THE EFFECTS OF STOCK DELISTINGS ON FIRM VALUE, RISK, MARKET LIQUIDITY AND MARKET INTEGRATION: WITH EVIDENCE ON WEALTH EFFECTS FROM THE STOCK EXCHANGES OF MALAYSIA AND SINGAPORE, USING GARCH

DISSERTATION

Presented to the Graduate Council of the
University of North Texas in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

Ahamed Kameel Meera, B.Econ., M.Econ.

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This study examines the effects of delisting on firm value, risk and market liquidity. In a world where markets are becoming increasingly integrated, delistings may prove counter productive.

We use the unique event, free from company specifics, that occurred on January 2, 1990 in the stock exchanges of Singapore and Malaysia to test for the above effects. On that day, dual listed companies were required to delist from the foreign stock exchange. We also use this event to test if the Singapore and Malaysia markets are globally integrated.

Since financial data is found to show persistence in volatility, we model the return generating process in

a generalized autoregressive conditionally heteroskedastic (GARCH) framework that takes into consideration changing volatility. For comparison purposes, OLS and Time-Deformation models are included.

The study found delistings to decrease firm value, the size of which is related to how actively the stocks were previously traded on the foreign stock exchange. Risk levels increased following delistings. Nevertheless, thinly traded stocks showed significant changes in neither firm value nor riskiness. Further evidence of new listings to increase firm value was noted. Consistent with the political motive hypothesis, delisted stocks showed an increase in post-event volume, but however, lost relative liquidity compared with other stocks.

While all portfolios considered show evidence for existence of conditional heteroskedasticity, comparison with standard OLS event-study results yields similar conclusions, although the return generating models with GARCH errors result in lower abnormal return variances. As for the time-deformation model, trading volume was found to be a good proxy for rate of information flow only for smaller capitalized stocks.

Correlation and regression analyses showed that the Singapore and Malaysia markets are integrated to some degree with the international markets, such that a major delistings event between both markets did not change the pricing of risk in these markets.

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Ahamed Kameel Meera

14 March, 1996

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CHAPTER 1

INTRODUCTION

1.1 Introduction

Dual listings of stocks in efficient markets, in essence integrate the markets. Hence, dual (or multiple) listings of stocks in different exchanges increase the liquidity and the marketability of the stocks. Dual listings benefit investors by providing a wider range of stocks to be included in their portfolio, possibly with a lower transaction cost. The wider choice and increased flow of new information, on top of an increase in the number of total investors for the stocks, would improve the efficiency of the markets. As for the firms themselves, the dual listings would enable them to raise funds at internationally competitive rates on top of other benefits like increasing the marketability of the stocks and raising their public profile.

In the existing literature for example, Varela and Lee (1993) found that international listings decrease equilibrium required rate of returns for the listed security due to an integration effect. Alexander, Eun and Janakiramanan (1987) studied the behavior of stock returns surrounding international listings. While assuming segmented capital markets beforehand, they found international listings to decrease the expected return on the security. Market segmentation can thus depress security prices, and to reduce such negative effects of segmentation, Stapleton and Subrahmanyam (1977) propose the international listing of stocks.

While most research have found that new listings increase firm value, it is plausible that delistings then decrease firm value by reducing liquidity and marketability of the delisted security. Sanger and Peterson (1990) found that equity values decline by approximately 8.5 percent on announcement day. Hence, the liquidity hypothesis predicts that delistings to reduce the market value of firm. Amihud and Mendelson (1986) studied the average risk-adjusted returns on NYSE stocks and found them to significantly increase with the bid-ask spread. This means a firm could increase its market value by increasing the liquidity of the securities it issues.

As for market integration, Alexander, Eun and Janakiramanan (1987) had shown the demand for dually listed security to depend on the covariance of its returns with both the returns of all pure domestic securities and the returns of all pure foreign securities, thus suggesting that dual-listing indirectly integrates markets. However, Foerster and Karolyi (1993) studied interlistings between the U.S and Canada markets and found stock prices to rise, on average by 9.4 percent during the one-hundred days before the week of interlisting, but only to drop by 9.7 percent during the one-hundred days after the delistings, consistent with market segmentation hypothesis. Howe and Madura (1990), on the other hand, studied the impact of international listings on permanent shifts in risk but found no such significant shifts, thus suggesting that markets to be well integrated.

1.2 Objective of Research

This research intends to study the simultaneous total delistings of all dual listed stocks that took place between the stock exchanges of Singapore and Malaysia on January 2, 1990. Particularly our interest is in the effects of the delistings on firm value, risk and thus the cost of capital, the stochastic behavior of price, market liquidity of the stocks and market integration. The event uniqueness lies in the fact that dual listed companies in both the exchanges were required by regulation to simultaneously delist themselves. Hence the delistings were involuntary in nature and independent from any company specific factors or changes in investor expectations of future performance. Since investor expectations remain unchanged, efficient market hypothesis predicts that prices should not change.

The Malaysia-registered stocks delisted from the Stock Exchange of Singapore (SES) comprised more than 50 percent of the listed stocks in the exchange, thus formed a significant portion of the securities market in

Singapore. Therefore, inorder to capture back some of the lost business, the Singapore authorities started immediately an over-the-counter market, called the Central Limit Order Book International (CLOBI) to trade most of the delisted Malaysia stocks. For the purpose of the present study, these stocks provide an experimental control group that is rare in financial research. The study of these two markets is also timely since the Pacific Basin markets belong to the group of emerging markets that are expected to show tremendous growth in the coming decades. Hence the developments that take place in these markets are of considerable significance to international investors, financial analysts and economic policy makers.

1.3 Research Problems

The purpose of this research is to investigate the effects of stock delistings on firm value (as measured by abnormal returns) and how the delisting news affected the risk of returns (measured by equity beta) of the involved stocks and hence the cost of capital. Also this research attempts to investigate if the delistings affected the stochastic price behavour of the stocks, market integration and the market liquidity of the delisted stocks in both the Kuala Lumpur Stock Exchange (KLSE) and the Stock Exchange of Singapore (SES).

Wu (1993) also studied the phenomena of delistings between the Malaysian and Singapore stock markets. However our present study differs in scope, methodology and scale. Wu (1993) studied only a small sample of Malaysia stocks that were delisted from the Singapore Stock Exchange using standard event-study methodology. However we intend to include all firms that were delisted from both the Singapore Stock Exchange and Kuala Lumpur Stock Exchange. Also we specify the return generating process in a GARCH (Generalized Autoregressive Conditional Heteroskedastic) framework in order to take into account time-varying heteroskedastic error structure depicted by financial data. Ignoring such volatility persistence may seriously affect statistical inference. There are also other differences in the way we formulate the market return and the abnormal returns. All the above differences will be explained further in the methodology section in Chapter 4.

We are curious to know how much our event-study results using GARCH models differ from a standard Ordinary Least Squares (OLS) approach that assumes constant variance throughout the estimation as well as the event periods and a time-deformation model that uses the rate of information flow to measure economic time as opposed to local time. Therefore we would also repeat the event-study with the return generating process specified in OLS and time-deformation frameworks.

1.4 Research Method

The following methods will be used for each essay respectively:

1.41 Effects of Stock Delistings on Firm Value

In order to determine the effects of delistings on firm value, we test for any abnormal returns surrounding the announcement of the delisting news. In our study, the returns process is modelled in a GARCH framework inorder to take into account persistence in variance as depicted by financial data. To control for general market movements, we use the returns to the United Kingdom market index instead of returns to the local market indices due to reasons discussed in Chapter 4.

1.42 Effects of Stock Delistings on risk and the stochastic behavour of price.

In order to determine the effects of delistings on risk and hence the cost of capital, we test for any significant beta shift for an equally weighted portfolio of delisted stocks. As for the effects on the stochastic behavour of stock price, we test for any structural change in the conditional variance.

1.43 Effects of Stock Delistings on the Market Liquidity.

As for the effects of delistings on the market liquidity of the delisted stocks, we test for changes in their average daily trading volume. We would also use the liquidity analysis to test the hypothesis that Malaysia's move to delist is politically motivated at a time a general market upswing was expected.

Studies have also used other indicators like bid-ask spread to test for effects on market liquidity but unfortunately we do not have the bid-ask data to conduct such tests.

1.44 Effects of the Delistings between SES and KLSE on Market Integration.

As for the above effects, we postulate that the Malaysia and Singapore Stock Markets are segmented among themselves and with international stock markets, and therefore local delistings will have effect on the pricing of risk. To determine the above effect we propose to study if stock prices in both the exchanges were infact priced according to some international market portfolio. If before and after the delistings the stocks were priced according to the international pricing model, then the effects of the delistings on local pricing mechanism may not be significant since a significant international market portfolio would mean that global markets are integrated enough to have some significant pricing implication. Simple OLS regression models are used for this test, but significance is determined using a randomization procedure.

1.5 Organization of Chapters

This chapter introduces the reader to the objective of this research. It starts with a brief discussion of the phenomena of listings and delistings and their effects, particularly on firm value, risk, cost of capital, liquidity and market integration. It then gives an outline of the research problems we are interested in and how the event of delistings between the stock exchanges of Malaysia and Singapore provides an unique setting for this research. Also the research methods used to address each problem is given in the chapter.

Chapter 2 gives a brief history of the stock exchanges of Singapore and Malaysia, how they were moving hand in hand with numerous dual listings between them; and the events that took place that gradually split them apart. The event of simultaneous delistings between both the exchanges is outlined with relevant announcements spelled-out and dates clearly defined.

Chapter 3 then goes on to review the existing literature on listings and delisting; and the empirical measure of their effects on firm value, risk, market liquidity and market integration.

Chapter 4 discusses the data sample used in the study and outlines the hypotheses and the research methodology used to test each of them. We attempt to define each research method as clearly as possible and provide arguments for their use.

Chapter 5 provides and discusses the empirical results of the research, while in the last chapter, Chapter 6, we provide the summary and the implications of the results.

CHAPTER 2

THE STOCK EXCHANGE OF SINGAPORE (SES), THE KUALA LUMPUR STOCK EXCHANGE (KLSE) AND THE EVENT OF DELISTINGS - A BRIEF HISTORY

2.1 Brief History of SES and KLSE

The Stock Exchange of Singapore (SES) and the Kuala Lumpur Stock Exchange (KLSE) were once nick-named as Siamese twins. The reason for this is that, historically the exchanges developed hand in hand until 1990. When the British colonized the Malay peninsula in 1786, the same currency was used in all the Malay sultanates in the peninsula and in the Straits Settlements in Penang, Malacca and Singapore. Singapore served as the British administrative and commercial center from 1830 onwards. Securities trading in the peninsula was then introduced by the British in the 19th. century.

In 1957 the Malayan Federation gained its independence and in May 1960 the Malayan Stock Exchange was formed. Companies registered in both Singapore and the Malay peninsula were traded in both the exchanges. After the creation of Malaysia in 1963, both the exchanges operated as a common exchange. However, in 1965 Singapore left the Federation of Malaysia with a common currency still being retained in both the countries. In 1973, with the interchangeability between the currencies being terminated and with the enactment of Malaysia's own Securities Industry Act, the Stock Exchanges of Singapore and Malaysia were formally split. The KLSE was established in July 1973, which operates in the Malaysia currency, Ringgit, with its own rules and regulations.

Despite the split between the two exchanges, numerous companies remained listed in both exchanges as before the split. The two exchanges continued to develop hand-in-hand with the dual listing as the common link until 1990 when all the dual-listed stocks were delisted so that they are traded only in the exchange of the country they were registered in. The delistings were triggered by the collapse of the Singapore registered Pan-Electric Industries group that forced the temporary closure of the KLSE. Hence on October 27, 1989, the Malaysia government announced a January 1, 1990 deadline for all the 182 Malaysia-registered companies dual listed in SES, to delist from the exchange. In retaliation, the Singapore authorities, on November 9, 1989 issued a similar order requiring all the 53 Singapore-registered companies to delist from the KLSE on the same date, January 1, 1990.

The Malaysia government justified the split saying that this would allow the KLSE to develop independently as one of the leading exchanges in the region. Other factors too may have warranted the Malaysia government's move. Before the delisting, the Malaysia companies dual listed in the SES accounted for 37% of the SES's market capitalization and 40% of SES's average daily volume[1]. On the other hand, the Singapore companies dual listed in the KLSE accounted for 35% of the KLSE's market

1 Park, Keith K. H. and Antoine W. Van Agtmael ed., *The World's Emerging Stock Markets*, Probus Publishing Company, Chicago, 1993. pp. 146.

capitalization but only 2% of the KLSE's average daily volume. Hence while the Malaysia companies provided the SES with abundant liquidity, it had always developed in the shadow of SES. Also Malaysia stockbrokers felt that their Singapore counterparts had an unfair advantage over them on Malaysia stocks. Hence there was also political pressure imposed on the government of Malaysia by these stockbrokers to call for the delistings.

CHAPTER 3

REVIEW OF EXISTING LITERATURE

3.1 Stock Delistings and Suspensions.

Eventhough research in listings are abundant in the literature, very little work has been done in the area of delistings of stocks. While many research have found that new listings increase firm value, delistings then might decrease firm value by taking away the benefits, particularly the liquidity and marketability aspects. The most extensive work on delistings is that of Sanger and Peterson (1990). Sanger and Peterson (1990) analyzed the price behavior of 520 stocks delisted from the New York Stock Exchange (NYSE) and the American Stock Exchange (ASE), and found that equity values decline by approximately 8.5 percent on announcement day. Compared with results of previous studies on stock listings, in the period prior to delistings, the market reacts oppositely to news of delistings. They examined four hypotheses to account for the decline in firm value, namely the liquidity hypothesis, the management signalling hypothesis, the exchange certification hypothesis and the downward sloping demand curve hypothesis. Each of these hypotheses predict delistings to reduce firm value. Using the bid-ask spread, and trading volume for the delisted common stocks around the delisting period, they found evidence consistent with the liquidity hypothesis. The liquidity hypothesis predicts delistings to reduce the market value of firm. Amihud and Mendelson (1986) studied the average risk-adjusted returns on NYSE stocks and found them to significantly increase with the bid-ask spread. This indicates that a firm could increase its market value by increasing the liquidity of the securities it issues. Therefore delistings bring about a decrease in liquidity which in turn lower asset values. The illiquidity of the delisted stocks is mirrored in the increased level of difficulty in trading them. The Management signalling hypotheses is ruled out since almost all delistings are involuntary events. However, delistings could be interpreted as signals from the exchange concerning the future prospects of the affected firms. During the period of non-trading interval, Sanger and Peterson (1990) found a significant abnormal return of negative 8.2 percent for firms that had no prior announcement, but for firms that had prior announcement, an abnormal return of negative 0.92 percent was observed (but statistically insignificant). As for the post-delisting period, the cumulative abnormal returns were all insignificant thus consistent with stock market efficiency. This result is in constrast with results of stock exchange listings that observed anomalous returns in the post-listing periods.

In an ealier research on delistings, Goetzmann and Garry (1986) examined the price behaviour of seven stocks that were delisted from the S&P 500. They found a negative abnormal return of 1.9 percent with extremely high volume on the day of the delistings. An examination of the cumulative abnormal returns of the sample during the post-delisting period, showed a steady downward trend. This suggests that the fall in firm value was permanent. Goetzmann and Garry (1986) attributed this fall in value to a fall in the quality and nature of future available information as anticipated by investors. Investors might now expect these stocks to be less scrutinized by analysts, and hence less information and less reliable predictions about their future performance would be made available.

Varela and Chandy (1989) examined the market reaction effects around events involving listing and delisting in the Dow Jones (DJ) Index. Using standard event-time study methodology, they observed significant abnormal returns of -1.75 percent three days prior to delistings. Hence there seems to be a market anticipation of the events about three trading days before the actual event, thus suggesting a leakage of news. However, in a somewhat similar study, Arnott and Vincent (1986) found stocks delisted from the S&P 500 to experience a price drop on the date of delisting. Thus their study did not find any evidence for leakage of news. Jain (1987) and Lamoureux and Wansley (1987) also studied delistings in the S&P 500 index and found delisted firms' to experience significant negative excess stock returns due to delisting announcement.

Wu (1993) studied the simultaneous delistings of dual listed stocks between the Stock Exchange of Singapore (SES) and the Kuala Lumpur Stock Exchange (KLSE). Wu examined a small sample of the Malaysia stocks alone that were delisted from the SES. Of the 182 Malaysia stocks that were delisted from the SES, 103 were later traded on the CLOBI while the remaining 79 were retrieved back to KLSE. Wu used a sample of sixty-four stocks from the former set and only ten stocks from the latter. Using standard event-study methods on three different return generating models, namely the mean-adjusted returns model, the market-adjusted returns model and the OLS two-index market model, Wu found that the ten stocks retrieved back to KLSE, on average lost about 10.5 percent of market value. On the other hand, the sixty-four stocks that were subsequently traded on the CLOBI experienced a loss about 2.7 percent on the delisting announcement day but later regained value on the announcement of the establishment of CLOBI and later on again on the annoucement of the list of stocks that will be traded on the CLOBI. Over the entire period, the cumulative abnormal returns for these stocks were a positive 22.12 percent, whereas for the entire seventy-four stocks it was 17.65 percent. This indicates that the market perceived the establishment of CLOBI as "favourable" news and infact increased firm values over the period studied. Wu also found the risk measures of the delisted firms to experience significant increases, thus implying an increase in the cost of equity capital. Inorder to determine the effect of delistings on market integration, Wu used correlation measures between both the stock market indices, namely the SES All-Share Index[1] and the KLSE Composite Index. He found a significant drop in the correlation measures, from 0.94 in the pre-delisting period to 0.80 in the post-delisting period[2]. However, the real indices for both showed no significant drop. Overall, Wu thus concluded that dual listed firms and the exchange should make

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[1] There may be an error in Wu's reporting since the Singapore All-Share Index ceased to exist after the delistings.

[2] Significant drop in the correlation value is also reported when the indices are stated in a common currency.

unified effort to avoid delisting. Nevertheless, we contend that the use of the SES All-Share and the KLSE Composite indices in the return generating models and in the correlation analysis may pose serious problems since the delisted firms comprise a large portion of all listed firms[3]. Around the delisting announcement period, there were about three hundred counters in both the SES and the KLSE. Hence a delisting of 182 firms for example comprise more than 50 percent of the listed firms. Therefore the use of the indices may not be suitable for the above event-studies.

While our present research intends to study the same phenomena of delistings between the SES and the KLSE, it is different in many ways from that of Wu (1993): 1) Firstly, the study is more extensive in that it would use most[4] of the delisted stocks instead of just small samples. 2) The Singapore stocks that were

[3]For example, the correlation coefficients between the returns for the KLSE Composite Index and the portfolio of Malaysia stocks, totally delisted from SES and stocks delisted but listed on CLOBI are 0.89162 and 0.95457 respectively. We believe the high correlation coefficients are due to the fact that the delisted firms comprise a significant portion of the index itself.

[4]Our sample size depends on the availability of data for each of the firms.

delisted from the KLSE are also analysed on top of the Malaysia stocks delisted from the SES. 3) As a comparison to delistings, another set of Malaysia stocks that were not listed on the SES before but were traded on the CLOBI on its introduction, is also analyzed. 4) The return generating processes are modeled to account for time-varying volatility as found in most financial data. 5) To check for robustness of results, in one model we define the abnormal returns in terms of local time, as measured by the inflow of news into the market. 6) As a surrogate for general price movements, we use an index for the United Kingdom market instead of the local market indices inorder to circumvent the earlier mentioned problem. 7) We also look at the market liquidity, international market integration and the market efficiency aspects of the listings and the delistings.

Other works in the literature that come close to research on delistings are that of stock suspensions. In the United States, stock suspensions may be initiated by the exchange or the Securities Exchange Commission

(SEC). Exchange initiated suspensions generally protect the specialist, for example by reducing the market-making risk exposure. On the contrary, SEC-initiated suspensions are meant to protect investors by ensuring the dissemination of new information to all investors, so that rational, informed decisions can be made. Suspensions can also occur if transactions in a security suggest possible manipulation. A temporary trading suspension is thus a signal by the exchange indicating the existence of or the expectation of a temporary disequilibrium in the market for a security. Hopewell and Schwartz (1976) analyzed stock price behaviour associated with temporary trading suspensions, in periods of bear and bull markets. Using a sample of NYSE-initiated trading suspensions, they found security prices to adjust at large absolute magnitude on average over the suspension period. They also noted that securities with longer suspensions to show a tendency to experience larger magnitude of price adjustments. Here the mean abnormal return for the multiday suspension group was found to be about two to three times greater in absolute magnitude than the single day suspension group. Their study also showed the price adjustment to be rapid on average, with most of the response confined to the suspension day. Similar to results of other delisting studies like that of Goetzmann and Garry (1986), the adjustments also appeared to be permanent in response to new information. In a somewhat similar work, Hopewell and Schwartz (1978) studied temporary trading suspensions in individual NYSE securities. They found: 1) substantial and permanent shifts in equilibrium security prices associated with the suspensions. Significant pre-suspension abnormal returns of the same sign were observed. They contended this to be consistent with partial adjustment prior to suspension, due to insider trading, information leakages, correlated new announcement or lags in the response of some investors to new information; 2) Price adjustments were consistent with efficient securities market. This they deduced from the observation that post-suspension abnormal returns were devoid of patterns presenting opportunities for systematic trading profits.

While the above studies investigated exchange-initiated trading suspension, Howe and Schlarbaum (1986) investigated security price behaviour in the period surrounding SEC-initiated trading suspensions. SEC suspensions protect investors by allowing time for a wider dissemination of new information deemed pertinent for rational, informed decisions and also by preventing monopoly exploitation of information. Howe and Schlarbaum found that the cumulative abnormal returns showed no peculiar behaviour for weeks before delisting. This means little evidence of anticipation of suspension. The above result is in contrast to results of Hopewell and Schwartz (1978) who noted anticipatory price behaviour during pre-suspension periods for exchange-initiated suspensions.

Kryzanowski (1979) examined the efficiency implications of trading suspensions. The study is limited to suspensions that were issued to prevent the exploitation of monopoly information. Regulators issue this kind of suspensions when they believe that a security is being traded with inadequate or poorly dispensed firm-specific information. Hence such suspension is expected to: 1) improve the strong-form market efficiency by making private information publicly available to all investors; 2) improve investor equity by making sure that investors have equal and costless access to all relevant information. An effective suspension would thus disseminate new information during the period of suspension and if the market is efficient in the semi-strong form, it would quickly impound the new public information into the opening prices when trading is resumed. The direction of the price movement, of course, depends upon whether the market perceives the new information as "favourable" or "unfavourable". Kryzanowski concluded the following three major findings: 1) Regulators have access to significant new information that is not fully reflected in stock prices prior to a trading suspension; 2) the market is not semi-strong form efficient for unfavourable new public information, since significant abnormal negative returns were observed in the post-suspension period; 3) however the market appears to be efficient in the semi-strong form for favorable new information since significant positive abnormal returns occur only in the period prior and over the suspension.

3.2 Domestic and International Listings

Dual listings of stocks with efficient information flows between markets, in essence integrate the markets. In the extreme, if all stocks are listed in all exchanges, then all the markets would be integrated. Hence, dual (or multiple) listings of stocks in different exchanges increase the liquidity and the marketability of the stocks. Dual listings benefit investors by providing a wider range of stocks to be included in their portfolio with a lower transaction cost (this is because the "foreign" stocks are quoted right in an exchange close to them). The wider choice and an increased flow of new information on top of a larger number of total investors for the stocks, would improve the efficiency of the markets. As for the firms themselves, the dual listings would enable them to raise funds at internationally competitive rates on top of other benefits like increasing the marketability of the stocks and raising their public profile.

Varela and Lee (1993) found that international listings decrease equilibrium required rate of returns for the listed security due to an integration effect. They noted that barriers like discriminatory taxes, lack of information and uncertainty surrounding investments and the relevant economic systems, may restrict international investments. These barriers may keep the capital markets reasonably segmented since to overcome such barriers may increase transaction and information costs, thus constraining the optimal portfolio choice for investors and restricting international capital flow. Market segmentation can depress security prices, and to reduce such negative effects of segmentation, Stapleton and Subrahmanyam (1977) propose the international listing of stocks.

Alexander, Eun and Janakiramanan (1987) studied the behavior of stock returns surrounding international listings. While assuming that capital markets are segmented beforehand, they found international listings to decrease the expected return on the security. The expected returns on dual listed securities were found to depend on their covariances with both the domestic and foreign market portfolios. This help to reduce the negative effects of segmentation and integrate the market for the dual listed stocks.

3.3 Capital Markets Integration

In this section we shall review general research on capital markets integration and in particular effects of delistings and listings on market integration. Knowledge of changes in the covariances between markets may prove useful in allocating the country weightings in global portfolio formation and investment management. Understanding capital market integration is also important from a development economics perspective since economic growth is fundamentally linked to financial integration.

If markets are completely integrated, then assets with similar risks would have similar expected returns irrespective of the market. Hence, the benefits may be limited if markets are cointegrated since the common factors between the markets may limit the amount of independent variation. As for corporate finance, if markets are segmented, then managers may be able to engage in investment and financing activities that lessen the effects of segmentation. Stapleton and Subrahmanyam (1977) provide three corporate policies by which managers can reduce the negative effects associated with market segmentation: 1) direct foreign investment, 2) corporate mergers with foreign firms, and 3) listing of securities on foreign exchanges.

In a recent work, Mervyn et.al.(1994) tried to account for the time-variation in the covariances between markets and estimate the level of capital markets integration. They noted average cross-country correlation to display significant variation over time. There were times markets seemed to move in unison like during the 1987 crash while at other times the correlation between them appeared to be low. Using a multivariate factor model on sixteen national markets data, they found idiosyncratic risk to be significantly priced, but however, the price risk was found to be not common across countries. Mervyn et.al (1994) thus contended this being either as evidence against the null of integrated capital markets or the failure of some other maintained assumptions.

Howe and Madura (1990) on the other hand studied the impact of international listings on common stock risk (permanent shifts) and their implications for capital markets integration. They found international listings to cause no significant shifts in risk. Contrary to Mervyn et.al. (1994), they found markets to be already well integrated and thus rendering listings an ineffective mechanism for reducing market segmentation.

Hamao, Masulis and Ng (1990) studied the interdependence of prices and volatility in the short run between three major international stock markets. Using autoregressive conditionally heteroskedastic (ARCH) models to examine the relationships, they found evidence of price volatility spillovers from New York and London to Tokyo and from New York to London but not vice-versa.

In a part of their study, Barclay, Litzenberger and Warner (1990) examined volume and daily price volatility for stocks dual listed on the New York Stock Exchange and the Tokyo Stock Exchange. They found positive correlations in daily close-to-close returns across the stock exchanges. They also noted that the dual listings, despite increasing the trading hours substantially, did not increase the overall variance since the trading of the dual listed stocks were thin in Tokyo. Basically, Barclay et.al. report evidence that substantial increased trading volume is required to affect stock return variance and that this increase in variance is due to private information revealed through trading.

Hung and Cheung (1995) studied the long-term interdependence between the emerging Asian equity markets and found that the five market indices measured in local currency are not cointegrated. But however, they found some evidence of cointegration among the indices when they are measured in terms of U.S. dollars.

Bekaert and Harvey (1995) measured capital market integration using a conditional regime-switching model. Their country specific investigation found some emerging markets to show time-varying integration, while that was not the norm. The Malaysian market is one of the emerging markets found to be integrated.

Ferson and Harvey (1994) on the other hand, studied the behavour of returns and expected returns for eighteen national equity markets using multifactor asset pricing models. They chose factors to measure global economic risks, which includes the return on a world equity market portfolio[5], and found this factor to be the most important factor. However the power of the world market betas to explain the average return differences across the countries was found to be low. Their study also found the Singapore/Malaysia return to be significantly explained by world stock market return

[5]The other monthly risk measures include a measure of exchange rate risk, a Eurodollar-U.S. Treasury bill yield spread, measures of global inflation, real interest rates and industrial production growth.

suggesting these markets to be integrated with the world markets.

From the above review of literature we may conclude that research on market integration seem to be inconclusive. Some report findings supporting market integration while others do not.

CHAPTER 4

HYPOTHESES AND RESEARCH METHODOLOGY

4.1 Hypotheses

The following hypotheses will be tested using stock returns data from both the KLSE and the SES. The time frame for the study is from September 1, 1988 to December 31, 1990 (two years). Figure 1 shows the sample data before and after the delisting. M_1 and M_2 are Malaysia registered stocks dual listed in SES before the delisting. M_2 is retrieved back to KLSE after the delisting while M_1 is traded on the CLOBI, an automated over-the-counter market established by the SES inorder to retain some of the Malaysia stock business after the delisting. Similarly, S is the set of Singapore-registered stocks dual listed on the KLSE, which are ultimately retrieved back to the SES after the delistings.

Hypothesis 1: Delistings decrease Firm Value if alternative trading place (like CLOBI) is not provided.

This hypothesis will be tested using both the Sample M_2 and S (See Figure 1), ie. the stocks that were delisted and retrived back to the respective exchange.

Hypothesis 2: Delistings do not decrease Firm Value if alternative trading place is provided (eg. CLOBI).

Hypothesis 2 is tested on Sample M_1, the Malaysia registered stocks delisted from the SES but then traded on the CLOBI.

Hypothesis 3: Delistings decrease market liquidity

Sample sets M_2 and S are again used here. However for this hypothesis we would determine any change in trading volume in the delisted stocks before and after the delistings event. To measure the effects on market liquidity, studies have also used the bid-ask spread, but unfortunately we do not have the bid-ask data to carry out such tests.

Hypothesis 4: Delistings increase risk and the cost of equity capital.

Here we postulate that delistings increase the riskiness of a stock and hence increase the cost of capital for that stock. We test this hypothesis on sample sets M_2 and S.

The Singapore-Malaysia stock delistings event also gives us an opportunity to test and provide additional evidence on the effects of listings on the same variables, ie. firm value, cost of capital and liquidity. This opportunity is provided by the sample set M_3 , ie. the Malaysia-registered stocks that were previously not listed on the SES before the delistings, but were later traded on the CLOBI immediately after its introduction. Hence with this additional sample, we test the following three hypotheses.

Hypothesis 5: New listings increase Firm Value.

Hypothesis 6: New listings increase market liquidity.

Hypothesis 7: New listings decrease risk and the cost of capital.

The final hypothesis that we test is related to market integration, ie.,

Hypothesis 8: The Malaysia and Singapore Stock Markets are segmented among themselves and with international stock markets (therefore local delistings will have effect on the pricing of risk).

4.2 Data and Sample Selection

The study would use stock data for the delisted firms from both the Singapore and Malaysia exchanges for the period from September 1, 1988 to December 31, 1990. Figure 1 provides a picture of the sample data used in this study. A total of 182 Malaysia and 53 Singapore stocks (Sample S) were delisted on January 2, 1990. Of the 182 Malaysia stocks that were delisted from the SES, 103 (Sample M_1) were subsequently traded on Central Limit Order Book International (CLOBI). The other 79 stocks (Sample M_2) were not traded on CLOBI and hence were traded on KLSE only. In addition to the 103 Malaysia stocks that were subsequently traded on CLOBI, there were another 31 Malaysia stocks (Sample M_3) that were not listed on SES before the delistings but were also traded on CLOBI immediately after its introduction. We would use this sample as a check to see if new listings would provide results opposite to delistings. However due to lack of data availability, our sample sizes are ninety-five for M_1, sixty-one for M_2, twenty-two for M_3 and forty-five for S. As for the market returns, we use the returns on the UK market index[1]. The reason why we use the UK index instead of the KLSE

[1] We chose the UK index since the UK market had historically always affected these markets. It was the British influence during the colonial times that started the stock markets in this region and hence the local markets had always looked to the UK market and responded to its movements.

Composite Index or the SES All-Share Index is because the delisted firms comprise a significant portion of the entire market. Around the time of delistings on January 2, 1990, there were about slightly over 300 counters on both the SES and KLSE. Hence the 182 delisted Malaysia firms for example comprise almost two thirds of the entire listed firms and hence the use of the indices from these markets may not be appropriate. Thus, the use of the UK index may be more suitable here since that will eliminate the possibility of our portfolio of delisted stocks to represent the market index itself.

Basically, the following data sets will be required for the present study: 1) Daily stock returns data for the sample firms in M_1, M_2, M_3 and S; 2) Daily trading volume in local currency for the delisted firms; 3) Daily exchange rate data between the Singapore and Malaysia currencies, ie. the Singapore Dollar and the Ringgit; 4) Local market index returns data for both the exchanges, and 5) World Index and UK index data.

The first three data sets will be acquired from the PACAP Databases[2] while the World index and UK index data are extracted from F-T Actuaries World Indices[3].

4.3 Research Methods

In this section, we underline the research methods used to test each of the above mentioned hypotheses:

Hypothesis 1,2 and 5: Delistings and Listings effect on firm value.

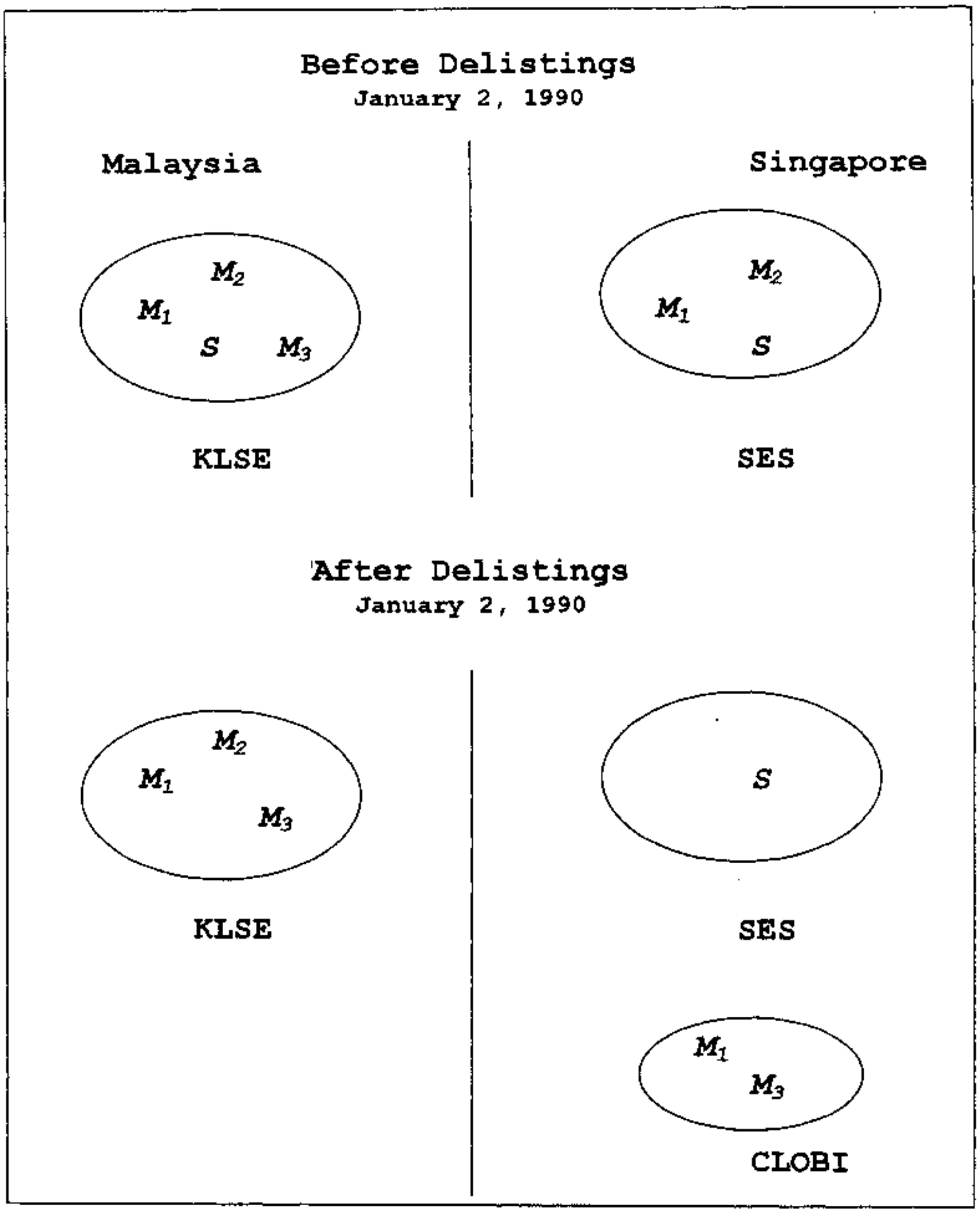
To test the hypothesis that delistings (or listings) affect firm value, this study examines the abnormal stock price performance for the firms that were delisted (sample M_1, M_2 and S) from the KLSE and the SES on January 2, 1990, and stocks that were newly listed on the CLOBI (Sample M_3). The announcement dates for the events were October 27,1989 for the Malaysia stocks to be delisted from the SES and November 9, 1989 for the

2 The PACAP Databases are compiled by the Pacific-Basin Capital Markets Research Center, College of Business Administration, The University of Rhode Island, Kingston, RI 02881-0802.

3 The F-T Actuaries World Indices are published daily in the Financial Times, London. The indices are jointly compiled, among others, by Financial Times Limited and Goldman, Sachs & Co.

FIGURE 1

THE DATA SETS BEFORE AND AFTER DELISTINGS



Key:

M_1 - Malaysia registered stocks delisted from SES but later traded on the CLOBI (95 Stocks)

M_2 - Malaysia registered stocks delisted from SES but are not traded on the CLOBI (61 Stocks)

M_3 - Malaysia registerd stocks that were traded on the CLOBI, but were not listed on the SES before (22 Stocks)

S - Singapore registered stocks delisted from the KLSE, and totally retrieved back to SES (45 Stocks)

Singapore stocks to be delisted from the KLSE (See Table 4.1). To determine the effects of delistings on stock returns and their risk, this paper uses an event study methodology that models the return and variance as ARCH processes with its various extensions if necessary. We justify the methodology below.

4.4 Modeling Time-Varying Volatility.

Stock returns are found to exhibit nonnormal fat-tailed distributions. The nonnormal unconditional sampling distributions are in the form of both skewness and excess kurtosis. The conditional normality assumption in ARCH generates some degree of unconditional excess kurtosis but does not fully account for the nonnormal properties of the data. Fatter tailed conditional distribution, like the t-distribution may be adopted to solve the kurtosis problem. Non-parametric methods are also possible alternatives used in the literature to tackle the excess kurtosis.

It is also well documented in the literature that financial data variance depends on time. Since volatility of returns is an important variable in pricing financial instruments, it is important that financial models take into consideration any time-varying changes in the volatility. A number of research, hence, relate market risk premium to changing volatility. Such studies include Merton (1980), Bollerslev (1987), French, Schwert and Stamburgh (1987), Fama and French (1988), Chou (1988) and Bollerslev, Engle and Wooldridge (1988). As for event-study methodology, the classical methods' assumption of constant variance through the pre-event and post-event periods may underestimate the variance and as Brown and Warner (1985) have noted, this will lead to the rejection of the null hypothesis of zero abnormal returns more frequently than it should. Schwert and Seguin (1990) provide a discussion on heteroskedasticity in stock returns and the importance of incorporating autoregressive conditionally heteroskedastic (ARCH) effects in the residuals of the market models.

Hence to incorporate the time-varying variance, the autoregressive conditionally heteroskedastic (ARCH) model proposed by Engle (1982) is popular in this respect. The conditional variance in an ARCH model depends on past squared values of the disturbance terms. That is shocks to variances are persistent over time, which explain partly the observed heteroskedasticity. Others have modified the ARCH in attempts to improve the estimates. For example since the ARCH(q) model uses a long lag of length q, Bollerslev (1986) suggested the Generalized ARCH (GARCH) model which provides a more flexible alternative to the lag structure. The GARCH process allows for lagged conditional variances to be included as well. As Bollerslev (1986) puts it, this corresponds to some type of adaptive learning mechanism.

In summary, substantial financial research have used ARCH and its various modifications as techniques that characterize changing variances since ignoring such ARCH errors may seriously affect statistical inferences.

4.5 Theoretical Rationale for Variance Persistence.

Eventhough the ARCH and its various modifications seem to give a good fit to the financial data, no substantial theoretical rationale was given until Lamoureux and Lastrapes (1988) examined the ability of trading volume data to explain the source of persistence in stock-return volatility. The study found that the dynamics of daily return variance are due to daily persistence in the latent speed of arrival of information to the market, which lead to similar dynamics in the level of trading volume. The speed of information arrival to the market measures the economic time in contrast to calendar time that is used in most studies. The information flow (i.e. the economic time) is proxied by daily trading volume. They showed that standardized volume adjusted returns tend to be normally distributed and that the ARCH effect, which is modeled to explain heteroskedasticity, is a proxy for time deformation (economic time). In a economic time market model, stock price moves much faster on days with more information flow (e.g. an anouncement day) than those with less information flow.

Locke and Sayers (1993), obtained similar results; that the persistence in the variance structure is captured by proxy variables for the rate of information arrival. Precisely, they examined the role of the rate of information arrival (proxied by variables like contract volume, floor transactions, number of price changes and executed order imbalance) as it relates to variance persistence in the minute-by-minute S&P 500 Index Futures series. They found all the above variables to explain a significant amount of the index returns variance, but however, they noted that some variance persistence still remained regardless of the definition of the rate of information arrival variable.

In another attempt to explain the sources of GARCH and to provide an economic motivation for it, Laux and Ng (1993) used a multivariate GARCH model (as opposed to univariate GARCH models) to distinguish between unique volatility and systematic volatility. Using high frequency data of currency futures market, they demonstrate that autocorrelation in the rate of information arrival proxy variable, number of price changes[4], accounts for a substantial part of the unique volatility, but however systematic volatility remained[5]. Earlier, Diebold (1989) also suggested that is the autocorrelation in the rate of information arrival that leads to persistence in the conditional volatility which are captured by GARCH models.

4.6 Common Event-Date (Calendar Clustering)

An important assumption in event-study methodology is that the abnormal returns for each firm is independently and identically distributed from that of every other firm. Nevertheless, in the case of a common event date (calendar clustering) this is no longer a reasonable assumption since the prediction errors are bound to be correlated. Table 4.1 gives a chronological account of the events associated with the delistings.

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4 This rate of information arrival proxy variable is said to be more inclusive than volume since it also reflects information arrival that does not result in trading, which the volume data would miss.

5 Hence they posit that univariate GARCH models of foreign-exchange futures are misspecified. Their argument is that systematic and unsystematic volatilities evolve at different rates with different persistence, and univariate GARCH models fail to take this into account.

However, since all the events with regard to the delistings are common to all firms in our study, the abnormal returns are bound to depict some cross-sectional correlation.

Since the delistings are expected to affect the firms in a similar manner at least in the direction of the abnormal returns if not the magnitude, the cross-sectional dependence will be positive. Failure to take into consideration the cross-sectional correlation would cause too many rejections of the null hypothesis of zero average abnormal return. We adjust for the cross-sectional correlation problem by forming equal weighted portfolios of Malaysia and Singapore stocks that were delisted.

For purposes of testing hypothesis 1, we specify the return generating process according to three different models to check for robustness of results.

Table 4.1

Chronology of Events In the Event-Window Encompassing the Split Between the SES and the KLSE.

Date	Announcement	Designated Event Date
October 27, 1989	Malaysia Government issued a ruling requiring Malaysia stocks to delist from the SES on December 31, 1989.	D_1
November 9, 1989	Singapore Government retaliated by requiring the Singapore stocks to delist from the KLSE on December 31, 1989.	D_2
November 14, 1989	The SES's annoucement on the establishment of CLOBI.	D_3
December 22, 1989	SES published the list of stocks that will be traded on the CLOBI.	D_4
January 2, 1990	Simultaneous delistings of dual-listed stocks between the KLSE and the SES.	D_5

4.7 The Return-Generating Models

Since most finance research using ARCH models found the GARCH(1,1) to adequately fit financial data well, we use a similar specification as the base return-generating process. Thus, we define the first set of estimated return generating process with GARCH(1,1) errors as below:

$$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t \qquad (4.1)$$

$$\varepsilon_t \sim N(0, h_t) \qquad (4.2)$$

$$h_t = \omega + \beta_1 \cdot h_{t-1} + \alpha_1 \cdot \varepsilon_{t-1}^2 \qquad (4.3)$$

Equation (4.1) is the market model, where

R_t = return on an equally weighted portfolio in the estimation period, t.

R_{mt} = return on the market portfolio, measured by the return on the UK index.

α, β = parameters defined by the estimation period, t.

ε_t = disturbance at time t.

h_t = conditional variance of ε_t.

4.8 Estimation of the Return Generating Models

The return-generating models in this study are estimated using quasi-maximum likelihood estimation (except for the standard OLS method that is done for comparison purposes). While we have assumed the error term to be normally distributed, the quasi-maximum likelihood estimator (QMLE) is robust to violations of this assumption[6]. Bollerslev and Wooldridge (1992) and Lumsdaine (1993) show that the QMLE estimators are consistent and asymptotically normal even when a finite fourth-moment is absent. Bollerslev and Wooldridge (1992) also show that the asymptotic results carry over to finite samples.

Under the QMLE method, the conditional mean and conditional variance functions are jointly parameterized by a finite dimensional vector θ. For the above GARCH(1,1) model, for example, $\theta = (\alpha, \beta, \omega, \alpha_1, \beta_1)'$ and QMLE estimators of the parameters are obtained by maximizing the quasi-log likelihood function, computed from the product of all conditional densities of the prediction errors[7].

$$L_T(R_t,\ldots,R_T;R_{mt},\ldots R_{mT},h_0;\theta) = L_T(\theta) = \sum_{t=1}^{T} l_t(\theta) = -\frac{1}{2}\sum_{t=1}^{T}\ln h_t - \frac{1}{2}\sum_{t=1}^{T}\frac{\varepsilon_t^2}{h_t} \qquad (4.4)$$

6 Initial results of the estimation of the model infact suggested a violation of the normality assumption.

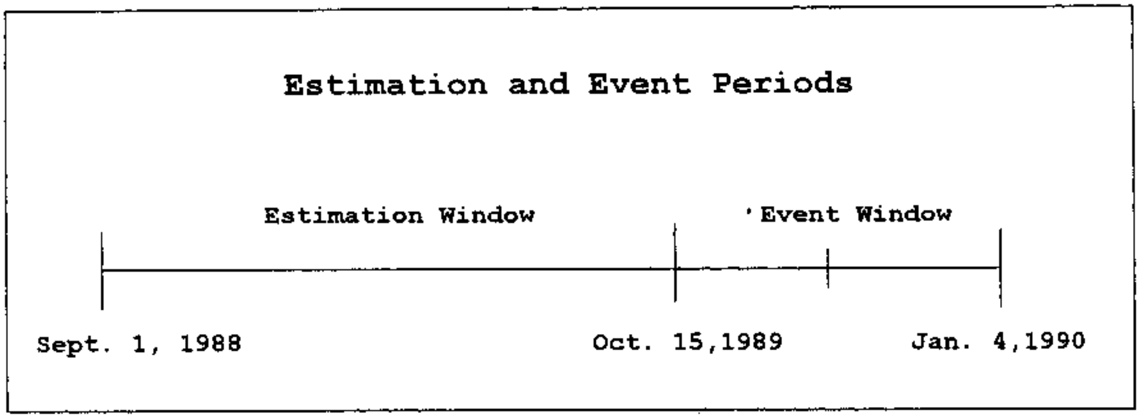
7 For a derivation of the likelihood function, please see Appendix B.

The process h_t is not observed and thus is constructed via recursion from the observed data using the estimated parameter values and an initial starting value h_0 . This starting value is chosen arbitrarily during the estimation process, and dependence on this initial condition is shown to be asymptotically negligible by Lumsdaine (1993).

4.9 Estimation Period, Events and Event Periods

For the event-studies of hypoteses 1, 2 and 5, the estimation periods begin with returns for September 1, 1988 and ends about two weeks prior to the first announcent date, ie. October 27, 1989 (See Table 4.1). The event widow encompasses a period of fifty-seven trading days, from October 16, 1989 - January 4, 1990. This period covers all the relevant events associated with the delistings which are described in Figure 2 below.

Figure 2



For M_1 and M_2, the delisted Malaysia firms, the events D_1 through D_4 except D_2 are expected to affect the portfolio value. D_2, the Singapore government's announcement requiring Singapore firms to delist from the KLSE is not expected to affect Malaysian firm values. For M_3, on the other hand, only event D_4, ie. the announcement of stocks that will be listed on CLOBI, is postulated to affect its value. For the Singapore sample, S, events D_1 and D_2 are hypothesised to affect its value. Unlike for M_1 and M_2, for which the Singapore announcement was not expected to affect their values, the Malaysia government announcent to delist, ie. event D_1 is expected to affect the Singapore sample, *S* since the market may expect a retaliatory move from the Singapore part.

4.10 The Test Statistics

We now define the estimated portfolio abnormal return $\hat{e}_s$ as the prediction error on day *s* in the event window:

$$AR_s = \hat{e}_s = R_s - \hat{\alpha} - \hat{\beta} \cdot R_{ms} \qquad \text{Where } s \in S \qquad (4.5)$$

The cumulative abnormal returns (CAR), as measured by the cumulative prediction error (CPE) is given by:

$$CAR = \sum_{s=1}^{S} AR_s = \sum_{s=1}^{S} \hat{e}_s \qquad (4.6)$$

and to test the hypothesis that an event (delistings or listings) had any effect on the abnormal returns, we test the following null hypothesis:

$$H_0 : CAR_i = 0$$
$$H_a : CAR_i \neq 0$$

The test statistics is,

$$Z = \frac{CAR}{\sigma_{CAR}} \sim N(0,1) \quad (4.7)$$

Where σ_{CAR} is the standard error[8] of the CAR.

4.11 The Time Deformation Model - Volume as a proxy variable for rate of information arrival.

The purpose of using a second return-generating model in our study is to check for robustness of results and to check if a economic time model may be appropriate. As for the second model, following Lamoureux and Lastrapes (1988) and Poon (1989), we specify a economic time market model as below. The economic time is measured by the speed of information flow into the market. Hence in this model the abnormal return is measured with respect to the economic time. The rate of information inflow into the market is proxied by the trading volume.

$$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t \quad (4.8)$$

$$\varepsilon_t | V_t \sim N(0, h_t) \quad (4.9)$$

$$h_t = a_1 + c_1 \cdot V_t \quad (4.10)$$

[8] For a derivation of σ_{CAR} please see the Appendix B.

As in the earlier model, equation (4.8) is the return generating process using the single-index market model. R_t is the return for portfolio at time t in the estimation period. R_{mt} is the daily return for the market as measured by the return on the UK Index (as opposed to KLSE Composite Index or the SES All-Share Index where the case may be). However, equation (4.9) specifies the distribution of the residual, ε_t, conditional on V_t , the average daily trading volume. The conditional distribution of e_t is assumed to be normally distributed with zero mean and variance, h_t. However, the conditional variance, equation (4.10) is specified as a linear function of the trading volume.

As before, we specify the abnormal return as the prediction error on day *s* in the event window,

$$\hat{e}_s = R_s - \hat{\alpha} - \hat{\beta} \cdot R_{ms} \qquad \text{Where } s \in S \qquad (4.11)$$

Again, the cumulative abnormal returns, the hypothesis and the test statistics are as below,

$$CAR = \sum_{s=1}^{S} AR_s = \sum_{s=1}^{S} \hat{e}_s \qquad (4.12)$$

The hypothesis,
$$H_0: CAR = 0$$
$$H_a: CAR \neq 0$$

The test statistics is,

$$Z = \frac{CAR}{\sigma_{CAR}} \sim N(0,1) \qquad (4.13)$$

Where σ_{CAR} is the standard error of the CAR.

The above equations are similar to those of the GARCH(1,1) model, but however the derivation for σ_{CAR} is slightly different[9].

4.12 The OLS Model - Market Model with Constant Variance Assumed.

In this section we would repeat the above event-study using standard event-study approach. Here a

[9] For a derivation of σ_{CAR} please see the Appendix B.

single index market model with constant variance is estimated:

$$R_t = \alpha + \beta R_{mt} + \varepsilon_t \tag{4.14}$$

$$\varepsilon_t \sim N(0,\sigma^2) \tag{4.15}$$

Where now the disturbance term is assumed to be normally distributed with mean zero and a constant variance, σ^2. The definition for abnormal return is as before.

4.13 Test for Shift in Risk and Stochastic Behaviour of Security Price

Hypotheses 4 and 7: Effects of Stock Delistings on Risk and the Stochastic Behaviour of Security Price.

In order to determine the impact of delistings on the risk (we use beta as a measure of systematic risk) and the stochastic behaviour of prices, we employ the following two tests:

1. For the Malaysia registered companies that were delisted from the SES, i.e. the subsets M_1 and M_2 , we perform a test of a shift in average β, the systematic

risk. A similar test is also performed on the sample of Singapore stocks that were delisted from the KLSE, i.e. the sample *S*. The null hypothesis is thus:

$$H_0: \qquad \frac{1}{J}\sum_{j=1}^{J}\left(\beta_{2j} - \beta_{1j}\right) = 0 \qquad (4.16)$$

And we assume cross-sectional correlation,

$$E\left(\mu_{it}, \mu_{jt}\right) = \sigma_{ij} \qquad \forall \ i \neq j \qquad (4.17)$$

Note that since we have common interval for all the stocks, the test for difference in average beta can be substituted with a test for difference in equally weighted portfolio beta. The portfolio returns and beta are respectively given by

$$R_{pt} = \frac{1}{J}\sum_{j=1}^{J} R_{jt} \qquad t \in 1,2 \qquad (4.18)$$

$$\beta_p = \frac{1}{J}\sum_{j=1}^{J} \beta_j \qquad (4.19)$$

and the null hypothesis becomes $H_0: \ \beta_{p2} - \beta_{p1} = 0$.

For each portfolio, we carry out the following regression in pre- and post-delisting periods, with the disturbance term specified to follow GARCH (1,1):

$$R_t = \alpha_i + \beta_i \cdot R_{mt} + \varepsilon_t \tag{4.20}$$
$$\varepsilon_t \sim N(0, h_t) \tag{4.21}$$
$$h_t = \omega_i + b_{1i} \cdot h_{t-1} + a_{1i} \cdot \varepsilon_{t-1}^2 \tag{4.22}$$

i = 1 for pre-delisting period
= 2 for post-delisting period

Where the variables and parameters are as defined for equations 4.1 to 4.3.

To test the above hypothesis for each portfolio, we form the following Z-statistics, assuming independence between the two periods:

$$Z = \frac{\hat{\beta}_2 - \hat{\beta}_1}{\sqrt{Var(\hat{\beta}_2) + Var(\hat{\beta}_1)}} \tag{4.23}$$

2. The second test is used to test for changes in the conditional variance structure after the delistings event. Here, similar to Poon (1989), we would determine if there was any significant structural shift in the conditional variance equation (4.10). In this model, we

assumed the conditional variance to depend on the flow of information into the market, proxied by the trading volume. Therefore, what we are basically testing here is that if there was any change in the structure of conditional variance response to new information. We add dummy variables for the constant and the coefficient of equation (4.10), i.e.

$$h_t = a_1 + a_2 \cdot D + c_1 \cdot V_t + c_2 D \cdot V_t \qquad (4.24)$$

Where D = 0 in the pre-delistings period
= 1 in the post-delistings period

Hence the coefficients a_2 and c_2 give the marginal shift in the intercept and the conditional variance due to the delistings event.

4.14 Test for Shift in Market Liquidity

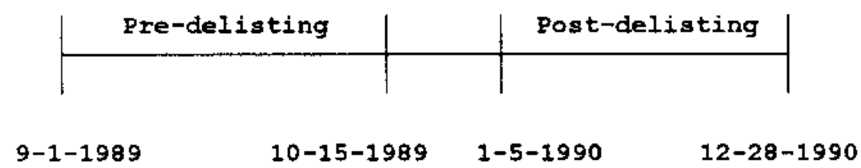
Hypotheses 3 and 6: Effects of Stock Delistings on the Market Liquidity.

To ascertain the effects of stock delistings on the market liquidity of the stocks, we would test for any significant changes in the average daily trading volume for the delisted stocks for about one year period before and after the delistings. Changes in liquidity within the respective local exchanges and within both exchanges together are tested for.

For each stock in a sample, we would compute the total daily dollar volume of the stock traded in both the KLSE and the SES. The volume is stated in a single currency using the prevailing daily exchange rate between the Malaysian Ringgit and the Singapore dollar. We then compute the average daily trading volume in both the pre-delisting and post-delisting periods. We ommit the period between October 15, 1989 and January 5, 1990 since this period encompasses all the relevant events associated with the delistings and the reaction of the market to these events might contaminate the results. This is shown in Figure 3 below:

Figure 3

Test Periods for Average Daily Volume Change
Between Pre- and Post Delistings



The average of observations for each firm is paired and then differenced (to obtain d_i in equation 4.25). We use both parametric and non-parametric methods to test the hypotheses. Simple t-statistics for average difference in paired observations and the Wilcoxon signed rank test are respectively used.

We hypothesize the delistings effects on liquidity to be different for samples M_2 , M_3 and S. Since M_2 and S consists of stock that were delisted and now only available in one of the exchanges, we hypothesize these stocks to be less liquid after the event. At this juncture, we would look for evidence for political motive hypothesis, that Malaysia's decision to delist was taken at a time when a general market upswing was expected. In the event we find support for the political motive hypothesis, we would then proceed to test for relative loss of liquidity for the delisted stocks vis-a-vis stocks unaffected by the event. On the other hand, for M_3, being stocks that were newly listed on CLOBI we hypothesize it to be more liquid after the event, but however within the local exchange we expect no change in liquidity. The hypotheses and the test statistics are thus as below:

4.141 For Liquidity Change (D) Within Local Exchanges.

Portfolio M_1 , $H_0: D = 0$
$H_a: D \neq 0$

Portfolio M_2 , $H_0: D \leq 0$
$H_a: D > 0$

Portfolio M_3 , $H_0: D = 0$
$H_a: D \neq 0$

Portfolio S , $H_0: D \leq 0$
$H_a: D > 0$

Where D is the population parameter for $\bar{d}$ as defined in equation 4.25.

4.142 For Liquidity Change (D) Within Both Exchanges.

Portfolio M_2 , $H_0: D \geq 0$
$H_a: D < 0$

Portfolio S , $H_0: D \geq 0$
$H_a: D < 0$

Porfolios M_1 and M_3 are not tested here due lack of data from the CLOBI.

1. The parametric t-statistics test is:

$$t_{n-1} = \frac{\bar{d}}{s_d / \sqrt{n}} \quad \text{Where} \quad \begin{aligned} \bar{d} &= \frac{\sum d_i}{n} \\ n &= \text{the number of pairs of observations} \\ s_d &= \text{the standard deviation of the } n \text{ differences} \\ &= \sqrt{\frac{\sum d_i^2 - \frac{\left(\sum d_i\right)^2}{n}}{n-1}} \end{aligned} \qquad (4.25)$$

2. The Wilcoxon Signed Rank Test.

Since the samples are large (n > 15), we use a normal approximation to the Wilcoxon test statistics:

$$Z = \frac{T_+ - \mu_{T_+}}{\sigma_{T_+}} \qquad (4.26)$$

Where T_+ - the sum of ranks for the positive differences, and

$$\mu_{T_+} = \frac{n(n+1)}{4} \quad \text{and} \quad \sigma_{T_+} = \sqrt{\frac{n(n+1)(2n+1)}{24}} \qquad (4.27)$$

3. Test for Relative Loss of Liquidity for the Delisted Stocks vis-a-vis Stocks Unaffected by the Event.

To test for relative loss of liquidity for the delisted stocks compared with stocks unaffected by the delistings event, we would compute the following daily ratio in pre- and post delisting periods:

$$p_i = \frac{\text{average daily volume for } M_2}{\text{average daily volume for } M'} \qquad \text{where} \quad i = \begin{array}{l} 1 \text{ for before delistings} \\ 2 \text{ for after delistings} \end{array}$$

Where *M′* (as in Table 5.1) is the portfolio of Malaysia stocks not involved in the delistings event.

We would then test the following hypothesis:

$$H_0: P_1 - P_2 \leq 0$$
$$H_a: P_1 - P_2 > 0$$

Where *P* is the population parameter of $\bar{p}$.

That is the ratio of M_2 average daily volume to average volume of M′ to have decreased in the post-delisting period. A statistical support for the alternative would mean that the relative liquidity of the delisted stocks to have deteriorated. The following Z-statistics is used to test the above hypothesis:

$$Z = \frac{\bar{p}_1 - \bar{p}_2}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}}$$

where $\bar{p}_i$ is the mean in the respective period
s_i^2 is the variance of the respective p's, and
n_i is the sample size in each period.

4.15 Test for Market Segmentation and Shift in Pricing Mechanism

Hypothesis 8: The Malaysia and Singapore Stock Markets are segmented among themselves and with international stock markets; therefore local delistings will have effect on the pricing of risk.

To determine the above effect we propose to study if risk in both the exchanges were infact priced according to some international market portfolio. If before and after the delisting risk were priced according to the international pricing model, then the effects of the delistings on local market integration may not be a significant matter since a significant international market portfolio would mean that global markets are integrated enough to have some significant pricing implication, at least as far as these two exchanges are concerned. If these markets were segmented from the international market, then further delistings from each others markets should increase the degree of segmentation.

The answers to these questions would shed more light on international finance and investments since if markets were infact segmented and stocks not priced according to an international model then, the cost of capital for a project will depend on where it is to be raised. As for portfolio diversification and risk reduction, the benefits depend on the level of international capital market integration.

It is plausible that stocks in the Singapore and Malaysian markets are priced according to some international market portfolio. Cho, Eun and Senbet (1986) found United States and Singapore markets to be most highly integrated with those of other countries'. On the other hand, in a study involving twenty-three markets, Fisher & Palasvirta (1990) found the Singapore and Malaysia markets to be the two most interdependent markets.

We use daily returns data for the period September 1, 1988 to December 28, 1990. However we drop the returns data for the five months from August 1, 1989 till December 31, 1989. This is because all the announcements related to the delistings were made in this period and we take this whole interval to represent the delisting period.

We pool cross-sectional and time series data and estimate the following regression:

$$R_{it} = \alpha + \beta_1 R_{m,t} + \beta_2 R_{s,t} + \beta_3 R_{w,t} + \delta D_t + \beta_4 D_t R_{m,t} + \beta_5 D_t R_{s,t} + \beta_6 D_t R_{w,t} + \varepsilon_t \tag{4.28}$$

Where
R_{it} = Return to stock i on day t
R_{mt} = Return on Malaysia market on day t
R_{st} = Return on Singapore market on day t
R_{wt} = Return on the World index on day t
D_t = Dummy variable, equal 0 for t before delisting and 1 after delisting

β_4, β_5 and β_6 would give the marginal shift in β_1, β_2 and β_3 after the delistings. We hypothesize β_3 to have a greater absolute value than β_1 and β_2, and that β_4, β_5 and β_6 to be not significantly different from zero. This would mean that the return on the world market to be more important than the return on the local market and that this phenomena did not change after the delistings

The test hypothesis for market integration can be written as:

$$H_0: \beta_4 = \beta_5 = \beta_6 = 0$$

$$H_a: \beta_4 \neq 0, \beta_5 \neq 0, \beta_6 \neq 0$$

Significance is tested using the joint F-test for restricted coefficients as shown below:

$$\frac{SSE(H_0) - SSE(H_a)}{SSE(H_a)} \cdot \frac{df(H_a)}{df(H_0) - df(H_a)} \sim F_{df(H_0)-df(H_a),df(H_a)} \qquad (4.29)$$

Where $SSE(H_0)$ = error sum of squares under the restrictions of the null hypothesis

$SSE(H_a)$ = error sum of squares under the alternative hypothesis

$df(H_0)$ = degree of freedom under the null hypothesis, and

$df(H_0)$ = degree of freedom under the alternative hypothesis

Since in the above method we are pooling time series and cross-sectional data, we are bound to violate the usual assumptions for OLS regression[10]. This is because with common time frame for all the stocks, the returns are bound to depict contemporaneous correlation. On top of this, as we have noted in earlier sections, the returns series are lso heteroskedastic. Therefore, the usual F-test may not be carried out. Hence to determine significance we use a randomization procedure. Here the dummy variable D is assigned a value of one or zero without regard to the pre- or post-delisting period, and the F-statistics is then recalculated. This procedure is repeated at least 1,000 times, and the random F-statistics are sorted to obtain a distribution of the F-statistic. Significance is then ascertained by comparing the computed F-value with the sorted randomized F-statistics.

The use of three beta model is rather unusual since most market integration studies use two beta models, the explanatory variables being the domestic and world market indices. We use a three beta model here to reflect the unique delisting event where the "local

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10 Johnston, J, *Econometric Methods*, Third Edition, New York: McGraw Hill, 1984, pp. 397.

market"[11] itself is split into separate Malaysia and Singapore components. If markets are integrated, returns should still be explained in terms of the single beta model, ie. the international CAPM. However, if markets are segmented, then the delistings event of 1990 may cause changes in the significance of the two components of the local market; Malaysia and Singapore. It is for this reason we propose a three beta model.

It is appropriate to discuss here the possibility of multicollinearity in the tested relationship. The market indices of Malaysia and Singapore are expected to be highly correlated. Therefore, it may not be possible to disentangle the separate estimates of the β_1 and β_2 coefficients, and consequently the incremental effects β_4 and β_5 , even though in theory, the estimators are still BLUE (Best Linear Unbiased Estimators). However this problem is not relevant in testing the joint hypothesis above for all incremental effects to be zero.

[11]The Singapore and Malaysia markets may be viewed as a single market before the delistings looking at the historical development of these markets as mentioned in Chapter 2. Infact, some investment companies like Morgan Stanley compile market data for these exchanges as if they were one.

The joint test uses the F-statistics, and this is not weakened by the correlation between the indices of Malaysia and Singapore.

The above hypothesis will be tested using data sets M_1, M_2, M_3 and S. If the markets are segmented, the delisting event would cause incremental changes in β_4 and β_5 that are in opposite directions for M_2 and M_3. M_2 contains Malaysia stocks that used to be traded in Singapore, but now are only available in Malaysia; and now if the markets are segmented, then this change should increase the degree of segmentation. The Malaysia market should become more significant in explaining returns for these stocks and the Singapore market should become less significant in explaining returns for these stocks. If the markets are already integrated, there should be no significant change in the pricing of risk.

M_3, on the other hand contains Malaysia stocks that were not previously listed in Singapore but now listed on CLOBI. Thus if markets were previously segmented, the listing of these stocks on the Singapore over-the-counter market should reduce segmentation. Thus the Singapore market will become more significant in explaining returns for these stocks and the Malaysia market should become less significant in explaining returns for these stocks. However, if the markets were already integrated, this subsequent listing on the Singapore over-the-counter market should have no effect on the pricing of risk. If markets are segmented, then both β_4 and β_5 move in opposite direction for M_2 and M_3.

CHAPTER 5

EMPIRICAL RESULTS

5.1 Descriptive Statistics of the Samples

Table 5.1 below gives the descriptive statistics for each of the sample portfolios M_1, M_2, M_3 and S, calculated from the pre-delistings period data set. It is obvious from the statistics that M_2, the Malaysia stocks that were delisted from SES but not traded on CLOBI are thinly traded stocks that depict a mean daily trading volume of about only RM42,000 while M_1 and M_3, the stocks that were traded on CLOBI show much higher average daily volumes, of about RM248,000 and RM335,000 respectively. M', the portfolio of other stocks, ie. apart from those delisted, show an average of RM69,207 which is higher than that of M_2. Also M_2 show a low mean daily return of only 0.3134 percent while M_1 , M_3 and M' show 0.8314%, 0.7548% and 0.3925% respectively. The Singapore dual listed stocks, S, show a mean daily volume of about S$608,000 with a mean daily portfolio return of 0.524%. The figures for SES-listed stocks, apart from those delisted, S′, are S$268,271 and 0.5904%.

The last item in the table measures for the dual listed stocks, the mean daily volume traded in the foreign stock exchange as a ratio of the daily volume in the local exchange. For example a ratio of 1.6693 for M_1 indicates that these stocks are traded about 167% times in the Singapore market than in the Malaysia market, eventhough these are Malaysia-registered. Thus these stocks are heavily traded in Singapore and gives us an idea why the Singapore authorities listed these on the CLOBI after their delisting from the Stock Exchange of Singapore. The ratio for M_2 is about 44%, ie. the volume of trade in Singapore is about 44 percent of the volume in Malaysia. However for the Singapore stocks, this ratio is only about 19 percent. Therefore it is obvious that the Singapore stocks are only thinly traded in Malaysia. The above observations could be partly the reason why the Malaysia authorities called for the delisting of Malaysia stocks from the SES - a retaliation on the Singapore part would not significantly affect the Malaysia market.

5.2 Event Study Results

5.21 Test for Conditional Heteroskedasticity and Parameter Estimates.

Table 5.2 below gives the tests for mispecification and for the presence of conditional heteroskedasticity for each of the portfolios M_1, M_2, M_3 and S. We tested if GARCH(1,1) errors add[1] explanatory power over a constant variance assumption using loglikelihood values. The Ljung-Box (1978) portmanteau statistics Q(10) and $Q^2(10)$ test for up to 10th order serial correlation in $\hat{\varepsilon}_t$ and $\hat{\varepsilon}_t^2$ respectively. A high and significant Q^2 value indicates misspecification and the presence of conditional heteroskedasticity.

The Ljung-Box statistics provide evidence against a constant variance specification. The $Q^2(10)$ statistics

[1] In most cases, the literature found GARCH(1,1) to sufficiently capture conditional heteroskedasticity in finance data. However, we did carry out other variations of the model including higher order GARCH estimates up to GARCH(2,2) with moving average, MA and autoregressive, AR specifications. All these variations did not add explanatory power over GARCH(1,1) except for M_2 and S where MA(1)-GARCH(1,1) did.

are significant at the 5 percent level for all the portfolios, thus indicating the presence of conditional heteroskedasticity. Portfolios M_2, M_3 and S also seem to depict serial correlation in the $\hat{\varepsilon}_t$ since the Q-statistics are significant for these. However, the GARCH(1,1) specification seem to have accounted for the conditional heteroskedasticity in all the portfolios since the Q^2 - statistics are no longer significant, or only marginally so, compared with the critical chi-square values[2]. However, there is evidence of serial correlation for portfolios M_2 and S; an MA(1)-GARCH(1,1) specification, which incorporates a lag in response to new information, proved sufficient for modeling the serial correlation.

Tables 5.3a to 5.3d give the quasi-maximum likelihood estimates for each of the portfolio M_1, M_2, M_3

[2] It is documented in the literature that with heteroskedastic and/or leptokurtic errors, the Chi-square critical values for the Q-statistics computed from the estimated residuals are inappropriate. However, a high value is still indicative of mispecification. See Diebold (1987) and Baillie and Bollerslev (1990) for example.

Table 5.2

Tests for Presence of Conditional Heteroskedasticity

	M_1	M_2	M_3	S
Model: Constant Variance				
$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$ $\varepsilon_t \sim N(0, h_t)$ $h_t = \omega$				
Loglikelihood Value (L_1):	-432.074	-135.701	-552.689	-288.232
Q(10)	15.1287	28.8526*	20.2822*	23.2093*
Q^2(10)	36.1756*	43.8557*	24.1204*	31.1231*
Model: GARCH(1,1)				
$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$ $\varepsilon_t \sim N(0, h_t)$ $h_t = \omega + \beta_1 \cdot h_{t-1} + \alpha_1 \cdot \varepsilon_{t-1}^2$				
Loglikelihood Value (L_2):	-424.922	-126.0935	-512.3619	-274.8308
$2(L_2-L_1)^a$=	14.304*	19.215*	80.624*	26.802*
Q(10)[b]	13.0410	21.0746*	5.1126	26.5757*
Q^2(10)[b]	13.6377	19.1507*	1.1008	3.9831
Model: MA(1)-GARCH(1,1)				
$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t + \theta\varepsilon_{t-1}$ $\varepsilon_t \sim N(0, h_t)$ $h_t = \omega + \beta_1 \cdot h_{t-1} + \alpha_1 \cdot \varepsilon_{t-1}^2$				
Loglikelihood Value (L_3):	-	-119.7631	-	-270.0252
$2(L_3-L_2)^c$ =	-	12.6948*	-	9.6112*
Q(10)	-	6.1013	-	15.3645
Q^2(10)	-	19.4135*	-	3.6382

[a] $2(L_2-L_1)$ ~ chi-square distributed with 2 degrees of freedom.
[b] Q(10), Q^2(10) ~ chi-square distributed with 10 degrees of freedom.
[c] $2(L_3-L_2)$ ~ chi-square distributed with 1 degree of freedom.
Critical chi-square values: $\chi^2_{1,.05} = 3.8415$; $\chi^2_{2,.05} = 5.9915$; $\chi^2_{10,.05} = 18.307$

and S respectively. For comparison purposes we also provide the ordinary least squares estimates. From the tables, it is obvious that all the portfolio residuals do depict conditional heteroskedasticity. The ARCH-parameter $\hat{\alpha}_1$, and the GARCH-parameter $\hat{\beta}_1$, are significant at 5 percent level for all using the maximum-likelihood estimation, except for portfolio S, the $\hat{\alpha}_1$ is not significant. However, the quasi-maximum likelihood estimation that takes into account departures from the normality assumption gives significant ARCH and GARCH parameters for only M_2, the smaller capitalized stocks. The robust t-values are greater than 2 for these estimates. Nevertheless, the GARCH-parameters are still significant for M_1 and M_3, the larger capitalized stocks that were traded on CLOBI. Portfolio S too showed similar dynamics with those of M_1 and M_3. The M_1 robust t-value for $\hat{\beta}_1$ is 2.0863 while for M_3 and S it is 4.3304 and 2.4353 respectively. The maximum likelihood estimation for $\hat{\beta}$ are also significant for all of them at least at the 5 percent level. Eventhough there is evidence of conditional variance, the simple ordinary least squares (OLS) estimates are not so different from the maximum-likelihood GARCH estimates for M_1, M_2 and S. However, for M_3, the $\hat{\beta}$ from OLS turned out to be not significant.

5.22 Volume as a proxy variable for rate of information flow

In this section we report if volume successfully accounted for the conditional heteroskedasticity for each of the portfolios. Analysis of the time deformation models is presented in Table 5.4 below. While in the constant variance case all the portfolios depicted the presence of conditional heteroskedasticity, inclusion of volume in the conditional variance equation seem to have accounted for the conditional heteroskedasticity only for portfolio M_2, the smaller capitalized stocks. For M_1, M_3 and S, the larger heavily traded stocks, the Q^2-statistics remained significant. From the loglikelihood values, it is obvious that inclusion of the volume had increased the explanatory power of the model but however, it seem to have accounted for only the serial dependence in $\hat{\varepsilon}_t$, and not in the conditional variance. The above results seem to suggest that volume as a proxy variable for rate of information inflow is appropriate only for smaller capitalized and thinly traded stocks. Whereas for the larger heavily traded stocks, volume is not a good proxy for rate of information inflow. We believe this is so since institutional investors are normally involved in the larger capitalized stocks, who buy and sell stocks for reasons like liquidy purposes, arbitrage portfolios and hedge portfolios. Thus, their actions may not necessarily be responses to news pertaining to the stocks in their portfolios[3]. Whereas for the thinly traded stocks, buying and selling decisions are made primarily based on information pertaining to the stocks. Hence for these stocks volume seems to be a good proxy for rate of information inflow.

[3] We also tried if absolute deviations from the mean volume could account for the conditional heteroskedasticity. The mean being a proxy for normal institutional investing and the deviation being a proxy for reaction to news inflow. However such a procedure did not account for the conditional heteroskedasticity.

Table 5.4

Test for Presence of Conditional Heteroskedasticity in the Time Deformation Models

Portfolio	M_1	M_2	M_3	S
Time Deformation Model.				
$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$ $\varepsilon_t \| V_t \sim N(o, h_t)$ $h_t = a_1 + c_1 \cdot V_t$				
Loglikelihood Value (L_2):	-432.056	-121.1718	-489.1751	-281.6755
$2(L_2-L_1)^a=$	0.0360	29.0584*	127.0278*	13.113*
$Q(10)^b$	15.0813	17.8066	12.2621	29.3494*
$Q^2(10)^b$	35.1602*	17.9400	28.2145*	33.4723*
Model: Constant Variance				
$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$ $\varepsilon_t \sim N(o, h_t)$ $h_t = \omega$				
Loglikelihood Value (L_1):	-432.074	-135.701	-552.689	-288.232
$Q(10)$	15.1287	28.8526*	20.2822*	23.2093*
$Q^2(10)$	36.1756*	43.8557*	24.1204*	31.1231*

[a] $2(L_2-L_1)$ ~ chi-square distributed with one degree of freedom.
[b] $Q(10)$, $Q^2(10)$ ~ chi-square distributed with 10 degrees of freedom.
Critical chi-square values: $\chi^2_{1,.05} = 3.8415$; $\chi^2_{10,.05} = 18.307$

Tables 5.5a to 5.5d provide the quasi-maximum likelihood estimates for the time deformation models for each of the portfolios. As expected from information from Table 5.4, the coefficient for volume for M_1,ie. $\hat{c}_1$, is not significant. Also the parameter estimates of the market model and their significane are not so different from an ordinary least squares estimate. For M_2, $\hat{c}_1$ is significant as expected with a parameter value of 0.003204 and a robust t-statistics value of 5.13683, which is significant at the 1 percent level. Compared to an OLS estimate the $\hat{\beta}$ is not so different. While the constant term, $\hat{\alpha} = 0.08475$, was significant in the OLS, it is no longer in the time deformation model. Hence volume seem to be a good proxy for the rate of information flow for the thinly traded stocks. As for M_3, eventhough $\hat{c}_1 = 0.003717$ is significant at the 1 percent level, we know that this is because it accounted for the serial dependence in $\hat{\varepsilon}_t$, and not the conditional heteroskedasticity. Therefore the values of $\hat{\alpha}$ and $\hat{\beta}$ in the market model are very different from that of an OLS estimate. For portfolio *S*, eventhough $\hat{c}_1$ is significant, its inclusion increased the values of both the Q(10) and $Q^2(10)$ statistics (See Table 5.4), thus did not provide evidence against misspecification.

5.23 EVENT-STUDY RESULTS

Having observed some evidence of conditional heteroskedasticity and the parameter estimates, we provide in Tables 5.6a to 5.6d the event-study results using GARCH models, for portfolio M_1, M_2, M_3 and S respectively. The event window encompasses fifty-seven trading days. For all these portfolios we do not report the first seven days in the event window, and thus start from day 8, which is two trading days before the Malaysia announcement on delistings. This is because on the first day in the event-window (Monday, October 16, 1989), the market was reacting nervously to a 191-point plunge in Wall Street on Friday October 13, 1989. Most stocks posted heavy losses and the KLSE composite index fell 12.027 percent. M_1, M_2 and M_3 showed a daily return of -14.668 percent, -6.541 percent and -13.784 percent respectively[4]. We refrained from including in our analysis, this day and the following six days to avoid contaminating our results, especially the cumulative abnormal returns.

Table 5.6a provides the event-study results for portfolio M_1, the Malaysia stocks that were delisted from SES but then traded on the CLOBI. This portfolio lost 3.89 percent of value (significant at the 1 percent level) on the day following the Malaysia announcement on the delistings (event D_1). However, the Singapore announcement on the delistings (event D_2) and the announcement of the establishment of the CLOBI (event D_3) did not have any statistically significant reaction on the returns. The reason for this could be that the market might have already anticipated such a reaction from the Singapore side and the announcement on the CLOBI did not identify the stocks to be listed yet. Nevertheless, when the list of companies to be traded on CLOBI was released (event D_4), the portfolio did show an

[4] Again, it is the heavily traded stocks that seem to react strongly to international news. M_1 and M_3 moved closely with the market while M_2 reacted only about half that of the market.

increase of 3.48 percent on the following day (significant at the 1 percent level). Event D_5 is the delistings day when the stocks ceased to be traded on SES but traded for the first time on the CLOBI. On this day and the following day the portfolio depicted significant abnormal returns of 2.81 and 2.73 percent respectively. There may be some end-of-the-year effect but may not be very pronounced since this portfolio comprises large firms. For the window(8-17), the portfolio showed a cumulative abnormal return of -11.84 percent (significant at the 1 percent level). These days encompass two trading days prior to the delisting announcement and end two days before the Singapore announcement. As for the CLOBI listing announcement we computed the cumulative abnormal returns (CAR) for the window(49-57). This window begins a day prior to the release of the list and encompasses three CLOBI trading days. The CAR for this window is 11.21 percent and is significant at the 1 percent level. Therefore we notice that while the portfolio lost 11.84 percent during the ten trading days encompassing the announcement, it gained 11.21 percent due to the CLOBI listing announcement.

Now we compare the above results with that of M_2, the Malaysia stocks that were delisted from SES, but were not traded on the CLOBI. These were small capitalization stocks that were thinly traded. It appears from Table 5.6b that on the day following the Malaysia announcement the portfolio depicted negative abnormal return of 1.38 percent which is significant at the 1 percent level. On the same day M_1 showed a negative abnormal return of 3.89 percent. For the window(8-17), the cumulative abnormal return is negative 4.13 percent only, compared with negative 11.84 percent for M_1. As for M_1, the Singapore announcement on the delistings and the establishment of the CLOBI did not have any significant impact on the returns. The positive abnormal return of 1.01 percent, a day prior to the delisting announcement is not consistent with theory and may be reaction to some other news. However this portfolio seems to depict significant positive abnormal returns in the days of waiting for CLOBI list to be released and also during the trading days encompassing the D_4, the day the CLOBI list was released. However two days after this release it showed a significant negative abnormal return of 0.46 percent. Again when the market opened for trade for the new year, the portfolio showed significant abnormal returns (0.47% and 0.57% on day 55 and 56 in the event window). The significance of these could also be attributed to end-of-year effect depicted strongly by the generally small firms contained in this portfolio. Overall we see this portfolio consisting of thinly traded stocks to be volatile and probably trading dominated by speculators. While this portfolio lost only about 4 percent of its value due to delisting news, it gained about 3 percent during listing announcement period which we believe is contaminated by the end-of-year effect.

Table 5.6c gives the results for M_3, the Malaysia stocks that were previously not traded on SES but now traded on the CLOBI. On the day prior to the release of the CLOBI list, the portfolio showed a significant positive abnormal return of 3.1254 percent. The cumulative abnormal return for the window(4-12) which comprises the same trading days as window(49-57) for M_1 and M_2, is 11.8755 percent. Therefore M_1 and M_3 being heavily trade stocks, reacted to the listing news with an increase of firm value of over 11 percent.

Interestingly however, the portfolio of Singapore stocks that were delisted from the KLSE did not seem to have reacted to any of the relevant announcements. There were no significant abnormal returns at all, except on day 12 where there was a significant positive abnormal return of 1.5431 percent. This must have been due to some contaminating event since we expect a negative reaction as its Malaysia counterpart. We contend that the Singapore stocks did not show any significant reduction in firm value due to the delisting announcements because these stocks are thinly traded in Malaysia. Earlier in Table 5.1 we showed that the volume of trade for these stocks in Malaysia is only about 19% of that in Singapore. Therefore we may expect the market liquidity for these stocks not to be significantly affected due to the delistings and hence their non-reaction to the news.

5.24 Comparison of the GARCH results with the OLS results

In this section we compare the above GARCH results with that of an OLS model that assumes constant variance in the estimation and the event window. The purpose of this part is to see if accounting for the conditional heteroskedasiticity gives results that are very different from that of a simple OLS method. Table 5.7a to 5.7d report the OLS event-study results for M_1, M_2, M_3 and S respectively. While the abnormal returns are very close in both the methods, the GARCH estimates seem to report slightly a lower variance[5]. For M_1 and S, the abnormal returns, the cumulative abnormal returns and their significance are very close in both models. For M_2 however, some of the significant abnormal returns in

[5] For M_3, the GARCH method gives larger variances. This might be due to the effect of including the returns on October 16, 1989 in the estimation period, where stocks reacted strongly to a 191-point plunge in Wall Street on Friday, October 13, 1989. We did not discard this observation since GARCH uses lagged values.

the GARCH method were no longer significant in the OLS method since OLS has higher variances. The cumulative abnormal returns in the windows considered and their significance were nevertheless, very close to each other. For M_3 too the abnormal returns and the cumulative abnormal returns are quite close.

Overall we conclude that the use of GARCH specifications, eventhough the returns data did depict variance clustering, did not alter event-study results very different from a simple OLS approach.

5.25 Comparison of the Time Deformation Model results with the GARCH and OLS results

Tables 5.8a to 5.8d report the event-study results using the time deformation model. We had earlier found that volume was able account for the conditional heteroskedasticity only for portfolio M_2, the smaller capitalized stocks.

From the tables it is obvious that the time deformation models have higher abnormal return variance than the GARCH or OLS method. For M_1, since the volume did not add any explanatory power to the model, the time deformation results are close to that of the OLS results. This is because the constant term in the conditional variance equation remained significant whereas the OLS method assumes constant variance by construction. For M_2, the larger abnormal return variances rendered all abnormal returns insignificant except for the day after the Malaysia announcement. Thus for this model, for which volume was a good proxy for rate of information flow, most of the significant abnormal returns are no longer significant when time is measured in economic time. The cumulative abnormal returns for the windows considered are slightly different from the earlier two methods and are significant only at the 5 percent level whereas they were significant at the 1 percent level before. For M_3, nevertheless, all the abnormal returns and the window(4-12) turned out to be not significant. This is because the abnormal return variances are much higher for this portfolio than that from the other models. Unlike for M_1, the results for M_3 are not close to that of OLS because the constant term in the conditional variance equation is no longer significant. In turn, the coefficient for volume turned out to be significant[6]. Therefore, inclusion of volume seem to have distorted the results for this portfolio. For portfolio *S* too, volume did not explain the conditional variance. Event-study results are very close to that of OLS method.

Overall we may conclude that volume as a proxy for rate of information inflow is appropriate for only the thinly traded stocks and that the time deformation model renders most abnormal returns insignificant which are otherwise found significant using the GARCH or OLS method. For the heavily traded stocks, volume is not an appropriate proxy variable for rate of information inflow and time deformation models either do not produce very different results than that of OLS or seem to produce totally insignificant results due to high variances.

[6] We would like remind here that volume did not account for the conditional heteroskedasticity for M_3, but rather the dependence in $\hat{\varepsilon}_t$.

5.3 TEST FOR BETA SHIFT

In this section we report the test for beta shift from periods before and after the stock delistings. We did a quasi-maximum likelihood estimation for both the periods and report the Z-statistics for difference in beta for each of the portfolios.

Table 5.9

Z-Values for Beta Shift

Portfolio M_1: $$Z = \frac{\hat{\beta}_2 - \hat{\beta}_1}{\sqrt{Var(\hat{\beta}_2) + Var(\hat{\beta}_1)}} = \frac{0.307042 - 0.149859}{\sqrt{0.081153^2 + 0.069948^2}} = 1.4671$$

Portfolio M_2: $$Z = \frac{\hat{\beta}_2 - \hat{\beta}_1}{\sqrt{Var(\hat{\beta}_2) + Var(\hat{\beta}_1)}} = \frac{0.199307 - 0.064792}{\sqrt{0.048438^2 + 0.027223^2}} = 2.4209^*$$

Portfolio M_3: $$Z = \frac{\hat{\beta}_2 - \hat{\beta}_1}{\sqrt{Var(\hat{\beta}_2) + Var(\hat{\beta}_1)}} = \frac{0.231688 - 0.387032}{\sqrt{0.061206^2 + 0.132170^2}} = -1.0665$$

Portfolio S : $$Z = \frac{\hat{\beta}_2 - \hat{\beta}_1}{\sqrt{Var(\hat{\beta}_2) + Var(\hat{\beta}_1)}} = \frac{0.093536 - 0.115861}{\sqrt{0.044309^2 + 0.038755^2}} = -0.3792$$

* Significant at the 5 percent level.

From Table 5.9, it is obvious that relative to the UK index as a surrogate for market, only portfolio M_2, the thinly traded stocks that were delisted from SES and totally retrieved to KLSE show a statistically significant shift in the beta. This is as expected by the theory. The total retrieval of these stocks from SES to KLSE will establish a barrier for Singapore investors to trade on these stocks. These stocks will be less scrutinized by Singapore professionals and thus the quality of information and forecasts for these stocks may be affected. On top of those, there is also exchange rate risk need to be considered eventhough investors may be able to trade in these through brokers in Singapore. Portfolio *S*, however did not show a significant fall in beta. We contend that this is again due to the reason that Singapore stocks are thinly traded in Malaysia.

Portfolio M_1, which was delisted from SES but then traded on CLOBI showed an increase in beta but however is not statistically significant. This is expected since there is only a shift in the location of trading for these stocks in Singapore, ie. from SES to CLOBI. Thus these stocks will be scrutinized by investors as they were scrutinized before.

Portfolio M_3, the Malaysia stocks that were never listed on SES but then listed on CLOBI showed a drop in its beta value but however is also not statistically significant. Since these stocks will now be more stringently scuritinized especially by professionals, more accurate and reliable information and forecasts may be expected. Thus we hypothesised these stocks to depict a fall in the beta. However, the insignificance of the shift suggest that the market does not expect these stocks to be no less riskier than before. This may be because Singapore investors might have tracked these stocks even before they were traded on CLOBI given the limited choice they had with the SES listings.

5.4 TEST FOR CHANGE IN CONDITIONAL VARIANCE STRUCTURE

Table 5.10 below provide the results of test for change in conditional variance structure.

Table 5.10

Test for Change in Conditional Variance Structure

Parameter	a_2	c_2
Portfolio M_1	-0.90169 (-2.33917)*	0.00238 (0.77570)
Portfolio M_2	-0.10567 (-1.91765)	-0.00373 (-1.44253)
Portfolio M_3	-0.57877 (-3.41825)*	0.00312 (2.07562)*
Portfolio S	0.04569 (0.24952)	0.00063 (1.18664)

Values in parentheses are robust t-values;
* - Significant at the 5 percent level.

Earlier we reported that volume proved to be a good proxy for rate of information flow only for the thinly traded stocks. Therefore the above test for change in conditional variance structure turned out to be a test if a change in volume changes the conditional variance structure. Hence the results of this section seem to be related to the liquidity analysis of the next section. M_2, the thinly traded stock, did not show any change in the conditional variance structure, eventhough earlier it was only for this portfolio volume was able to explain conditional variance. For M_1 and S , volume did not explain conditional variance earlier and no change in this is noted after the delistings. However, M_3, the newly dual listed portfolio, depicted significant changes in both the constant and the parameter estimates. We contend this is due to the fact that the ability of Singapore investors to trade in them in Singapore itself after the delistings event, brings about a fall in the trading volume for this portfolio in KLSE. The sign of the non-parametric statistics in Table 5.12 suggests this fall eventhough the statistics itself is insignificant.

5.5 DELISTINGS AND MARKET LIQUIDITY OF THE STOCKS

5.51 Market Liquidity Within Local Exchanges

In this section we report any change in the market liquidity for stocks in each of the above portfolios in KLSE, after the delistings. We computed the average daily trading volume for each stock in each portfolio in the pre- and post-delisting periods and then used parametric and non-parametric techniques on paired observations (d_i) to test for change. The results for each portfolio are given in Table 5.11.

It is obvious from Table 5.11 that the mean difference in trading volume per stock is significantly different from zero for portfolio M_1 and M_2. However for M_3 the test could not reject a null of zero difference. M_1 and M_2 being the delisted stocks tend to show an increase in trading volume in KLSE since Singapore investors would now totally or partly trade the stocks here. M_1 show a mean positive difference of RM287,530 per day per stock while M_2 show a mean difference of RM136,173. M_1 show an increase eventhough it is traded on CLOBI in Singapore. Hence the place of trading seem to have an effect on liquidity. CLOBI being an automated over-the-counter market seem not to be as prestegious as listing on the main stock exchange, ie. SES. The increase in the volume of trading is part of what the Malaysia authorities and stock brokers wanted from the delistings. Hence the above result seem to show that the objective was met.

We substantiate the above results with the non-parametric technique, ie. Wilcoxon Signed Rank Test. Normal approximations to the Wilcoxon Signed Rank Test are reported in Table 5.12.

Table 5.12

Wilcoxon Signed Rank Test
Normal Approximations

Portfolio M_1:	$Z = \frac{T_+ - \mu_{T_+}}{\sigma_{T_+}} = \frac{3474 - 2280}{269.406756} = 4.43196^{**}$
Portfolio M_2:	$Z = \frac{T_+ - \mu_{T_+}}{\sigma_{T_+}} = \frac{1309 - 945.5}{139.221945} = 2.610939^{**}$
Portfolio M_3:	$Z = \frac{T_+ - \mu_{T_+}}{\sigma_{T_+}} = \frac{101 - 126.5}{30.801786} = -0.82787$
Portfolio S:	$Z = \frac{T_+ - \mu_{T_+}}{\sigma_{T_+}} = \frac{450 - 517.5}{88.5932} = -0.76191$

**Significant at the 1 percent level.

The above non-parametric technique, as its parametric counterpart, also gives significant mean difference in daily volume for portfolios M_1 and M_2, while failing to reject the null of zero mean difference for M_3 and S.

5.52 Liquidity Analysis Using Both Exchanges

In this section we shall analyze the change in market liquidity for the stocks that were delisted and retrieved totally to their respective local markets, ie. portfolio M_2 and S. M_1 and M_3 are not analyzed here since we do not have volume data from CLOBI.

Table 5.13 reports both the parametric and non-parametric tests for the liquidity change. We hypothesized portfolio M_2 to experience a drop in average trading volume after the delistings. However, in contrary, the parametric test showed a significant increase in trading volume while the non-parametric test did not provide evidence against a zero change[7]. However, this result is consistent with the political motive hypothesis. Malaysia seem to have decided on

[7] The non-parametric test may be more appropriate here since the data set for this test has high skewness and kurtosis values.

Table 5.13

Tests for Shift in Market Liquidity Using Both the Exchanges, SES and KLSE for the Delisted Stocks

Portfolio	M_2	S
Parametric test:		
Number of Stocks (n)	60[a]	45
Mean difference $(\bar{d})$	RM122.7095	S$3.6779
Skewness	3.08655	2.936244
Kurtosis	9.11747	15.90893
Standard deviation (s_d)	351.2704	453.1381
t: $\bar{d} = 0$	2.7059 (0.0089)[b]	0.0544 (0.9568)
Non-Parametric test: (Normal approximation to the Wilcoxon Signed Rank Test)		
$Z = \dfrac{T_+ - \mu_{T_+}}{\sigma_{T_+}}$	0.84658	-1.36015

Relative Liquidity Test for M_2 vis-a-vis M'

$$Z = \frac{\bar{p}_1 - \bar{p}_2}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}} = \frac{0.619969 - 0.489281}{\sqrt{\dfrac{0.236987^2}{272} + \dfrac{0.388515^2}{244}}} = 4.5496^{**}$$

[a] One firm had incomplete data-set in SES, hence its ommission.
[b] p-Values in parentheses.
** Significant at the 1 percent level.

delistings when a general market upswing was expected since even the delisted stocks showed an increase in trading volume in the post-delisting period. However, this portfolio's relative liquidity vis-a-vis the unaffected stocks have deteriorated as shown in the last panel. The Z-value of 4.5496 is significant at the 1 percent level. Nevertheless, portfolio *S* did not show any significant change in average trading volume. Again we attribute this to the fact that Singapore stocks were thinly traded in the Malaysian market.

5.6 Market Integration Test Results

Table 5.14 below reports the Pearson correlation coefficient values between the Malaysia (KLSE), Singapore (SES) and World (WRLD) indices. The Malaysia and Singapore market indices depict a high correlation of 0.88 which is significant at 0.01 percent level. However, the correlation coefficient between KLSE and WRLD is 0.44 while its value between SES and WRLD is 0.45 (both are significant at the 0.01 percent level). The correlation values alone thus seem to indicate that both the Malaysia and Singapore markets are, to some degree, integrated with the world markets. We substantiate the above result by investigating the effects of market delistings on the Malaysia and Singapore stocks.

Tables 5.15a to 5.15c report the test for pricing changes due to delistings. Owing to the high correlation between KLSE and SES, multicollinearity is bound to pose a problem in interpreting individual coefficients of the regression. Table 5.15a show that the Malaysia market has become more sensitive to the local index after the

Table 5.14

Pearson Correlation Coefficients Between the SES, KLSE and the World Indices

	KLSE	SES	WRLD
KLSE	1.0000 (0.0)	0.8810 (0.0001)	0.4448 (0.0001)
SES	0.8810 (0.0001)	1.0000 (0.0)	0.4536 (0.0001)
WRLD	0.4448 (0.0001)	0.4536 (0.0001)	1.0000 (0.0)

KLSE, SES and WRLD represent the Kuala Lumpur Composite Index, All-Singapore Index and the World Index. P-Values in parentheses.

delistings but however, the t-tests cannot be depended upon for accurate significant levels. The negative coefficient for the Singapore market index, SES for example, simply suggests the presence of multicollinearity. The joint F-test shows that the pricing change is not significant since the F-value for the joint test has a significance level[8] of 0.933. While generally an F-value equal 19.92 would be significant, its insignificant using the randomization procedure prove our test to be powerful. The results also indicate a no change in the pricing of risk for Singapore stocks after the delistings, although the coefficient for the Singapore index has declined while the coefficients for Malaysia and World indices has increased. Subsequent tests are aimed at confirming the above results by looking at the subsets of the data.

Table 5.15b reports changes in the pricing of delisted stocks, ie. M_2 and S. These stocks are the most likely to be effected by pricing changes, but

[8] The significance of the F-values are determined using the randomization procedure outlined in Chapter 4.

however, both these portfolios too show no change in the pricing mechanism after delistings. The respective F-values are 22.82 and 6.23 , both being not significant.

Table 5.15c contains stocks for which either the pricing is expected to reflect more integration after delistings or is expected to remain unchanged. The first panel contains portfolio M_3. If the Malaysia and Singapore stock markets are somewhat segmented, then these stock should show an increased sensitivity to the Singapore index and a decreased sensitivity to the Malaysia and World indices after the delistings. However, the results again show no significant change in the pricing of risk. Although the change coefficients for the Singapore and Malaysia indices move in the expected direction after the delisting, the F-value of 1.12 is not significant at all.

The second and third panels of Table 5.15c report results for stocks that are not expected to be effected by the delistings. The second panel consists of portfolio M_1 which were available in Singapore before and after the delistings while the third panel consists of Singapore stocks apart from those involved in the delistings event. As expected, the insignificant F-values support a no change in the pricing mechanism.

We failed to reject the null of market integration for all the portfolios considered. Therefore we do not have statistical proof that the Malaysia and Singapore markets are segmented. Hence, we contend that the above no change in pricing of risk after the delistings as shown by every portfolio considered, together with the correlation analysis, are in line with findings that the Malaysia and Singapore markets are somewhat globally integrated.

CHAPTER 6

SUMMARY, CONCLUSIONS AND IMPLICATIONS OF STUDY

6.1 Summary and Conclusion

6.11 Wealth Effects of Stock Delistings

We examined the effects of stock delistings on firm value, risk, market liquidity and market integration. We specified the return generating process using three different models; with GARCH errors, Time-Deformation and the OLS Model. Using stocks dual listed between the stock exchanges of Malaysia and Singapore, we found delistings to decrease firm value. The above wealth effect seems to be related to how actively the stocks are traded on the foreign stock exchange. For example, the larger capitalized Malaysia stocks delisted from the SES showed a cumulative abnormal return of -11.84 percent in the two weeks encompassing the delisting announcement. However, the lesser capitalized stocks showed a drop of only 4.13 percent in the same period. The Singapore stocks that were thinly traded in Malaysia did not show any fall in firm value at all. A listing news, on the other hand, was found to increase firm value. A cumulative abnormal return of 11.88 percent was showed by the Malaysia stocks that were newly listed on the CLOBI, in the two weeks encompassing the news of listing. Therefore this study supports earlier findings that delistings bring about a fall in firm value whereas new listings increase the value.

There seem to be a lag in reaction to news since significant abnormal returns are depicted generally on the day following the announcement day. Therefore the markets are not quick to impound news in security prices. However efficiency is still portrayed since significant adjustment takes place within a day.

While all portfolios showed the existence of conditional heteroskedasticity, a comparison of the abnormal returns results with a standard OLS event-study yields similar conclusions, although the return generating model with GARCH errors results in lower variances for the abnormal returns.

Analysis of the time-deformation model showed that volume is a good proxy for rate of information flow for only smaller capitalized stocks. For heavily traded stocks volume proved to be a bad proxy variable for information flow. We contend that this is due to the reason that institutional investors are usually involved in the trading of larger capitalized stocks, who buy and sell for a variety investment reasons like liquidity, arbitrage portfolios and hedging risk. Compared with GARCH and OLS framework, the Time-Deformation model depicted the largest abnormal return variances.

6.12 Shift in Beta and Stochastic Behavior of Stock Price

As for a shift in beta, we found only the smaller capitalized stocks that were totally retrieved from a foreign exchange, to show a shift in beta. Those that were listed again (in CLOBI) or that were not actively traded in the foreign market did not show any significant change in beta value. The above result is in line with theory, that delisting indirectly creates a trading barrier for the stocks. Delisted stocks would also be lesser scrutinized and followed by professionals, which in turn may affect the quality of information and forecasts pertaining to these stocks.

6.13 Market Liquidity

Our findings show that stocks that are heavily traded on a foreign stock market tend to show a significant increase in volume of trade in the local market after being delisted from the foreign market. This is only as expected.

As for market liquidity as a whole, contrary to what was expected, the Malaysian stocks totally retrieved back did not show a decrease in trading volume. Infact, the parametric statistics showed an increase in volume for this portfolio. We contend that this supports the political motive hypothesis that Malaysia made a move to delist its stocks at a time when markets were expected to experience a general uptrend, so that it can successfully split itself and develop independently from Singapore. However, the delisted stocks still showed a loss in relative liquidity compared to other stocks. The Singapore stocks did not show any evidence of change in liquidity. Again after all, these stocks were not actively traded in Malaysia in the first place.

6.14 Market Segmentation and Shift in Pricing Mechanism

The market segmentation analysis showed that securities in Kuala Lumpur Stock Exchange (KLSE) and the Stock Exchange of Singapore are to some extent priced according the World index. This suggests that the KLSE and SES are integrated among themselves and to some degree with the international markets, such that a major delistings event between these two markets did not change the pricing of stocks in these markets.

6.2 Implications of the Results of this Study

The above results have implications for both the firm and the economy of a nation as a whole. As far as the firm is concerned, it should strive to list its stock in other markets as possible. Not only this would increase the firm value, it would also bring about other benefits of dual listing like opening itself a wider choice of capital markets while improving the marketability and thus liquidity of the securities it issues. The firm should also strongly oppose any attempts to delist its stock since this brings about the opposite effects of listing, i.e. fall in firm value, restricted capital market, poorer marketability and liquidity of its stock.

However, as far as the economy as a whole is concerned, the effects of delistings may be mixed. While firms may experience a negative wealth effect, the increased liquidity of the stocks in the home market would increase income to other sectors of the economy, especially the brokerage firms. The net effect may even be positive since the fall in firm value is a one time fall where as the income to brokerage firms would be a continuos one. Hence Malaysia's decision to delist its stocks from Singapore may actually bring about a net benefit even though the decision harms the firms. International investors would now be forced to trade with Malaysia brokers and thus indirectly help the development of the Malaysia market[1]. Hence, while delistings may bring about economic benefits to segmented markets, Malaysia being an integrated market, seems to have decided delistings for national interests, that is to bring home some of the benefits of its stock tradings without the intermediation of the Singapore market.

Stocks that are heavily traded on a foreign market should resist delisting since this action would increase its risk and hence the cost of capital. Its choice of internationally competitive rates would now be limited.

Our analysis of market segmentation suggest that when markets are somewhat integrated, delistings may not affect the pricing of risk in these markets. However, our results do not necessarily imply that if markets are segmented, delistings would affect the pricing mechanism.

[1] This action may also contain an option value for Malaysia since all these years the Malaysia market developed in the shadow of the Singapore market. Most international investors traded Malaysia stocks through Singapore brokers.

APPENDIX A

TABLES

Table 5.1

Univariate Statistics of the Data Sets[a]

Portfolio:	M_1	M_2	M_3	S	M'^{b}	S'^{b}
No. of Firms in Portfolio[c]	95	61	22	45	123	142
Mean daily volume per firm[d]	RM247,646	RM42,338	RM335,405	S$608,031	RM69,207	S$286,271
Std. deviation of volume	RM186,012	RM69,656	RM218,445	S$898,419	RM127,715	S$559,032
Mean daily portfolio return	0.8314%	0.3134%	0.7548%	0.5240%	0.3925%	0.5904%
Standard deviation of return	0.7362%	0.2729%	0.6531%	0.4142%	0.3316%	0.4277%
Skewness of daily return	1.7726	1.5441	1.7957	1.6230	1.7138	1.3640
Kurtosis of daily return	4.9600	3.0860	5.4615	4.9682	4.5051	3.5483
Ratio of mean daily foreign volume over local volume	1.6693	0.4376	-	0.1930	-	-

a - These figures are computed using data from the pre-delisting period.
b - Portfolios M' and S' comprise of firms apart from those delisted, traded on KLSE and SES respectively.
c - Portfolio size is constrained by the availability of data.
d - volume is stated in Ringgit (Malaysia currency) and Singapore dollar respectively.

Table 5.3a

Quasi-Maximum Likelihood Estimates for Porfolio M_1

		Parameter Estimate	Std.Error	t-value	Robust Std.Error	Robust t-value
Model: GARCH(1,1)	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$;	$\varepsilon_t \sim N(o, h_t)$;	$h_t = \omega + \beta_1 \cdot h_{t-1} + \alpha_1 \cdot \varepsilon_{t-1}^2$			
	$\hat{\alpha}$	0.186114	0.073113	2.54557*	0.064983	2.86404**
	$\hat{\beta}$	0.149859	0.075627	1.98115*	0.069948	2.14245*
	$\hat{\omega}$	0.453408	0.311096	1.45746	0.267275	1.69641
	$\hat{\alpha}_1$	0.138708	0.062895	2.20538*	0.086582	1.60203
	$\hat{\beta}_1$	0.528677	0.245655	2.15211*	0.253405	2.08630*
Ordinary Least Squares Estimate		$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$;	$\varepsilon_t \sim N(o, \sigma^2)$			
	$\hat{\alpha}$	0.198146	0.072217	2.743767**		
	$\hat{\beta}$	0.161492	0.075946	2.126395*		

*, ** - Significant at the 5 percent and 1 percent level respectively.

Table 5.3b

Quasi-Maximum Likelihood Estimates for Porfolio M_2

		Parameter Estimate	Std.Error	t-value	Robust Std.Error	Robust t-value
Model: MA(1)-GARCH(1,1)	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t + \theta\varepsilon_{t-1}$; $\varepsilon_t \sim N(o,h_t)$; $h_t = \omega + \beta_1 \cdot h_{t-1} + \alpha_1 \cdot \varepsilon_{t-1}^2$					
	$\hat{\alpha}$	0.080359	0.031163	2.57863**	0.025386	3.16545**
	$\hat{\beta}$	0.064792	0.021557	3.00564**	0.027223	2.38007*
	$\hat{\theta}$	0.232129	0.065687	3.53387**	0.069024	3.36303**
	$\hat{\omega}$	0.036236	0.018021	2.01072*	0.024092	1.50406
	$\hat{\alpha}_1$	0.160009	0.075078	2.13125*	0.076273	2.09785*
	$\hat{\beta}_1$	0.598169	0.157407	3.80014**	0.207336	2.88502**
Ordinary Least Squares Estimate	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$; $\varepsilon_t \sim N(o,\sigma^2)$					
	$\hat{\alpha}$	0.084750	0.024291	3.48901**		
	$\hat{\beta}$	0.063499	0.025545	2.48577*		

*, ** - Significant at the 5 percent and 1 percent level respectively.

Table 5.3c

Quasi-Maximum Likelihood Estimates for Porfolio M_3

		Parameter Estimate	Std.Error	t-value	Robust Std.Error	Robust t-value
Model: GARCH(1,1)	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$;	$\varepsilon_t \sim N(o, h_t)$;	$h_t = \omega + \beta_1 \cdot h_{t-1} + \alpha_1 \cdot \varepsilon_{t-1}^2$			
	$\hat{\alpha}$	0.069980	0.066173	1.05754	0.112634	0.62130
	$\hat{\beta}$	0.387032	0.055372	6.98962**	0.132170	2.92829**
	$\hat{\omega}$	0.415304	0.149250	2.78261**	0.184760	2.24780*
	$\hat{\alpha}_1$	0.587927	0.116363	5.05253**	0.507335	1.15885
	$\hat{\beta}_1$	0.356438	0.117307	3.03851**	0.082310	4.33043**
Ordinary Least Squares Estimate		$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$;	$\varepsilon_t \sim N(o, \sigma^2)$			
	$\hat{\alpha}$	0.253922	0.078037	3.25387**		
	$\hat{\beta}$	0.053012	0.077927	0.68027		

*, ** - Significant at the 5 percent and 1 percent level respectively.

Table 5.3d

Quasi-Maximum Likelihood Estimates for Porfolio *S*

		Parameter Estimate	Std.Error	t-value	Robust Std.Error	Robust t-value
Model: MA(1)-GARCH(1,1)	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t + \theta\varepsilon_{t-1}$; $\varepsilon_t \sim N(o,h_t)$; $h_t = \omega + \beta_1 \cdot h_{t-1} + \alpha_1 \cdot \varepsilon_{t-1}^2$					
	$\hat{\alpha}$	0.103523	0.045939	2.25351*	0.041158	2.51524*
	$\hat{\beta}$	0.115861	0.042346	2.73606**	0.038755	2.98960**
	$\hat{\theta}$	0.177723	0.064691	2.74723**	0.067946	2.61563**
	$\hat{\omega}$	0.133024	0.078207	1.70093	0.082461	1.61318
	$\hat{\alpha}_1$	0.154240	0.079813	1.93252	0.079157	1.94853
	$\hat{\beta}_1$	0.528739	0.239651	2.20629*	0.217114	2.45331*
Ordinary Least Squares Estimate	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$; $\varepsilon_t \sim N(o,\sigma^2)$					
	$\hat{\alpha}$	0.109065	0.040928	2.66480**		
	$\hat{\beta}$	0.120938	0.043595	2.77413**		

*, ** - Significant at the 5 percent and 1 percent level respectively.

Table 5.5a

Quasi-Maximum Likelihood Estimates for Portfolio M_1: Time Deformation Model

		Parameter Estimate	Std.Error	t-value	Robust Std.Error	Robust t-value
Time Deformation Model:	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$; $\varepsilon_t \mid V_t \sim N(o, h_t)$; $h_t = a_1 + c_1 \cdot V_t$					
	$\hat{\alpha}$	0.187307	0.071685	2.61293**	0.071800	2.60875**
	$\hat{\beta}$	0.164868	0.076702	2.14947*	0.076120	2.16591*
	$\hat{a}_1$	1.331051	0.221752	6.00243**	0.207210	6.42368**
	$\hat{c}_1$	0.000256	0.000814	0.31496	0.000608	0.42126
Ordinary Least Squares Estimate	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$; $\varepsilon_t \sim N(o, \sigma^2)$					
	$\hat{\alpha}$	0.198146	0.072217	2.743767**		
	$\hat{\beta}$	0.161492	0.075946	2.126395*		

*, ** - Significant at the 5 percent and 1 percent level respectively.

Table 5.5b

Quasi-Maximum Likelihood Estimates for Porfolio M_2: Time Deformation Model

		Parameter Estimate	Std.Error	t-value	Robust Std.Error	Robust t-value
Time Deformation Model:	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$; $\varepsilon_t \mid V_t \sim N(o, h_t)$; $h_t = a_1 + c_1 \cdot V_t$					
	$\hat{\alpha}$	0.028261	0.022032	1.28276	0.021106	1.33900
	$\hat{\beta}$	0.064965	0.024421	2.66020**	0.023443	2.77177**
	$\hat{a}_1$	0.034088	0.013960	2.44184*	0.014255	2.39135*
	$\hat{c}_1$	0.003204	0.000552	5.80066**	0.000624	5.13683**
Ordinary Least Squares Estimate	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$; $\varepsilon_t \sim N(o, \sigma^2)$					
	$\hat{\alpha}$	0.084750	0.024291	3.48901**		
	$\hat{\beta}$	0.063499	0.025545	2.48577*		

*, ** - Significant at the 5 percent and 1 percent level respectively.

Table 5.5c

Quasi-Maximum Likelihood Estimates for Porfolio M_3:

Time Deformation Model

		Parameter Estimate	Std.Error	t-value	Robust Std.Error	Robust t-value
Time Deformation Model:	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$; $\varepsilon_t \| V_t \sim N(o,h_t)$; $h_t = a_1 + c_1 \cdot V_t$					
	$\hat{\alpha}$	0.113591	0.057990	1.95880	0.057089	1.98974*
	$\hat{\beta}$	0.155514	0.061434	2.53138*	0.064263	2.41996*
	$\hat{a}_1$	0.185435	0.074130	2.50147*	0.195764	0.94723
	$\hat{c}_1$	0.003717	0.000226	16.43088**	0.001374	2.70474**
Ordinary Least Squares Estimate	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$; $\varepsilon_t \sim N(o,\sigma^2)$					
	$\hat{\alpha}$	0.253922	0.078037	3.25387**		
	$\hat{\beta}$	0.053012	0.077927	0.68027		

*, ** - Significant at the 5 percent and 1 percent level respectively.

Table 5.5d

Quasi-Maximum Likelihood Estimates for Portfolio *S*: Time Deformation Model

		Parameter Estimate	Std.Error	t-value	Robust Std.Error	Robust t-value
Time Deformation Model:	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$; $\varepsilon_t \mid V_t \sim N(o, h_t)$; $h_t = a_1 + c_1 \cdot V_t$					
	$\hat{\alpha}$	0.076668	0.040828	1.87784	0.039089	1.96139*
	$\hat{\beta}$	0.118508	0.048055	2.46611*	0.039532	2.99779**
	$\hat{a}_1$	0.236050	0.047484	4.97116**	0.087305	2.70374**
	$\hat{c}_1$	0.000369	0.000090	4.11917**	0.000174	2.12645*
Ordinary Least Squares Estimate	$R_t = \alpha + \beta \cdot R_{mt} + \varepsilon_t$; $\varepsilon_t \sim N(o, \sigma^2)$					
	$\hat{\alpha}$	0.109065	0.040928	2.664799**		
	$\hat{\beta}$	0.120938	0.043595	2.774133**		

*, ** - Significant at the 5 percent and 1 percent level respectively.

Table 5.6a

Event-Study Results for M_1: GARCH(1,1) Model

M_1 contains 95 Malaysia-Registered firms delisted from the Stock Exchange of Singapore but later traded on the Central Limit Order Book International (CLOBI)

	Days into Event Window	AR(%)	VAR(AR)	Z-Value	CAR(%)	VAR(CAR)	Z-Value
	8	-2.2392	1.3559	-1.9230	-2.2392	1.3559	-1.9230
	9	-0.3099	1.3594	-0.2656	-2.5491	2.7163	-1.5467
D1	10	-0.6642	1.3669	-0.5681	-3.2133	4.1024	-1.5865
	11	-3.8939	1.4577	-3.2252**	-7.1072	5.6451	-2.9913**
	12	-0.1561	1.3755	-0.1331	-7.2633	6.9680	-2.7516**
	13	0.1507	1.3749	0.1285	-7.1125	8.3262	-2.4649*
	14	0.0731	1.3718	0.0624	-7.0394	9.7178	-2.2582*
	15	-1.3604	1.3761	-1.1597	-8.3999	11.1772	-2.5125*
	16	-2.9333	1.3755	-2.5011*	-11.3332	12.5786	-3.1955**
	17	-0.5098	1.3683	-0.4358	-11.8429	14.0134	-3.1636**
	18	1.4663	1.3682	1.2535	-10.3766	15.4597	-2.6391**
D2	19	0.2435	1.3788	0.2074	-10.1331	16.9187	-2.4635*
	20	-0.1462	1.3674	-0.1250	-10.2793	18.3862	-2.3973*
	21	0.2969	1.3673	0.2539	-9.9824	19.8634	-2.2398*
D3	22	0.5347	1.3674	0.4573	-9.4477	21.3494	-2.0447*
	23	2.1292	1.3674	1.8208	-7.3184	22.8439	-1.5312
	24	-0.4888	1.3683	-0.4179	-7.8072	24.3435	-1.5824
	25	-0.0233	1.3674	-0.0199	-7.8305	25.8544	-1.5400
	26	1.4578	1.3674	1.2467	-6.3727	27.3733	-1.2180
	27	0.5652	1.3908	0.4793	-5.8075	28.9158	-1.0800
	28	0.7119	1.3687	0.6085	-5.0956	30.4438	-0.9235
	29	0.6069	1.3677	0.5189	-4.4888	31.9854	-0.7937
	30	1.4415	1.3719	1.2307	-3.0472	33.5332	-0.5262
	31	1.2863	1.3675	1.1000	-1.7610	35.0944	-0.2973
	32	0.3971	1.3674	0.3396	-1.3639	36.6641	-0.2252
	33	0.1622	1.3718	0.1385	-1.2016	38.2478	-0.1943
	34	-0.2254	1.3712	-0.1925	-1.4270	39.8474	-0.2261
	35	-0.0635	1.3726	-0.0542	-1.4905	41.4675	-0.2315
	36	0.2066	1.3745	0.1762	-1.2839	43.1135	-0.1955
	37	0.3705	1.3680	0.3168	-0.9135	44.7111	-0.1366
	38	0.4836	1.3780	0.4120	-0.4298	46.3976	-0.0631
	39	0.7887	1.3779	0.6719	0.3589	48.1134	0.0517
	40	1.0518	1.3678	0.8993	1.4107	49.7320	0.2000
	41	0.9990	1.3718	0.8530	2.4097	51.4428	0.3360
	42	1.1278	1.3676	0.9644	3.5376	53.1120	0.4854
	43	0.6410	1.3766	0.5463	4.1786	54.8868	0.5640
	44	-1.1526	1.3681	-0.9854	3.0260	56.5924	0.4022
	45	-0.2235	1.3687	-0.1911	2.8025	58.2241	0.3673
	46	0.6024	1.3682	0.5150	3.4049	59.8771	0.4400
	47	-0.2329	1.3685	-0.1991	3.1720	61.6140	0.4041
	48	0.0735	1.3701	0.0628	3.2455	63.2556	0.4081
	49	1.3612	1.3713	1.1624	4.6067	65.0446	0.5712
D4	50	1.4567	1.3680	1.2455	6.0634	66.7981	0.7419
	51	3.4823	1.3714	2.9736**	9.5458	68.6159	1.1524
	52	-1.1584	1.3679	-0.9905	8.3873	70.3869	0.9997
	53	0.9995	1.3761	0.8520	9.3868	72.2818	1.1041
	54	-0.5265	1.3687	-0.4501	8.8602	73.9760	1.0301
D5	55	2.8102	1.3720	2.3992*	11.6705	75.8535	1.3400
	56	2.7341	1.3686	2.3370*	14.4045	77.6885	1.6343
	57	0.0537	1.3746	0.0458	14.4583	79.6303	1.6202
Window (8-17)		...	...	...	-11.8429	14.0134	-3.1636**
Window (49-57)		...	...	...	11.2128	12.7842	3.1360**

* ; ** - Significant at the 5 percent and 1 percent level respectively.

D1 - Malaysia announcement on delistings; D2 - Singapore announcement on delistings; D3 - Establishment of CLOBI announced; D4 - List of companies to be traded on CLOBI released; D5 - Delistings day / CLOBI first trading day

Table 5.6b

Event-Study Results for M_2: MA(1)- GARCH(1,1) Model

M_2 contains 61 Malaysia-registered firms delisted from the Stock Exchange of Singapore but subsequently not traded on the Central Limit Order Book (CLOBI)

	Days into Event Window	AR(%)	VAR(AR)	Z-Value	CAR(%)	VAR(CAR)	Z-Value
	8	-0.9718	0.0479	-4.4426**	-0.9718	0.0479	-4.4426**
	9	0.3486	0.0475	1.5994	-0.6232	0.0955	-2.0165*
D1	10	-0.2917	0.0482	-1.3292	-0.9149	0.1467	-2.3885*
	11	-1.3809	0.0617	-5.5598**	-2.2958	0.2219	-4.8733**
	12	-0.2894	0.0487	-1.3106	-2.5852	0.2628	-5.0434**
	13	-0.0951	0.0485	-0.4318	-2.6803	0.3087	-4.8242**
	14	0.1378	0.0479	0.6292	-2.5425	0.3595	-4.2402**
	15	-0.1287	0.0486	-0.5836	-2.6712	0.4213	-4.1152**
	16	-0.7153	0.0484	-3.2528**	-3.3865	0.4734	-4.9219**
	17	-0.7413	0.0473	-3.4098**	-4.1279	0.5308	-5.6659**
	18	1.0126	0.0472	4.6588**	-3.1153	0.5898	-4.0563**
D2	19	0.0332	0.0488	0.1501	-3.0821	0.6502	-3.8222**
	20	-0.0690	0.0471	-0.3180	-3.1511	0.7127	-3.7326**
	21	0.0103	0.0471	0.0474	-3.1408	0.7766	-3.5641**
D3	22	0.3469	0.0471	1.5986	-2.7939	0.8417	-3.0453**
	23	0.1208	0.0471	0.5567	-2.6731	0.9082	-2.8050**
	24	-0.2185	0.0472	-1.0053	-2.8916	0.9758	-2.9273**
	25	-0.0937	0.0471	-0.4319	-2.9853	1.0448	-2.9207**
	26	0.6104	0.0471	2.8127**	-2.3749	1.1151	-2.2491*
	27	0.1350	0.0507	0.5993	-2.2399	1.1908	-2.0527*
	28	0.3246	0.0473	1.4927	-1.9154	1.2621	-1.7050
	29	0.3053	0.0471	1.4062	-1.6101	1.3356	-1.3932
	30	0.6118	0.0477	2.8003**	-0.9983	1.4095	-0.8409
	31	0.8907	0.0471	4.1038**	-0.1077	1.4861	-0.0883
	32	0.9022	0.0471	4.1574**	0.7945	1.5641	0.6353
	33	0.6139	0.0477	2.8102**	1.4084	1.6432	1.0987
	34	0.1031	0.0476	0.4725	1.5115	1.7248	1.1509
	35	0.2504	0.0478	1.1449	1.7620	1.8092	1.3099
	36	-0.0036	0.0481	-0.0165	1.7583	1.8973	1.2765
	37	0.3971	0.0472	1.8279	2.1555	1.9799	1.5318
	38	0.3102	0.0486	1.4063	2.4656	2.0737	1.7122
	39	0.4123	0.0486	1.8698	2.8779	2.1718	1.9529
	40	0.3622	0.0472	1.6678	3.2401	2.2575	2.1565*
	41	0.3652	0.0477	1.6716	3.6053	2.3554	2.3492*
	42	0.2743	0.0471	1.2637	3.8796	2.4480	2.4796*
	43	-0.2077	0.0484	-0.9437	3.6719	2.5549	2.2972*
	44	-0.1906	0.0472	-0.8775	3.4813	2.6528	2.1374*
	45	0.4776	0.0473	2.1957*	3.9589	2.7408	2.3913*
	46	1.1316	0.0472	5.2069**	5.0905	2.8320	3.0250**
	47	-0.3927	0.0472	-1.8066	4.6979	2.9344	2.7425**
	48	0.3048	0.0475	1.3981	5.0027	3.0244	2.8766**
	49	1.5687	0.0476	7.1866**	6.5715	3.1340	3.7120**
D4	50	0.6230	0.0472	2.8684**	7.1944	3.2391	3.9974**
	51	0.4495	0.0477	2.0591*	7.6439	3.3530	4.1745**
	52	-0.4632	0.0472	-2.1333*	7.1807	3.4608	3.8600**
	53	0.3988	0.0484	1.8137	7.5795	3.5854	4.0029**
	54	0.0968	0.0473	0.4452	7.6764	3.6831	3.9999**
D5	55	0.4673	0.0478	2.1387*	8.1437	3.8056	4.1745**
	56	0.5655	0.0473	2.6013**	8.7092	3.9227	4.3973**
	57	-0.3263	0.0481	-1.4873	8.3829	4.0543	4.1633**
Window (8-17)					-4.1279	0.5308	-5.6660**
Window (49-57)					3.3802	0.4944	4.8071**

* ; ** - Significant at the 5 percent and 1 percent level respectively.

D1 - Malaysia announcement on delistings; D2 - Singapore announcement on delistings; D3 - Establishment of CLOBI announced; D4 - List of companies to be traded on CLOBI released; D5 - Delistings day / CLOBI first trading day

Table 5.6c

Event-Study Results for M_3: GARCH(1,1) Model

M_3 contains 22 Malaysia-registered stocks that were not previously listed on the Stock Exchange of Singapore but then were listed on the Central Limit Order Book.

	Days into Event Window	AR(%)	VAR(AR)	Z-Value	CAR(%)	VAR(CAR)	Z-Value
	1	0.5997	0.7455	0.6945	0.5997	0.7455	0.6945
	2	-0.1050	1.1412	-0.0983	0.4947	1.9049	0.3584
	3	0.7338	1.4720	0.6048	1.2285	3.3889	0.6673
	4	3.1254	1.8478	2.2992*	4.3538	5.3321	1.8855
D4	5	2.7913	2.1385	1.9087	7.1451	7.6045	2.5910**
	6	0.2895	2.4610	0.1846	7.4346	10.3182	2.3145*
	7	-0.9597	2.7158	-0.5824	6.4749	13.2688	1.7775
	8	-0.2349	3.0340	-0.1348	6.2400	16.8070	1.5221
	9	1.0790	3.2154	0.6017	7.3190	20.1261	1.6315
D5	10	2.9012	3.4983	1.5512	10.2203	24.1851	2.0782*
	11	2.6927	3.6990	1.4000	12.9130	28.3806	2.4239*
	12	0.1909	3.9477	0.0961	13.1039	33.1607	2.2756*
Window (4-12)					11.8755	29.0094	2.2049*

* ; ** - Significant at the 5 percent and 1 percent level respectively.

D4 - List of companies to be traded on CLOBI released; D5 - Delistings day / CLOBI first trading day

Table 5.6d

Event-Study Results for S: MA(1)- GARCH(1,1) Model

S contains 45 Singapore-registered stocks that were delisted from the Kuala Lumpur Stock Exchange and totally retrieved back to the Stock Exchange of Singapore.

	Days into Event Window	AR(%)	VAR(AR)	Z-Value	CAR(%)	VAR(CAR)	Z-Value
	8	-0.9027	0.4143	-1.4024	-0.9027	0.4143	-1.4024
	9	-0.2792	0.4164	-0.4327	-1.1819	0.8318	-1.2959
D1	10	-0.2915	0.4195	-0.4500	-1.4734	1.2589	-1.3132
	11	-0.2795	0.4480	-0.4175	-1.7529	1.7362	-1.3303
	12	1.5431	0.4229	2.3729*	-0.2098	2.1461	-0.1432
	13	-0.1615	0.4230	-0.2484	-0.3713	2.5677	-0.2317
	14	-0.2118	0.4222	-0.3259	-0.5831	3.0006	-0.3366
	15	-0.4845	0.4237	-0.7444	-1.0676	3.4561	-0.5743
	16	-0.4066	0.4235	-0.6249	-1.4743	3.8936	-0.7471
	17	-0.2415	0.4214	-0.3720	-1.7158	4.3425	-0.8234
	18	0.3927	0.4214	0.6049	-1.3231	4.7958	-0.6042
D2	19	-0.1705	0.4247	-0.2616	-1.4936	5.2530	-0.6517
	20	0.5535	0.4213	0.8528	-0.9401	5.7147	-0.3933
	21	0.1990	0.4212	0.3066	-0.7411	6.1800	-0.2981
D3	22	-0.2967	0.4213	-0.4571	-1.0378	6.6488	-0.4025
	23	-0.1669	0.4213	-0.2571	-1.2047	7.1210	-0.4514
	24	-0.3752	0.4216	-0.5779	-1.5799	7.5960	-0.5732
	25	0.1313	0.4213	0.2023	-1.4486	8.0748	-0.5098
	26	0.2425	0.4213	0.3737	-1.2061	8.5570	-0.4123
	27	0.3887	0.4286	0.5937	-0.8174	9.0494	-0.2717
	28	0.4674	0.4217	0.7197	-0.3500	9.5356	-0.1133
	29	0.2548	0.4214	0.3926	-0.0952	10.0269	-0.0301
	30	-0.0698	0.4226	-0.1073	-0.1649	10.5202	-0.0508
	31	0.3921	0.4213	0.6041	0.2272	11.0192	0.0684
	32	0.5720	0.4213	0.8812	0.7992	11.5217	0.2354
	33	-0.0603	0.4226	-0.0927	0.7389	12.0282	0.2130
	34	-0.3232	0.4224	-0.4973	0.4157	12.5404	0.1174
	35	-0.4042	0.4229	-0.6216	0.0115	13.0593	0.0032
	36	-0.0021	0.4234	-0.0033	0.0093	13.5867	0.0025
	37	0.3120	0.4215	0.4805	0.3213	14.1022	0.0856
	38	0.5384	0.4245	0.8264	0.8597	14.6430	0.2247
	39	0.7028	0.4245	1.0787	1.5625	15.1935	0.4009
	40	-0.0324	0.4214	-0.0499	1.5302	15.7176	0.3860
	41	-0.2950	0.4226	-0.4538	1.2351	16.2688	0.3062
	42	0.1866	0.4214	0.2874	1.4217	16.8093	0.3468
	43	0.4982	0.4241	0.7650	1.9199	17.3808	0.4605
	44	0.2230	0.4215	0.3434	2.1428	17.9336	0.5060
	45	-0.7000	0.4217	-1.0779	1.4428	18.4662	0.3358
	46	0.1689	0.4216	0.2601	1.6117	19.0058	0.3697
	47	0.3675	0.4216	0.5659	1.9792	19.5704	0.4474
	48	0.5605	0.4222	0.8627	2.5397	20.1089	0.5664
	49	0.5349	0.4225	0.8229	3.0746	20.6902	0.6759
D4	50	1.0593	0.4215	1.6317	4.1339	21.2624	0.8965
	51	0.3509	0.4225	0.5398	4.4848	21.8540	0.9593
	52	-0.4211	0.4214	-0.6486	4.0637	22.4331	0.8580
	53	0.1249	0.4239	0.1918	4.1886	23.0489	0.8725
	54	-0.6236	0.4217	-0.9602	3.5650	23.6079	0.7337
D5	55	0.6999	0.4227	1.0766	4.2649	24.2205	0.8666
	56	0.2107	0.4217	0.3244	4.4756	24.8220	0.8983
	57	0.6310	0.4235	0.9696	5.1066	25.4552	1.0121
Window (8-17)					-1.7158	4.3425	-0.8234
Window (49-57)					2.5669	3.9646	1.2892

* ; ** - Significant at the 5 percent and 1 percent level respectively.

D1 - Malaysia announcement on delistings; D2 - Singapore announcement on delistings; D3 - Establishment of CLOBI announced; D4 - List of companies to be traded on CLOBI released; D5 - Delistings day / CLOBI first trading day

Table 5.7a

OLS Event-Study Results for M_1

M_1 contains 95 Malaysia-Registered firms delisted from the Stock Exchange of Singapore but later traded on the Central Limit Order Book International (CLOBI)

	Days into Event Window	AR(%)	VAR(AR)	Z-Value	CAR(%)	VAR(CAR)	Z-Value
	8	-2.2393	1.4257	-1.8754	-2.2393	1.4257	-1.8754
	9	-0.3304	1.4216	-0.2771	-2.5697	2.8492	-1.5224
D1	10	-0.6621	1.4282	-0.5540	-3.2318	4.3041	-1.5578
	11	-3.8542	1.5361	-3.1097**	-7.0860	5.9585	-2.9029**
	12	-0.1853	1.4306	-0.1549	-7.2713	7.3290	-2.6859**
	13	0.1228	1.4288	0.1027	-7.1485	8.7379	-2.4183*
	14	0.0488	1.4247	0.0409	-7.0997	10.1852	-2.2246*
	15	-1.3556	1.4319	-1.1329	-8.4554	11.7323	-2.4685*
	16	-2.9604	1.4278	-2.4775*	-11.4158	13.1867	-3.1437**
	17	-0.5274	1.4199	-0.4426	-11.9431	14.6870	-3.1164**
	18	1.4491	1.4198	1.2162	-10.4940	16.2006	-2.6072**
D2	19	0.2141	1.4309	0.1790	-10.2799	17.7143	-2.4425*
	20	-0.1560	1.4193	-0.1310	-10.4360	19.2596	-2.3780*
	21	0.2847	1.4189	0.2390	-10.1513	20.8139	-2.2251*
D3	22	0.5220	1.4189	0.4382	-9.6293	22.3784	-2.0355*
	23	2.1165	1.4189	1.7768	-7.5127	23.9532	-1.5350
	24	-0.4953	1.4205	-0.4155	-8.0080	25.5446	-1.5844
	25	-0.0356	1.4189	-0.0298	-8.0436	27.1407	-1.5440
	26	1.4469	1.4191	1.2146	-6.5967	28.7492	-1.2303
	27	0.5791	1.4491	0.4811	-6.0175	30.4341	-1.0908
	28	0.6942	1.4200	0.5825	-5.3234	32.0434	-0.9404
	29	0.5924	1.4191	0.4973	-4.7310	33.6747	-0.8153
	30	1.4188	1.4232	1.1893	-3.3122	35.2953	-0.5575
	31	1.2729	1.4189	1.0686	-2.0393	36.9516	-0.3355
	32	0.3854	1.4190	0.3235	-1.6540	38.6222	-0.2661
	33	0.1396	1.4232	0.1170	-1.5144	40.2824	-0.2386
	34	-0.2472	1.4225	-0.2073	-1.7616	41.9619	-0.2719
	35	-0.0871	1.4240	-0.0730	-1.8487	43.6594	-0.2798
	36	0.1809	1.4261	0.1515	-1.6677	45.3801	-0.2476
	37	0.3631	1.4201	0.3047	-1.3046	47.0943	-0.1901
	38	0.4549	1.4299	0.3804	-0.8497	48.8509	-0.1216
	39	0.7601	1.4298	0.6356	-0.0897	50.6395	-0.0126
	40	1.0435	1.4198	0.8758	0.9539	52.3758	0.1318
	41	0.9764	1.4232	0.8185	1.9303	54.1746	0.2623
	42	1.1139	1.4190	0.9351	3.0442	55.9523	0.4070
	43	0.6135	1.4283	0.5133	3.6576	57.8073	0.4811
	44	-1.1686	1.4194	-0.9809	2.4891	59.6193	0.3224
	45	-0.2289	1.4212	-0.1920	2.2601	61.3830	0.2885
	46	0.5956	1.4204	0.4998	2.8557	63.1680	0.3593
	47	-0.2500	1.4198	-0.2098	2.6058	65.0138	0.3232
	48	0.0706	1.4230	0.0592	2.6764	66.8031	0.3275
	49	1.3393	1.4226	1.1229	4.0157	68.6910	0.4845
D4	50	1.4410	1.4193	1.2096	5.4567	70.5617	0.6496
	51	3.4602	1.4227	2.9010**	8.9170	72.4808	1.0474
	52	-1.1737	1.4192	-0.9852	7.7433	74.3729	0.8979
	53	0.9724	1.4277	0.8138	8.7157	76.3586	0.9974
	54	-0.5319	1.4212	-0.4462	8.1837	78.2033	0.9254
D5	55	2.7874	1.4233	2.3364*	10.9711	80.1852	1.2252
	56	2.7166	1.4199	2.2798*	13.6877	82.1409	1.5103
	57	0.0281	1.4261	0.0235	13.7158	84.1823	1.4949
Window (8-17)					-11.9431	14.6870	-3.1164**
Window (49-57)					11.0394	13.2943	3.0277**

* ; ** - Significant at the 5 percent and 1 percent level respectively.

D1 - Malaysia announcement on delistings; D2 - Singapore announcement on delistings; D3 - Establishment of CLOBI announced; D4 - List of companies to be traded on CLOBI released; D5 - Delistings day / CLOBI first trading day

Table 5.7b

OLS Event-Study Results for M_2

M_2 contains 61 Malaysia-registered firms delisted from the Stock Exchange of Singapore but subsequently not traded on the Central Limit Order Book (CLOBI)

	Days into Event Window	AR(%)	VAR(AR)	Z-Value	CAR(%)	VAR(CAR)	Z-Value
	8	-0.9775	0.1613	-2.4340*	-0.9775	0.1613	-2.4340*
	9	0.3451	0.1608	0.8606	-0.6324	0.3223	-1.1139
D1	10	-0.2977	0.1616	-0.7405	-0.9301	0.4869	-1.3328
	11	-1.3911	0.1738	-3.3368**	-2.3211	0.6741	-2.8270**
	12	-0.2918	0.1619	-0.7254	-2.6130	0.8292	-2.8695**
	13	-0.0977	0.1616	-0.2430	-2.7107	0.9886	-2.7263**
	14	0.1347	0.1612	0.3356	-2.5759	1.1523	-2.3997*
	15	-0.1349	0.1620	-0.3352	-2.7109	1.3273	-2.3530*
	16	-0.7180	0.1615	-1.7866	-3.4289	1.4919	-2.8073**
	17	-0.7451	0.1606	-1.8590	-4.1740	1.6616	-3.2381**
	18	1.0088	0.1606	2.5171*	-3.1652	1.8328	-2.3380*
D2	19	0.0307	0.1619	0.0763	-3.1345	2.0041	-2.2142*
	20	-0.0736	0.1606	-0.1838	-3.2082	2.1789	-2.1734*
	21	0.0059	0.1605	0.0148	-3.2023	2.3548	-2.0868*
D3	22	0.3426	0.1605	0.8551	-2.8597	2.5318	-1.7972
	23	0.1165	0.1605	0.2908	-2.7432	2.7099	-1.6664
	24	-0.2235	0.1607	-0.5576	-2.9667	2.8900	-1.7451
	25	-0.0981	0.1605	-0.2448	-3.0648	3.0705	-1.7490
	26	0.6059	0.1605	1.5121	-2.4589	3.2525	-1.3634
	27	0.1277	0.1639	0.3154	-2.3312	3.4431	-1.2563
	28	0.3208	0.1606	0.8004	-2.0104	3.6252	-1.0559
	29	0.3011	0.1605	0.7516	-1.7092	3.8098	-0.8757
	30	0.6086	0.1610	1.5167	-1.1006	3.9931	-0.5508
	31	0.8864	0.1605	2.2124*	-0.2142	4.1805	-0.1048
	32	0.8977	0.1605	2.2406*	0.6835	4.3695	0.3270
	33	0.6107	0.1610	1.5220	1.2942	4.5573	0.6063
	34	0.0998	0.1609	0.2488	1.3941	4.7473	0.6398
	35	0.2473	0.1611	0.6162	1.6414	4.9394	0.7385
	36	-0.0065	0.1613	-0.0162	1.6349	5.1340	0.7215
	37	0.3922	0.1607	0.9785	2.0271	5.3280	0.8782
	38	0.3076	0.1618	0.7649	2.3347	5.5267	0.9931
	39	0.4098	0.1618	1.0189	2.7445	5.7291	1.1466
	40	0.3574	0.1606	0.8917	3.1019	5.9255	1.2743
	41	0.3620	0.1610	0.9021	3.4638	6.1290	1.3991
	42	0.2701	0.1605	0.6741	3.7339	6.3301	1.4841
	43	-0.2104	0.1616	-0.5233	3.5236	6.5400	1.3778
	44	-0.1945	0.1606	-0.4855	3.3290	6.7450	1.2818
	45	0.4725	0.1608	1.1784	3.8015	6.9445	1.4426
	46	1.1266	0.1607	2.8105*	4.9282	7.1465	1.8435
	47	-0.3965	0.1606	-0.9893	4.5317	7.3553	1.6709
	48	0.2994	0.1610	0.7462	4.8311	7.5577	1.7573
	49	1.5655	0.1609	3.9021**	6.3966	7.7713	2.2946*
D4	50	0.6190	0.1606	1.5447	7.0155	7.9830	2.4830*
	51	0.4463	0.1610	1.1123	7.4618	8.2001	2.6058**
	52	-0.4673	0.1606	-1.1661	6.9945	8.4141	2.4113
	53	0.3961	0.1615	0.9856	7.3906	8.6388	2.5145
	54	0.0917	0.1608	0.2287	7.4823	8.8475	2.5155
D5	55	0.4642	0.1610	1.1567	7.9465	9.0717	2.6383
	56	0.5617	0.1606	1.4015	8.5082	9.2930	2.7910
	57	-0.3292	0.1613	-0.8195	8.1790	9.5239	2.6503
Window (8-17)					-4.1740	1.6729	-3.2272**
Window (49-57)					3.3479	1.5040	2.7299**

* ; ** - Significant at the 5 percent and 1 percent level respectively.

D1 - Malaysia announcement on delistings; D2 - Singapore announcement on delistings; D3 - Establishment of CLOBI announced; D4 - List of companies to be traded on CLOBI released; D5 - Delistings day / CLOBI first trading day

Table 5.7c

OLS Event-Study Results for M_3

M_3 contains 22 Malaysia-registered stocks that were not previously listed on the Stock Exchange of Singapore but then were listed on the Central Limit Order Book.

	Days into Event Window	AR(%)	VAR(AR)	Z-Value	CAR(%)	VAR(CAR)	Z-Value
	1	0.2654	1.9269	0.1912	0.2654	1.9269	0.1912
	2	-0.1431	1.9260	-0.1031	0.1224	3.8628	0.0623
	3	0.2860	1.9298	0.2058	0.4083	5.8185	0.1693
	4	3.2270	1.9289	2.3235*	3.6354	7.7740	1.3038
D4	5	2.7114	1.9256	1.9539	6.3467	9.7473	2.0329*
	6	0.3943	1.9290	0.2839	6.7411	11.7367	1.9677*
	7	-1.0515	1.9255	-0.7578	5.6895	13.7367	1.5351
	8	0.0128	1.9342	0.0092	5.7023	15.7699	1.4359
	9	0.7043	1.9278	0.5073	6.4067	17.7774	1.5195
D5	10	3.0281	1.9297	2.1799*	9.4348	19.8320	2.1186*
	11	2.6641	1.9262	1.9196	12.0989	21.8906	2.5859**
	12	0.3985	1.9325	0.2867	12.4975	23.9933	2.5514*
Window (4-12)					12.0892	17.90936	2.8566**

* ; ** - Significant at the 5 percent and 1 percent level respectively.

D4 - List of companies to be traded on CLOBI released; D5 - Delistings day / CLOBI first trading day

Table 5.7d

OLS Event-Study Results for S

S contains 45 Singapore-registered stocks that were delisted from the Kuala Lumpur Stock Exchange and totally retrieved back to the Stock Exchange of Singapore.

	Days into Event Window	AR(%)	VAR(AR)	Z-Value	CAR(%)	VAR(CAR)	Z-Value
	8	-0.9030	0.4694	-1.3180	-0.9030	0.4694	-1.3180
	9	-0.2885	0.4681	-0.4217	-1.1915	0.9381	-1.2302
D1	10	-0.2908	0.4703	-0.4241	-1.4824	1.4170	-1.2453
	11	-0.2624	0.5059	-0.3689	-1.7448	1.9618	-1.2457
	12	1.5300	0.4711	2.2293*	-0.2148	2.4127	-0.1383
	13	-0.1740	0.4705	-0.2537	-0.3888	2.8761	-0.2292
	14	-0.2227	0.4691	-0.3251	-0.6114	3.3521	-0.3340
	15	-0.4827	0.4715	-0.7030	-1.0942	3.8611	-0.5568
	16	-0.4188	0.4701	-0.6108	-1.5130	4.3392	-0.7263
	17	-0.2495	0.4675	-0.3648	-1.7624	4.8324	-0.8017
	18	0.3849	0.4675	0.5630	-1.3775	5.3299	-0.5967
D2	19	-0.1836	0.4711	-0.2675	-1.5611	5.8272	-0.6467
	20	0.5489	0.4673	0.8029	-1.0122	6.3350	-0.4022
	21	0.1934	0.4672	0.2829	-0.8189	6.8457	-0.3130
D3	22	-0.3025	0.4672	-0.4426	-1.1214	7.3597	-0.4134
	23	-0.1727	0.4672	-0.2527	-1.2941	7.8769	-0.4611
	24	-0.3783	0.4677	-0.5532	-1.6724	8.3997	-0.5771
	25	0.1256	0.4672	0.1838	-1.5468	8.9238	-0.5178
	26	0.2375	0.4673	0.3474	-1.3093	9.4519	-0.4259
	27	0.3945	0.4772	0.5710	-0.9149	10.0056	-0.2892
	28	0.4594	0.4676	0.6718	-0.4555	10.5337	-0.1403
	29	0.2482	0.4673	0.3631	-0.2073	11.0691	-0.0623
	30	-0.0800	0.4686	-0.1168	-0.2872	11.6006	-0.0843
	31	0.3860	0.4672	0.5647	0.0987	12.1440	0.0283
	32	0.5666	0.4672	0.8289	0.6653	12.6921	0.1867
	33	-0.0705	0.4686	-0.1029	0.5948	13.2364	0.1635
	34	-0.3330	0.4684	-0.4866	0.2618	13.7870	0.0705
	35	-0.4148	0.4689	-0.6058	-0.1530	14.3433	-0.0404
	36	-0.0136	0.4695	-0.0198	-0.1666	14.9071	-0.0431
	37	0.3085	0.4676	0.4511	0.1419	15.4692	0.0361
	38	0.5256	0.4708	0.7660	0.6675	16.0446	0.1666
	39	0.6900	0.4708	1.0056	1.3575	16.6303	0.3329
	40	-0.0363	0.4675	-0.0530	1.3212	17.1994	0.3186
	41	-0.3052	0.4686	-0.4458	1.0160	17.7885	0.2409
	42	0.1802	0.4672	0.2636	1.1962	18.3708	0.2791
	43	0.4859	0.4703	0.7085	1.6821	18.9781	0.3861
	44	0.2157	0.4674	0.3155	1.8978	19.5715	0.4290
	45	-0.7027	0.4680	-1.0272	1.1951	20.1492	0.2662
	46	0.1656	0.4677	0.2422	1.3607	20.7339	0.2988
	47	0.3597	0.4675	0.5261	1.7204	21.3361	0.3724
	48	0.5590	0.4686	0.8166	2.2794	21.9242	0.4868
	49	0.5250	0.4684	0.7671	2.8044	22.5419	0.5907
D4	50	1.0522	0.4673	1.5392	3.8566	23.1541	0.8015
	51	0.3410	0.4684	0.4982	4.1976	23.7819	0.8607
	52	-0.4280	0.4673	-0.6261	3.7695	24.4009	0.7631
	53	0.1128	0.4701	0.1645	3.8823	25.0502	0.7757
	54	-0.6262	0.4680	-0.9154	3.2561	25.6539	0.6429
D5	55	0.6896	0.4687	1.0074	3.9457	26.3020	0.7694
	56	0.2028	0.4675	0.2966	4.1485	26.9415	0.7992
	57	0.6195	0.4696	0.9040	4.7680	27.6088	0.9074
Window (8-17)					-1.7624	4.8324	-0.8017
Window (49-57)					2.48859	4.3739	1.1899

* ; ** - Significant at the 5 percent and 1 percent level respectively.

D1 - Malaysia announcement on delistings; D2 - Singapore announcement on delistings; D3 - Establishment of CLOBI announced; D4 - List of companies to be traded on CLOBI released; D5 - Delistings day / CLOBI first trading day

Table 5.8a

Event-Study Results for M_1: Time Deformation Model

M_1 contains 95 Malaysia-Registered firms delisted from the Stock Exchange of Singapore but later traded on the Central Limit Order Book International (CLOBI)

	Days into Event Window	AR(%)	VAR(AR)	Z-Value	CAR(%)	VAR(CAR)	Z-Value
	8	-2.2250	1.4159	-1.8699	-2.2250	1.4159	-1.8699
	9	-0.3221	1.4113	-0.2711	-2.5471	2.8289	-1.5144
D1	10	-0.6472	1.4173	-0.5436	-3.1942	4.2718	-1.5455
	11	-3.8283	1.5204	-3.1048**	-7.0225	5.9052	-2.8899**
	12	-0.1795	1.4025	-0.1516	-7.2020	7.2465	-2.6754**
	13	0.1290	1.4029	0.1089	-7.0730	8.6294	-2.4078*
	14	0.0561	1.3882	0.0476	-7.0169	10.0405	-2.2145*
	15	-1.3399	1.3953	-1.1343	-8.3568	11.5459	-2.4594*
	16	-2.9540	1.3861	-2.5091*	-11.3108	12.9599	-3.1419**
	17	-0.5181	1.3808	-0.4409	-11.8289	14.4206	-3.1150**
	18	1.4585	1.3837	1.2399	-10.3704	15.8978	-2.6009**
D2	19	0.2199	1.3948	0.1862	-10.1506	17.3793	-2.4349*
	20	-0.1445	1.3697	-0.1235	-10.2951	18.8729	-2.3698*
	21	0.2954	1.3732	0.2521	-9.9997	20.3800	-2.2151*
D3	22	0.5327	1.3906	0.4517	-9.4670	21.9147	-2.0223*
	23	2.1272	1.4408	1.7721	-7.3398	23.5100	-1.5138
	24	-0.4828	1.4184	-0.4054	-7.8227	25.0946	-1.5616
	25	-0.0248	1.3969	-0.0210	-7.8475	26.6667	-1.5197
	26	1.4580	1.4134	1.2264	-6.3894	28.2667	-1.2018
	27	0.5975	1.4441	0.4972	-5.7919	29.9292	-1.0587
	28	0.7034	1.4196	0.5903	-5.0885	31.5382	-0.9061
	29	0.6025	1.4482	0.5006	-4.4861	33.1969	-0.7786
	30	1.4266	1.4849	1.1707	-3.0595	34.8829	-0.5180
	31	1.2833	1.5036	1.0465	-1.7762	36.6218	-0.2935
	32	0.3963	1.5062	0.3229	-1.3799	38.3762	-0.2227
	33	0.1473	1.5543	0.1182	-1.2326	40.1723	-0.1945
	34	-0.2392	1.4817	-0.1965	-1.4718	41.9157	-0.2273
	35	-0.0796	1.4854	-0.0653	-1.5514	43.6812	-0.2347
	36	0.1878	1.4830	0.1543	-1.3635	45.4678	-0.2022
	37	0.3753	1.4709	0.3095	-0.9882	47.2262	-0.1438
	38	0.4609	1.5270	0.3730	-0.5273	49.0927	-0.0753
	39	0.7661	1.5517	0.6150	0.2387	51.0170	0.0334
	40	1.0555	1.5480	0.8483	1.2942	52.8758	0.1780
	41	0.9842	1.5633	0.7871	2.2784	54.8236	0.3077
	42	1.1242	1.5722	0.8966	3.4025	56.7545	0.4517
	43	0.6198	1.5976	0.4904	4.0223	58.7939	0.5246
	44	-1.1589	1.5300	-0.9369	2.8634	60.7194	0.3675
	45	-0.2162	1.4784	-0.1778	2.6473	62.5308	0.3348
	46	0.6080	1.5228	0.4927	3.2553	64.4100	0.4056
	47	-0.2406	1.5293	-0.1946	3.0147	66.3694	0.3700
	48	0.0841	1.5323	0.0680	3.0988	68.2542	0.3751
	49	1.3472	1.5266	1.0904	4.4460	70.2562	0.5304
D4	50	1.4508	1.6334	1.1352	5.8968	72.3434	0.6933
	51	3.4682	1.6990	2.6608**	9.3650	74.5499	1.0846
	52	-1.1638	1.6212	-0.9140	8.2012	76.6462	0.9368
	53	0.9789	1.5821	0.7782	9.1801	78.8052	1.0341
	54	-0.5192	1.6390	-0.4055	8.6609	80.8562	0.9632
D5	55	2.7951	1.7048	2.1407*	11.4560	83.1334	1.2564
	56	2.7259	1.8443	2.0072*	14.1819	85.5196	1.5336
	57	0.0349	1.7075	0.0267	14.2168	87.8614	1.5167
Window (8-17)					-11.8289	14.4206	-3.1150**
Window (49-57)					11.1180	15.4624	2.8274**

* ; ** - Significant at the 5 percent and 1 percent level respectively.

D1 - Malaysia announcement on delistings; D2 - Singapore announcement on delistings; D3 - Establishment of CLOBI announced; D4 - List of companies to be traded on CLOBI released; D5 - Delistings day / CLOBI first trading day

Table 5.8b

Event-Study Results for M_2: Time Deformation Model

M_2 contains 61 Malaysia-registered firms delisted from the Stock Exchange of Singapore but subsequently not traded on the Central Limit Order Book (CLOBI)

	Days into Event Window	AR(%)	VAR(AR)	Z-Value	CAR(%)	VAR(CAR)	Z-Value
	8	-0.9195	0.3720	-1.5077	-0.9195	0.3720	-1.5077
	9	0.4006	0.2081	0.8781	-0.5190	0.5802	-0.6814
D1	10	-0.2394	0.1504	-0.6172	-0.7584	0.7329	-0.8858
	11	-1.3280	0.1502	-3.4267**	-2.0864	0.8941	-2.2066*
	12	-0.2375	0.1319	-0.6541	-2.3239	1.0198	-2.3013*
	13	-0.0432	0.2815	-0.0815	-2.3672	1.2989	-2.0770*
	14	0.1897	0.3400	0.3253	-2.1775	1.6404	-1.7001
	15	-0.0763	0.3861	-0.1228	-2.2538	2.0368	-1.5792
	16	-0.6634	0.2614	-1.2977	-2.9173	2.2999	-1.9236
	17	-0.6893	0.1933	-1.5679	-3.6066	2.4999	-2.2810*
	18	1.0646	0.2896	1.9783	-2.5420	2.7974	-1.5198
D2	19	0.0850	0.2924	0.1572	-2.4570	3.0966	-1.3962
	20	-0.0169	0.2613	-0.0330	-2.4738	3.3687	-1.3479
	21	0.0624	0.3083	0.1123	-2.4115	3.6886	-1.2556
D3	22	0.3990	0.3152	0.7107	-2.0125	4.0162	-1.0042
	23	0.1729	0.3731	0.2831	-1.8396	4.4027	-0.8767
	24	-0.1663	0.3192	-0.2944	-2.0059	4.7365	-0.9217
	25	-0.0416	0.1741	-0.0998	-2.0475	4.9257	-0.9226
	26	0.6625	0.2435	1.3425	-1.3850	5.1855	-0.6082
	27	0.1875	0.3365	0.3232	-1.1976	5.5424	-0.5087
	28	0.3766	0.5264	0.5190	-0.8210	6.0847	-0.3328
	29	0.3573	0.3703	0.5872	-0.4636	6.4731	-0.1822
	30	0.6637	0.4491	0.9905	0.2001	6.9387	0.0760
	31	0.9427	0.7153	1.1147	1.1428	7.6742	0.4125
	32	0.9543	0.7545	1.0986	2.0971	8.4503	0.7214
	33	0.6659	0.9905	0.6691	2.7630	9.4608	0.8983
	34	0.1551	0.5432	0.2104	2.9180	10.0259	0.9216
	35	0.3024	0.6445	0.3766	3.2204	10.6938	0.9848
	36	0.0483	0.5465	0.0653	3.2686	11.2655	0.9738
	37	0.4493	0.6849	0.5429	3.7179	11.9754	1.0744
	38	0.3620	0.7049	0.4312	4.0799	12.7084	1.1445
	39	0.4642	0.7131	0.5497	4.5441	13.4527	1.2389
	40	0.4144	0.7994	0.4634	4.9585	14.2789	1.3122
	41	0.4171	0.6490	0.5178	5.3756	14.9604	1.3898
	42	0.3264	0.7948	0.3661	5.7019	15.7859	1.4351
	43	-0.1558	1.0931	-0.1490	5.5461	16.9162	1.3485
	44	-0.1386	0.9379	-0.1431	5.4075	17.8879	1.2786
	45	0.5298	0.8432	0.5770	5.9374	18.7599	1.3708
	46	1.1838	1.1129	1.1221	7.1212	19.9036	1.5962
	47	-0.3406	0.8092	-0.3787	6.7805	20.7494	1.4885
	48	0.3571	0.6806	0.4328	7.1376	21.4608	1.5407
	49	1.6207	0.8716	1.7360	8.7583	22.3726	1.8517
D4	50	0.6750	1.3596	0.5789	9.4333	23.7709	1.9348
	51	0.5015	0.8946	0.5302	9.9348	24.7085	1.9986*
	52	-0.4112	0.7508	-0.4745	9.5236	25.4999	1.8860
	53	0.4507	1.1912	0.4129	9.9743	26.7398	1.9289
	54	0.1490	1.2959	0.1309	10.1233	28.0713	1.9107
D5	55	0.5193	0.7523	0.5987	10.6426	28.8721	1.9807*
	56	0.6175	1.6467	0.4812	11.2601	30.5650	2.0367*
	57	-0.2744	0.8153	-0.3039	10.9857	31.4341	1.9594
Window (8-17)					-3.6066	2.4999	-2.2810*
Window (49-57)					3.8481	9.6213	1.2406*

* ; ** - Significant at the 5 percent and 1 percent level respectively.

D1 - Malaysia announcement on delistings; D2 - Singapore announcement on delistings; D3 - Establishment of CLOBI announced; D4 - List of companies to be traded on CLOBI released; D5 - Delistings day / CLOBI first trading day

Table 5.8c

Event-Study Results for M_3: Time Deformation Model

M_3 contains 22 Malaysia-registered stocks that were not previously listed on the Stock Exchange of Singapore but then were listed on the Central Limit Order Book.

	Days into Event Window	AR(%)	VAR(AR)	Z-Value	CAR(%)	VAR(CAR)	Z-Value
	1	0.4519	2.8443	0.2679	0.4519	2.8443	0.2679
	2	-0.0475	2.5128	-0.0300	0.4044	5.3620	0.1746
	3	0.5073	2.6281	0.3129	0.9116	8.0041	0.3222
	4	3.2797	4.6311	1.5240	4.1914	12.6482	1.1785
D4	5	2.8198	6.2781	1.1254	7.0111	18.9518	1.6105
	6	0.4461	3.9807	0.2236	7.4572	22.9653	1.5561
	7	-0.9395	2.9926	-0.5431	6.5177	25.9983	1.2783
	8	0.0207	2.3239	0.0136	6.5384	28.3785	1.2274
	9	0.9032	4.0164	0.4507	7.4416	32.4347	1.3067
D5	10	3.0731	4.9117	1.3866	10.5147	37.4168	1.7190
	11	2.7568	7.9575	0.9773	13.2715	45.4476	1.9686*
	12	0.4187	6.1702	0.1686	13.6902	51.7161	1.9037
Window (4-12)					12.7785	43.5781	1.9357

* ; ** - Significant at the 5 percent and 1 percent level respectively.

D4 - List of companies to be traded on CLOBI released; D5 - Delistings day / CLOBI first trading day

Table 5.8d

Event-Study Results for S: Time Deformation Model

S contains 45 Singapore-registered stocks that were delisted from the Kuala Lumpur Stock Exchange and totally retrieved back to the Stock Exchange of Singapore.

	Days into Event Window	AR(%)	VAR(AR)	Z-Value	CAR(%)	VAR(CAR)	Z-Value
	8	-0.8731	0.4735	-1.2688	-0.8731	0.4735	-1.2688
	9	-0.2543	0.4570	-0.3762	-1.1274	0.9314	-1.1683
D1	10	-0.2614	0.4848	-0.3754	-1.3888	1.4241	-1.1638
	11	-0.2408	0.4298	-0.3674	-1.6297	1.8879	-1.1861
	12	1.5660	0.4434	2.3519*	-0.0637	2.3159	-0.0418
	13	-0.1383	0.4414	-0.2082	-0.2020	2.7528	-0.1217
	14	-0.1877	0.3930	-0.2994	-0.3897	3.1530	-0.2194
	15	-0.4539	0.3995	-0.7181	-0.8435	3.5863	-0.4454
	16	-0.3832	0.3350	-0.6621	-1.2267	3.9298	-0.6188
	17	-0.2159	0.3900	-0.3457	-1.4426	4.3435	-0.6922
	18	0.4184	0.3701	0.6877	-1.0243	4.7411	-0.4704
D2	19	-0.1476	0.4080	-0.2311	-1.1719	5.1727	-0.5152
	20	0.5808	0.4952	0.8254	-0.5910	5.7050	-0.2474
	21	0.2258	0.3963	0.3587	-0.3652	6.1409	-0.1474
D3	22	-0.2700	0.3749	-0.4409	-0.6352	6.5584	-0.2480
	23	-0.1402	0.6930	-0.1684	-0.7754	7.2970	-0.2870
	24	-0.3471	0.4350	-0.5263	-1.1225	7.7826	-0.4024
	25	0.1581	0.3963	0.2511	-0.9644	8.2309	-0.3362
	26	0.2697	0.3857	0.4342	-0.6947	8.6722	-0.2359
	27	0.4214	0.3662	0.6964	-0.2733	9.1104	-0.0906
	28	0.4929	0.4411	0.7422	0.2196	9.6067	0.0709
	29	0.2811	0.4682	0.4108	0.5007	10.1370	0.1573
	30	-0.0453	0.4842	-0.0651	0.4554	10.6782	0.1394
	31	0.4187	0.4189	0.6469	0.8741	11.1665	0.2616
	32	0.5989	0.4401	0.9028	1.4730	11.6805	0.4310
	33	-0.0359	0.4928	-0.0511	1.4371	12.2413	0.4108
	34	-0.2986	0.4733	-0.4341	1.1385	12.7883	0.3184
	35	-0.3800	0.4695	-0.5545	0.7586	13.3358	0.2077
	36	0.0216	0.4771	0.0313	0.7802	13.8961	0.2093
	37	0.3399	0.5049	0.4783	1.1201	14.4882	0.2943
	38	0.5615	0.5943	0.7284	1.6816	15.1739	0.4317
	39	0.7259	0.6863	0.8762	2.4074	15.9604	0.6026
	40	-0.0047	0.5760	-0.0061	2.4028	16.6298	0.5892
	41	-0.2706	0.3973	-0.4293	2.1322	17.1334	0.5151
	42	0.2130	0.4660	0.3120	2.3452	17.7035	0.5574
	43	0.5215	0.5966	0.6752	2.8667	18.4192	0.6680
	44	0.2489	0.6125	0.3180	3.1156	19.1446	0.7121
	45	-0.6716	0.5848	-0.8783	2.4440	19.8319	0.5488
	46	0.1969	0.4487	0.2940	2.6409	20.3889	0.5849
	47	0.3932	0.5200	0.5452	3.0340	21.0313	0.6616
	48	0.5895	0.5273	0.8118	3.6235	21.6691	0.7784
	49	0.5595	0.4707	0.8154	4.1830	22.2717	0.8864
D4	50	1.0854	0.4748	1.5751	5.2683	22.8767	1.1015
	51	0.3755	0.4040	0.5907	5.6438	23.4212	1.1662
	52	-0.3949	0.3944	-0.6289	5.2488	23.9521	1.0725
	53	0.1483	0.4312	0.2258	5.3971	24.5390	1.0895
	54	-0.5952	0.4583	-0.8791	4.8019	25.1241	0.9580
D5	55	0.7243	0.3925	1.1561	5.5262	25.6741	1.0906
	56	0.2363	0.4939	0.3362	5.7625	26.3214	1.1232
	57	0.6547	0.6910	0.7876	6.4173	27.1845	1.2308
Window (8-17)					-1.4426	4.3435	-0.6922
Window (49-57)					2.7938	4.3487	1.3397

* ; ** - Significant at the 5 percent and 1 percent level respectively.

D1 - Malaysia announcement on delistings; D2 - Singapore announcement on delistings; D3 - Establishment of CLOBI announced; D4 - List of companies to be traded on CLOBI released; D5 - Delistings day / CLOBI first trading day

Table 5.11

Tests for Shift in Market Liquidity in the Local Exchange for the Delisted Stocks

Parametric Approach

Portfolio	M_1	M_2	M_3	S
Number of Stocks (n)	95	61	22	45
Mean difference $(\bar{d})$	RM287.5303	RM136.1731	RM63.4478	S$21.9386
Standard deviation (s_d)	724.0248	351.0438	319.1457	463.8787
Skewness	4.924297	2.976368	2.229219	3.099138
Kurtosis	32.84848	8.550606	6.121226	16.55542
t: $\bar{d}=0$	3.8707 (0.0002)	3.0297 (0.0036)	0.9325 (0.3617)	0.3173 (0.7525)

p-Values in parentheses

Table 5.15a

Changes in the Pricing of Singapore and Malaysia Stocks Following Delistings

Variable	All Malaysia stocks (177 stocks). Slope (β)	t-stat	All Singapore stocks (143 stocks). Slope (β)	t-stat
MALIND	.525	35.40	.065	4.56
DMALIND	.063	3.42	.050	2.84
SININD	-.182	-10.89	.269	16.78
DSININD	.007	0.32	- .083	- 3.96
WRLIND	.022	1.78	- .029	- 2.42
DWRLIND	.004	0.25	.047	2.97
Joint Test:	F-value = 19.92	Significance = .933	F-value = 7.08	Significance = .938

For each portfolio, the general model is tested:

$$R_{it} = \alpha_0 + \alpha_1 D + \beta_1 R_{mt} + \beta_2 R_{s,t} + \beta_3 R_{w,t} + \beta_4 DR_{mt} + \beta_5 DR_{s,t} + \beta_6 DR_{w,t} + \varepsilon_t$$

Where,

MALIND, SININD and WRLIND represent the slope coefficients for the Malaysia, Singapore and World indices, and the bold entries, DMALIND, SININD and WRLIND represent the change in each slope coefficients after delistings.

The F-test represents a joint test for the null hypothesis that all three slope changes, DMALIND, DSININD and DWRLIND are zero.

Table 5.15b

Changes in the Pricing of Stocks that were Delisted

	Malaysia stocks delisted from Singapore (M_2, 61 Stocks)		Singapore stocks delisted from Malaysia (S, 45 Stocks)	
Variable	Slope (β)	t-stat	Slope (β)	t-stat
MALIND	.290	12.80	.006	0.28
DMALIND	.129	4.58	.061	2.30
SININD	-.150	-5.93	.308	12.80
DSININD	-.017	-.513	-.111	-3.55
WRLIND	.017	.889	-.037	-2.09
DWRLIND	-.016	-.641	.069	2.95
Joint Test:	F-value = 22.82	Significance = .257	F-value = 6.23	Significance = .807

For each portfolio, the general model is tested:

$$R_{it} = \alpha_0 + \alpha_1 D + \beta_1 R_{mt} + \beta_2 R_{s,t} + \beta_3 R_{w,t} + \beta_4 DR_{mt} + \beta_5 DR_{s,t} + \beta_6 DR_{w,t} + \varepsilon_t$$

Where,
MALIND, SININD and WRLIND represent the slope coefficients for the Malaysia, Singapore and World indices, and the bold entries, DMALIND, SININD and WRLIND represent the change in each slope coefficients after delistings.

The F-test represents a joint test for the null hypothesis that all three slope changes, DMALIND, DSININD and DWRLIND are zero.

Table 5.15c

Changes in the Pricing of Newly Listed Malaysia Stocks, and Malaysia and Singapore Stocks that were not Delisted.

Variable	Newly Listed Malaysia stocks (M_3, 21 stocks) Slope (β)	t-stat	Malaysia Stocks Moved to CLOBI (M_1, 95 stocks) Slope (β)	t-stat	Other Singapore Stocks* (S', 98 stocks) Slope (β)	t-stat
MALIND	.623	14.70	.654	31.00	.092	5.03
DMALIND	-.057	-1.09	.048	1.82	.046	1.99
SININD	-.237	-4.95	-.190	-8.00	.252	12.20
DSININD	.076	1.22	.007	0.23	-.070	-2.59
WRLIND	.085	2.38	.012	0.67	-.025	-1.64
DWRLIND	-.067	-1.42	.033	1.40	.037	1.80
Joint Test:	F-value = 1.12	Significance = .977	F-value = 8.17	Significance = .984	F-value = 2.89	Significance =.970

*Apart from those delisted.

For each portfolio, the general model is tested:

$$R_{it} = \alpha_0 + \alpha_1 D + \beta_1 R_{mt} + \beta_2 R_{st} + \beta_3 R_{wt} + \beta_4 DR_{mt} + \beta_5 DR_{st} + \beta_6 DR_{wt} + \varepsilon_t$$

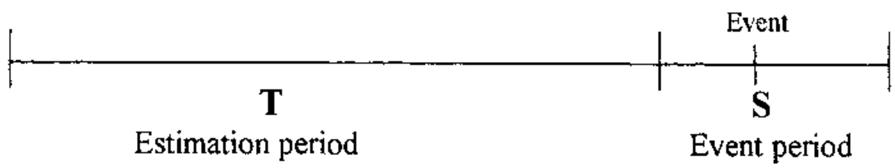
Where,
MALIND, SININD and WRLIND represent the slope coefficients for the Malaysia, Singapore and World indices, and the bold entries, DMALIND, SININD and WRLIND represent the change in each slope coefficients after delistings.

The F-test represents a joint test for the null hypothesis that all three slope changes, DMALIND, DSININD and DWRLIND are zero.

APPENDIX B

Appendix to Chapter 4.

Derivation of Cumulative Abnormal Return Variance, σ^2_{CAR}



1. For GARCH(1,1) Models.

The estimated model:

$$R_t = \alpha + \beta R_{mt} + \varepsilon_t \qquad t \in T \quad (1)$$
$$R_s = \alpha + \beta R_{ms} + \varepsilon_s \qquad s \in S \quad (2)$$

The estimated abnormal return, is the prediction error, $\hat{e}_s$, in the event window,

$$AR_s = \hat{e}_s = R_s - \hat{R}_s = \alpha + \beta R_{ms} + \varepsilon_s - \hat{\alpha} - \hat{\beta} R_{ms}$$
$$= (\alpha - \hat{\alpha}) + (\beta - \hat{\beta}) R_{ms} + \varepsilon_s$$

And the variance of abnormal return, Var(AR_s), is given by

$$Var(\hat{e}_s) = Var(\hat{\alpha}) + R^2_{ms} Var(\hat{\beta}) + 2R_{ms} Cov(\hat{\alpha}, \hat{\beta}) + Var(\varepsilon_s)$$

Where in the GARCH(1,1) framework, $Var(\varepsilon_s)$ is given by[1]

$$Var(\varepsilon_s) = E_T(\varepsilon_{T+s}^2) = E_T(h_{T+s}) = \sigma^2 + (\alpha_1 + \beta_1)^{s-1}(h_{T+1} - \sigma^2)$$

and σ^2 is the unconditional variance,

$$\sigma^2 = \frac{\omega}{1 - \alpha_1 + \beta_1}$$, for feasibility estimated values are used.

For $s, q \in S$, the covariances between the abnormal returns are,

$$Cov(\hat{e}_s, \hat{e}_q) = E\left\{(\alpha - \hat{\alpha}) + (\beta - \hat{\beta})R_{ms} + \varepsilon_s\right\}\left\{(\alpha - \hat{\alpha}) + (\beta - \hat{\beta})R_{mq} + \varepsilon_q\right\}$$

$$= Var(\hat{\alpha}) + R_{ms}R_{mq}Var(\hat{\beta}) + R_{ms}Cov(\hat{\alpha},\hat{\beta}) + R_{mq}Cov(\hat{\alpha},\hat{\beta})$$
$$E\left\{(\alpha - \hat{\alpha})\varepsilon_q\right\} + E\left\{R_{ms}(\beta - \hat{\beta})\varepsilon_q\right\} + E(\varepsilon_s, \varepsilon_q)$$

$$= Var(\hat{\alpha}) + R_{ms}R_{mq}Var(\hat{\beta}) + R_{ms}Cov(\hat{\alpha},\hat{\beta}) + R_{mq}Cov(\hat{\alpha},\hat{\beta})$$ Since the other terms equal zero.

The cumulative abnormal return and its variance are thus given by:

$$CAR_S = \sum_{s=1}^{S} AR_s$$

$$Var(CAR_S) = \sum_{s=1}^{S} Var(\hat{e}_s) + 2\sum_{q \cdot s} Cov(\hat{e}_s, \hat{e}_q) \qquad s, q \in S$$

[1] See Baillie and Bollerslev (1992), page 98 for its derivation and a discussion on prediction of the variance in GARCH(p,q) models.

2. For MA(1) - GARCH(1,1) Model.

The estimated model:

$$R_t = \alpha + \beta R_{mt} + \varepsilon_t + \theta\varepsilon_{t-1} \qquad t \in T \quad (1)$$
$$R_s = \alpha + \beta R_{ms} + \varepsilon_s + \theta\varepsilon_{s-1} \qquad s \in S \quad (2)$$

The estimated abnormal return,

$$AR_s = \hat{e}_s = R_s - \hat{R}_s = \alpha + \beta R_{ms} + \varepsilon_s + \theta\varepsilon_{s-1} - \hat{R}_s$$
$$= (\alpha - \hat{\alpha}) + (\beta - \hat{\beta})R_{ms} + \varepsilon_s + (\theta - \hat{\theta})\varepsilon_T \qquad \text{for } s = 1$$
$$= (\alpha - \hat{\alpha}) + (\beta - \hat{\beta})R_{ms} + \varepsilon_s \qquad \text{for } s > 1$$

For feasibility we use $\hat{\varepsilon}_T$, and assuming independence of $\hat{\varepsilon}_T$ from $\hat{\alpha}$, $\hat{\beta}$ and $\hat{\theta}$, the variance of abnormal return, Var(AR_s) is thus,

$$Var(\hat{e}_s) = Var(\hat{\alpha}) + R_{ms}^2 Var(\hat{\beta}) + Var(\varepsilon_s) + Var(\hat{\varepsilon}_T)Var(\hat{\theta})$$
$$+ 2R_{ms}Cov(\hat{\alpha}, \hat{\beta}) \qquad \text{for } s = 1$$

$$= Var(\hat{\alpha}) + R_{ms}^2 Var(\hat{\beta}) + Var(\varepsilon_s) + 2R_{ms}Cov(\hat{\alpha}, \hat{\beta}) \qquad \text{for } s > 1$$

Where as in the GARCH(1,1) framework,

$$Var(\varepsilon_s) = E_T(\varepsilon_{T+s}^2) = E_T(h_{T+s}) = \sigma^2 + (\alpha_1 + \beta_1)^{s-1}(h_{T+1} - \sigma^2)$$

and σ^2 is the unconditional variance,

$$\sigma^2 = \frac{\omega}{1 - \alpha_1 + \beta_1}$$

For feasibility estimated values are used.

For $s,q \in S$, the covariances between the abnormal returns are,

$$Cov(\hat{e}_s, \hat{e}_q) = Var(\hat{\alpha}) + R_{ms}R_{mq}Var(\hat{\beta}) + R_{ms}Cov(\hat{\alpha},\hat{\beta}) + R_{mq}Cov(\hat{\alpha},\hat{\beta}) \qquad \text{for s,q} > 1$$

However, the covariances between the first abnormal return, $\hat{e}_1$, with the others are given by

$$Cov(\hat{e}_{q=1}, \hat{e}_s) = E\left\{(\alpha-\hat{\alpha}) + (\beta-\hat{\beta})R_{mq} + \varepsilon_q + (\theta-\hat{\theta})\varepsilon_T\right\}\left\{(\alpha-\hat{\alpha}) + (\beta-\hat{\beta})R_{ms} + \varepsilon_s\right\}$$

$$= Var(\hat{\alpha}) + R_{ms}Cov(\hat{\alpha},\hat{\beta}) + R_{mq}Cov(\hat{\alpha},\hat{\beta}) + R_{ms}R_{mq}Var(\hat{\beta})$$
$$+ \mathrm{E}[(\theta-\hat{\theta})(\alpha-\hat{\alpha})\hat{\varepsilon}_T] + \mathrm{E}[(\theta-\hat{\theta})(\beta-\hat{\beta})\hat{\varepsilon}_T] \qquad \text{for q} = 1,\ \text{s} > 1$$

$$= Var(\hat{\alpha}) + R_{ms}Cov(\hat{\alpha},\hat{\beta}) + R_{mq}Cov(\hat{\alpha},\hat{\beta}) + R_{ms}R_{mq}Var(\hat{\beta})$$

Since we assume the independence of $\hat{\varepsilon}_T$ from $\hat{\alpha}$, $\hat{\beta}$ and $\hat{\theta}$. The cumulative abnormal return and its variance are then given by:

$$CAR_S = \sum_{s=1}^{S} AR_s$$

$$Var(CAR_S) = \sum_{s=1}^{S} Var(\hat{e}_s) + 2\sum_{q \cdot s} Cov(\hat{e}_s, \hat{e}_q) \qquad s,q \in S$$

3. For Time-Deformation Model.

The derivation of cumulative abnormal return variance for the time-deformation model is similar to that for GARCH(1,1) model except that the variance of ε_s is given by $Var(\varepsilon_s) = E_T(\varepsilon^2_{T+s}) = E_T(h_{T+s}) = \hat{a}_1 + \hat{c}_1 \cdot V_{T+s}$.

Derivation of Normal Log-Likelihood Function for Models With GARCH Errors

Equation of a normal distribution: $\frac{1}{\sqrt{2\pi\sigma^2}} \cdot e^{\frac{-(X_i-\mu)^2}{2\sigma^2}}$

The conditional density of a prediction error is : $(2\pi)^{-\frac{1}{2}} \cdot (h_t)^{-\frac{1}{2}} \cdot e^{-\frac{\varepsilon_t^2}{2h_t}}$

The likelihood function is the product of all conditional densities of the prediction errors:

$$(2\pi)^{-\frac{1}{2}} \cdot (h_1)^{-\frac{1}{2}} \cdot e^{-\frac{\varepsilon_1^2}{2h_1}} \cdot (2\pi)^{-\frac{1}{2}} \cdot (h_2)^{-\frac{1}{2}} \cdot e^{-\frac{\varepsilon_2^2}{2h_2}} \cdots (2\pi)^{-\frac{1}{2}} \cdot (h_T)^{-\frac{1}{2}} \cdot e^{-\frac{\varepsilon_T^2}{2h_T}}$$

$$= (2\pi)^{-\frac{T}{2}} \cdot \prod_{t=1}^{T} (h_t)^{-\frac{1}{2}} \cdot e^{-\frac{1}{2}\sum(\frac{\varepsilon_1^2}{h_1}+\frac{\varepsilon_2^2}{h_2}+\ldots\ldots+\frac{\varepsilon_T^2}{h_T})}$$

The log-likelihood function is thus,

$$L_T(\theta) = -\frac{T}{2}\ln(2\pi) - \frac{1}{2}\sum_{t=1}^{T}\ln h_t - \frac{1}{2}\sum_{t=1}^{T}\frac{\varepsilon_t^2}{h_t}$$

$$= -\frac{1}{2}\sum_{t=1}^{T}\ln h_t - \frac{1}{2}\sum_{t=1}^{T}\frac{\varepsilon_t^2}{h_t}$$ apart from the constant term.

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