (December 23, 1987) on foreign portfolio investment (see Bapepam, 1988, pp. 5-6). This is because Pakdes I itself only stated that foreign investors could purchase shares up to an amount allowed by the effective provisisons of BKPM (the Investment Coordination Board) on foreign capital participation without making explicit the eligible companies and the general limits.

The third segment sees volatility reaching its highest level for the whole sample period. This segment starts with a break located two weeks before Pakdes II (December 20, 1988). It coincides with a period of accelerated growth in trading activities and volume of shares issued. In the two years following Pakdes II, the number of listed companies rose from 25 to 67 in 1989, and from 67 to 132 in 1990. The total value of equity public offerings listed at the JSE increased from Rupiah 131 million at the end of 1988 to Rupiah 2 billion at the end of 1989, a remarkable 1500% increase! It reached Rupiah 7.2 billion at the end of 1990, a 400% increase from 1989!

The fourth segment is the longest of the whole sample and exhibits a conditionally heteroskedastic behaviour.[9] In this segment volatility is low and stable. The segment starts with a break which coincides with the MOF decree issued

[9]The corresponding conditionally heteroskedastic structure is given by

$$y_t = \varepsilon_t$$

where $\varepsilon_t = \sqrt{h_t} \times u_t$, $u_t$ is $iid\ N(0,1)$ and

$$h_t \underset{}{=} \underset{(0.089)}{1.222} + \underset{(0.063)}{0.438}\varepsilon_{t-1}^2 .$$

on September 14, 1989, which opens the stock market to foreign investor.[10] Capitalisation continues to expand but the growth in trading activities and volume of shares issued decelerates.

The fifth segment coincides with the Asian crisis. This segment exhibits homoskedastic behaviour. Unsurprisingly, there is a significant increase in volatility. The segment starts with a break located in the week during which the decision to float the Rupiah was taken (August 14, 1997). The resulting sharp devaluation of the Rupiah against the US dollar significantly affected the stock market as most issuers had un-hedged foreign exchange liabilities.

The sixth segment is short and exhibits homoskedastic behaviour. There is a significant decrease in volatility. The segment starts with the fifth break which is located one week after Indonesia held its first free parliamentary election since 1955, on the day (June 7, 2002) that the IMF approved a US$450 million loan package (IMF, 1999). The announcement sparked positive sentiment in the stock market. Share prices up went up to a 22-month high, with the JCI gaining 76.8 points from the previous month's level.

Finally, the seventh and last segment also exhibits homoskedastic behaviour. Volatility returns to the level observed in the period from the opening of the market through to the start of the crisis. The segment starts with the last break located in the second week of January 2003. This break coincides with the Working Meeting of Indonesian Capital Market Industry held on January 17-18, 2003. The meeting yelded a strategic agreement between Bapepam as the regulator and securities companies as the major player of the industry to implement a new policy on securties firms' capitalisation and organisational structure (Bapepam, 2003). This new policy was geared towards achieving tactical goals such as strengthening capital structure, improving services quality,

[10]The decree came after Minister of Finance Sumarlin's press conference on August 5, 1989. During the conference Mr Sumarlin reportedly said that 49% of all stocks could be sold to foreign investors. A mini-boom occurred in the capital market on the basis of rumors that the stock of the PMA (a join venture firm) would be eligible for purchase by foreigners (Cole and Slade, 1996).

and increasing compliance with existing existing rules and regulation.

# 5 Summary and Concluding Remarks

In this paper we employed data-driven techniques to identify both the number and timing of breaks in the volatility of the Indonesian stock market. Noticeably, we found a number of breaks which coincide with significant policy events, most notably the "official" opening of the market to foreign investors in September 1989 and the decision to float the Rupiah in August 1997.

Capital market reforms that eased entry requirements and the issuance of brokerage licenses coincided with a dramatic increase in stock market volatility. In contrast, volatility significantly decreased when the market was opened to foreign investors. Following market opening and until the Asian crisis, stock market volatility remained low while the economy benefited from large external capital inflows.[11] Remarkably, the significant increase in volatility which accompanied the crisis was of short duration. Volatility subsequently decreased two years and six years after the crisis and returned to the same level that had prevailed from the opening of the market.

The evidence herein adds more weight to the view that Indonesia benefited from increased accessibility to foreign investors as a result of the capital market reforms it implemented in the late 1980s. This, in turn, suggests that integration with the world markets made the equilibrating process more efficient for stocks in Indonesia. Proponents of capital controls should take note of thet fact that liberalisation took place 8 years before the Asian crisis began. It would seem unlikely that the act of market liberalisation was responsible for the crisis.

Our results are consistent with those obtained in a number of empirical

[11] Ariff and Khalid (2005) pointed out that foreign direct investments increased from an average of about US$250 million to US$600 million in the early years after market opening. The total inflow of foreign direct investments in the 1991-97 period amounts to a US$23 billion injection of capital representing an average of 15 percent of GDP. Next to China, this is the largest flow of foreign investments. Porfolio investment also increased considerably.

studies, which fail to show that foreign investors' participation in emerging markets was characterised by market volatility. For example, Richards (1996) and Kim and Singal (2000) find no evidence that volatility has increased; rather results indicate that it has fallen. In addition, Chan *et al.* (1998) find no evidence of rational speculative bubbles following the 1997 crisis in Asian markets (Hong Kong, Japan, Korea, Malaysia, Thailand and Taiwan).

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**Table 1: Descriptive statistics**

| Segment | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|
| Mean | -0.000285 | 0.006161 | 0.012906 | 0.000413 | -0.00024 | -0.001248 | 0.003013 |
| Std. Dev. | 0.003594 | 0.008721 | 0.075245 | 0.013591 | 0.03767 | 0.017364 | 0.013559 |
| VARHAC | 0.0086678 | 0.013393 | 0.033681 | 0.020976 | 0.029564 | 0.017397 | 0.01369 |
| Skewness | 0.22 | 1.17 | 3.65 | 0.50 | 0.31 | -0.50 | -0.33 |
| Kurtosis | 5.36 | 6.00 | 20.35 | 7.54 | 3.39 | 4.39 | 3.62 |
| Jarque-Bera | 61.38*** | 24.23*** | 575.78*** | 372.24*** | 2.11 | 22.96*** | 5.35* |
| Probability | 0.00 | 0.00 | 0.00 | 0.00 | 0.35 | 0.00 | 0.07 |
| Observations | 255 | 40 | 39 | 414 | 96 | 187 | 159 |

Note: *, **, and *** denote statistical significance at 10%, 5%, and 1% level respectively.

**Table 2: Robustness tests**

| Segments | t-test | F-test | Siegel-Tukey | Bartlett | Levene | Brown-Forsythe |
|---|---|---|---|---|---|---|
| 1 and 2 | 8.21*** | 5.89*** | 5.15*** | 77.02*** | 32.93*** | 30.66*** |
| 2 and 3 | 0.56 | 74.45*** | 3.35*** | 113.3*** | 6.72** | 4.89** |
| 3 and 4 | 2.93*** | 30.65*** | 1.3 | 430.9*** | 43.9*** | 30.85*** |
| 4 and 5 | 0.28 | 7.68*** | 8.6*** | 217.37*** | 152.63*** | 139.94*** |
| 5 and 6 | 0.31 | 4.71*** | 5.58*** | 80.77*** | 54.08*** | 48.73*** |
| 6 and 7 | 2.51** | 1.64*** | 1.65* | 10.19*** | 4.83** | 4.89** |

Note: *, **, and *** denote statistical significance at 10%, 5%, and 1% level respectively.

**Table 3: Timing of breaks and policy events**

| Timing of breaks | Policy events |
|---|---|
| February 1988 (week 4) | Bapepam publication (February 1988) clarifies the provisions of Pakdes I (December 23, 1987) on foreign portfolio investment: foreign participation is authorised under tight restrictions. |
| December 1988 (week 1) | Pakdes II (December 20, 1988) eases listing requirements; increase in the number of brokerage licenses issued; partial listing is authorised for large well-established companies. |
| September 1989 (week 2) | MOF decree 1055 (September 14, 1989) authorises up to 49% foreign ownership in shares of companies listed on the JSX excluding bank shares. |
| August 1997 (week 2) | Rupiah is floated (August 14, 1997) as Thai Baht crisis spread; financial crisis. |
| June 1999 (week 2) | IMF board approves a US$450 million rescue package for Indonesia (June 7, 1999); first free parliamentary elections since 1955 (June 7, 1999). |
| January 2003 (week 2) | Working meeting of Indonesian Capital Maket Industry (June 17-18, 2003) yields strategic agreement between Bapepam and securities companies on securities firms' capitalisation and organisational structure. |

Sources: Bapepam reports, Bank Indonesia reports, Ariff and Khalid (2005), Cole and Slade (1996).

**Figure 1: JSX stock returns**

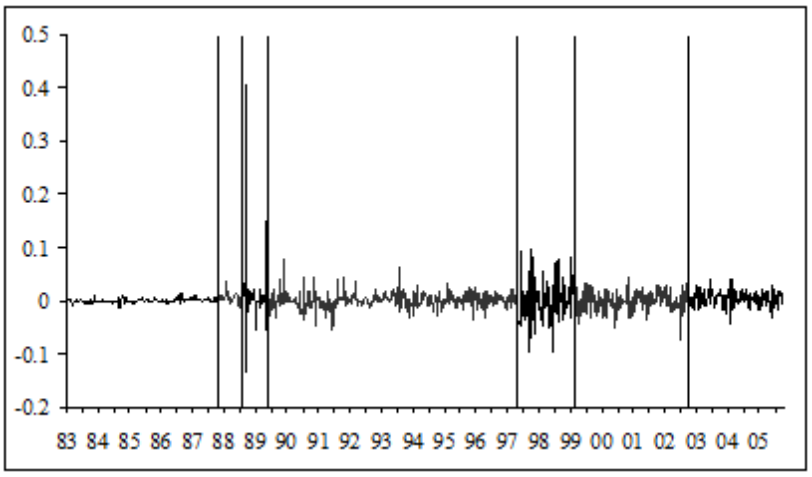


**Figure 2: Volatility dynamics of JSX stock returns**

