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Market Microstructure Changes and Time to Equilibrium (TTE)? Evidence Bursa Malaysia

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Abstract

The central idea of market microstructure changes is to gain market efficiency. Since 1990, Bursa Malaysia has made various changes to the market microstructure, including the introduction of computerized trading, a central depository system, and efficient clearing and settlement systems. This study determines whether market microstructure changes affect market efficiency using the time to equilibrium (TTE) estimator as the main investigative tool. Theobald and Yallup's (2002, 2004) Auto covariance ratios and the ARMA processes provide the framework for the analysis of this study. The response of the time to equilibrium coefficients for this study was determined for individual sample stocks, based on all information announcements made at specific dates from 1990 to 2001. The findings of this study provide some evidence that the market microstructure changes implemented by the Bursa Malaysia reduced the time to equilibrium for all information from 14 days in 1993 to nine days in 2001. The findings presented in this study also reveal that the prices of stocks traded in Bursa Malaysia generally under-react for the first nine days from the day the announcement is made publicly available.

Key words: Market Microstructure, Time to equilibrium, Over-reaction, Under-reaction,
JEL Classification: G14

Introduction

Market microstructure deals with the financial intermediation in the process of trading a financial asset, such as a stock or a bond. In a trading market, assets are not transformed (as they are, for example, by banks that transform deposits into loans) but are simply transferred from one investor to another. The financial intermediation service provided by a market, first described by Demsetz (1968) is immediacy. An investor who wishes to trade immediately is a demander of immediacy and one does it by placing a market order to trade at the best available price; the bid price if selling or the ask price if buying. Suppliers of immediacy establish the bid and ask prices. Depending on the market design, suppliers of immediacy may be professional dealers that quote bid and ask prices or investors that place limit orders, or some combination.

Studies on the subject of market microstructure include Stoll (1999) and Madhavan (2000). Coughenour and Shastri (1999) provide a detailed summary of empirical studies regarding the estimation of the components of the bid-ask spread, order flow properties, the Nasdaq controversy, and linkages between option and stock markets. Keim and Madhavan (1998) survey the literature on trading costs, with a focus on institutional trades. Lyons (1999) examines the market microstructure of foreign exchange markets. Meanwhile, the development of market microstructure as a subject has coincided with a period of establishment of new stock markets and revitalization of existing markets in many developing and transitional economies. The revitalization of these "emerging" stock markets is typically characterized by institutional reforms, including modernization of the trading and information systems, expanding stock market membership, revamping the regulatory framework, and opening access to foreign capital. The reforms are aimed at improving stock market performance by increasing liquidity and transparency, enhancing efficiency, and reducing volatility and trading costs. The wider goal is to promote the development of local capital markets and facilitate access to long-term capital.

The main issue in stock markets is whether and how market microstructure changes can create a positive value in terms of liquidity, efficiency, and volatility. Previous studies on more established markets, which have implemented changes in trading systems, have reported a positive impact, creating gains in market efficiency, increased liquidity and lower volatility. These include studies in Milan (Amihud, Mendelson and Murgia, 1990), Tokyo (Amihud and Mendelson, 1991) and Tel Aviv (Amihud, Mendelson and Lauterbach, 1997). Blennerhassett and Bowman (1998) reported a fall in transactions costs on the New Zealand stock exchange following the move from open outcry to screen trading, and Majnoni and Massa (2001) report broadly positive results after implementing market microstructure changes in terms of trading regulations and transaction cost introduced by the Italian Stock Exchange. There are fewer such studies in emerging markets, and their results are more mixed. Some suggest that the entry of foreign investors is an important factor than internal market reform (although the former may be predicated on the latter), and that this is followed by increased liquidity and enhanced market efficiency, with market volatility either remaining unchanged or declining (Richards, 1996; Kim and Singal, 2000; Ngugi, Murinde, and Green, 2002a, 2002b). However, Chang, Hsu, Huang and Rhee (1999) found no change in liquidity or in the efficiency of the price discovery process, while volatility increased, following the introduction of a continuous auction system in Taipei.

However, the central idea of market microstructure change is to gain market efficiency. Stock markets are constantly thriving to implement changes in market microstructure, which is most obviously driven by the rapid structural, technological, and regulatory changes affecting the securities industry worldwide. The causes of these structural shifts are complex. They include the substantial increase in trading volume, competition between exchanges within the same country and regions, the introduction of Electronic Communications Networks (ECNs), changes in the regulatory environment, technological innovations, the growth of the Internet usage, and the proliferation of new financial instruments. When the relevant market microstructures are changed in tandem with the said changes the market is expected to gain efficiency.

Objectives of Study

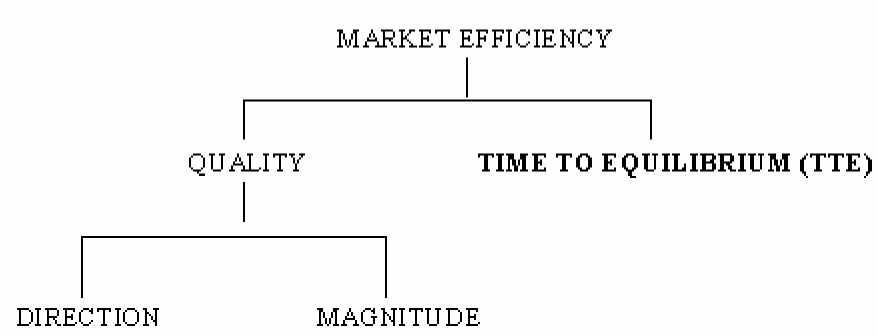
The main objective of this paper is to determine whether market microstructure changes affect the stock price's *Time to Equilibrium* (TTE), thus to measure the relative changes in the efficiency of prices of the stocks listed in the main board of Bursa Malaysia in terms of *time to equilibrium* (TTE) coefficient as the changes in the market microstructure were implemented. The *time to equilibrium* is measured for every two years starting 1990 to 2001, after some key market microstructure changes were implemented. This is to ensure that the aggregate effect of the market microstructure changes is well established by each time the *time to equilibrium* coefficient is measured.

Time to Equilibrium as another Dimension of Market Efficiency

The study and analysis of how share prices of listed companies react and adjust to publicly available information in particular, has long been a focus of attention in the finance literature. Most of the early studies confined its attention to the direction and magnitude of the price movement around the announcement time. These studies gathered many evidence on the share price reactions or impacts and the wealth effects of different types of price sensitive announcement events.

Besides the direction and magnitude, the *time to equilibrium* (TTE) is another dimension of market efficiency that received less attention from the researchers all this while. The Time to equilibrium or also known as "the speed of price adjustment" to new information, measures how fast in terms of time lapse over which information is incorporated as price changes, thus enabling researchers to typecast a market with the quickness to incorporate the full information content into the price discovery.

Figure 1: Dimensions of Market Efficiency



Therefore the *time to equilibrium* can be identified as another important measure to determine the market efficiency. The Time to equilibrium of stock price can be linked directly to market efficiency in terms of the quickness of information inducement into price discovery. In an efficient market, observed stock price should instantaneously incorporate new information released into its price in order to reflect the change that occurred to the equilibrium price of the stock. Such a reflection or adjustment should be instantaneous if the process is considered to be strongly efficient (Fama, 1991).

Currently, even in the developed stock markets there are limited numbers of studies that have documented the *time to equilibrium* either in terms of intra-day hours or inter-days. Although the measurement of the Time to equilibrium was attempted by several studies, most of them have not developed a right coefficient of the *time to equilibrium*.

This paper aims to improve and extend other market efficiency research in general and emerging market in particular such as Bursa Malaysia, which is a fast growing security market in the Asian region by using the *time to equilibrium* methodology as the principle investigative tool.

As the *time to equilibrium* coefficients are determined for the sample stocks listed in Bursa Malaysia, the said estimator also provide direct measure of the degrees of price over and under-reactions in this stock market. The empirical documentation of overreactions (DeBondt and Thaler, 1985, 1987), under-reactions (Michaely et al., 1995; Bernard and Thomas, 1989) have identified two families of pervasive regularities: under-reaction and over-reaction.

The Malaysian Stock Market: Structure, Historical Performance and Changes in Market Microstructure

Bursa Malaysia (formerly known as Kuala Lumpur Stock Exchange: KLSE) is the premier secondary stock market in Malaysia, which is classified to be one of the 16 emerging stock markets that exist in the Asia Pacific region. The Bursa Malaysia (KLSE) was established in 1930, when the Singapore Stockbrokers' Association was formed. In July 1973, the Kuala Lumpur Stock Exchange Berhad was incorporated under the Companies Act of 1965. The Malaysian stock market has undergone a robust development since the late 1980s. With the proliferation of privatization projects and the equity boom in 1993, market capitalization exceeded the Singapore Stock Exchange by mid-1990s.

Since then, Bursa Malaysia has taken various measures in changing the market microstructure, including the introduction of computerized trading, a central depository, and efficient clearing and settlement systems, to develop market infrastructure in the effort to gain market efficiency.

Some of the key changes in the market microstructure of Bursa Malaysia are that the fist major market microstructure change was the implementation of the fully computerized screen based trading system in November 1992. The Implementation of SCORE (System On Computerized Order Routing and Execution) eliminated the open outcry system and hence, the use of a trading floor at the Exchange's premises. At the same epoch, the launching of Central Depository System (CDS) account opening in November 1992 marked a major milestone for Bursa Malaysia and expected to result in a more efficient settlement and clearing system. The third major market microstructure change was the establishment of the Securities Commission (SC) which monitors and implements regulatory changes to enhance the investor confidence and meet the requirements by statute.

The implementation of Broker Front End System, or WinSCORE, in 1994, was another key change in the market microstructure of the Bursa Malaysia. A system of graduated commissions was implemented also in 1995 to increase Malaysia's competitiveness in regard to transaction costs.

The year 1996 recorded two other eventful market microstructure changes. The first is the Ministry of Finance approving the listing of foreign companies on the Bursa Malaysia and also marked the successful completion of prescribing the ordinary shares of all listed companies, (except Amanah Harta PNB) under the Central Depository System (CDS).

In 1997, Bursa Malaysia was granted the status of an "approved foreign stock exchange" by the Australian Securities Commission on 2 July. Bursa Malaysia launched the KLSE-RIIAM Information System, which is a unique, comprehensive and consolidated Malaysian securities industry information system on 15th August 1997. In line with other developed stock exchanges, Bursa Malaysia implemented the T + 5 Rolling Settlement System on 18 August 1997. This system applies to all instruments listed on the Exchange. The MESDAQ was launched on 6th October 1997. Effective 15th December, KLSE began trading at 9.00 a.m. Previously trading starts at 9.30 a.m. The 12.30 p.m. noon close and 5.00 p.m. end of day close remain same as before.

The year 1998 was the year during Asian Currency Crisis, which has brought serious regressive implications to the Malaysian economy and its capital market. However, the Bursa Malaysia's activities on the market microstructure changes did go on to enhance investor confidence and further regularize its trading and settlement system.

Effective 1st September, 1998 Bursa Malaysia instituted incisive new measures to further enhance transparency in the stock market with changes in the rules, regulations and procedures of the Exchange. Effective from 16th September, trading of Malaysia securities on the Stock Exchange of Singapore's Central Limit Order Book International OTC market ceased.

In 1999, on 17th April, Bursa Malaysia launched a new index called the KLSE Syariah Index, to expand participation in the stock market from local and foreign investors who are keen to invest in securities approved by the Islamic principles of Syariah. In May 1999 Bursa Malaysia became an affiliate member of the International Organization of Securities Commissions (IOSCO). The membership will serve as another platform for Bursa Malaysia to learn from other members, and also present its views and opinions in various areas of securities regulations.

On 12th May, 2000 Bursa Malaysia launched the Technology sector and a corresponding technology index to track technology stock investments. On 7th June, 2000 the Borneo Securities was admitted as a member company of the Bursa Malaysia and effective from 1st September, the new brokerage rates were implemented.

The T+3 settlement cycle was implemented on 20th December 2000 in place of the previous T+5 Rolling Settlement System. The transition from T+5 to T+3, which shortens the delivery and settlement period for securities transactions from five (5) market days to three (3) market days.

In 2001, Bursa Malaysia issued its revamped Listing Requirements on 22nd January, a move widely seen as a major effort to further strengthen the capital market and securities industry in Malaysia. The Securities Commission launched the Capital Market Masterplan (CMP), which details recommendation in the strategic positioning and future direction of the Malaysian capital market, on 22 February 2001. Malaysia Derivatives Exchange (MDEX), an integrated derivatives exchange was launched on 11th June 2001. MDEX will offer a wide range of derivatives products and services including Bursa Malaysia Composite Index Futures and Options, Crude Palm Oil Futures and Kuala Lumpur Inter-Bank Offered Rate Futures.

The inaugural listing on Labuan International Financial Exchange (LFX) took place on 20th June, with the secondary listing of USD250 million bonds by 1st Silicon (Labuan) Inc.

The various key market microstructure changes in the observed two years between 2000 and 2001 were very critical to enhance transparency, trading efficiency and transaction costs of not only individual investors bit also for institutional investors. These changes were aimed to strengthen the stock market in terms of investor confidence and efficient price discovery at the post Asian Currency Crisis.

Evidence that Stock Market Microstructure affects Time to Equilibrium

Masulis and Shivakumar (2001) studied how different stock markets with different market microstructure affect the speed with which new information is incorporated into prices. Using transactions data, they compared the price reaction speeds on NASDAQ with those on the New York Stock Exchange (NYSE) and American Stock Exchange (AMEX). These markets are governed by separate rules and employ distinctly different organizational structures. Thus, they offered the opportunity to explore how these structural differences affect the speed of price reaction to news. Their results also suggest that differences in market microstructure can significantly accelerate or retard the incorporation of news into market prices.

A number of prior studies examine the impact of alternative market structures on stock return volatility (e.g., Amihud and Mendelson (1987), Stoll and Whaley (1990), Masulis and Ng (1995)). Masulis and Shivakumar (2001), extend this comparative analysis by examining price adjustment speeds across markets to a common type of information event, an announcement of seasoned equity offering (SEO) Studies by Jennings and Stark (1985) and Woodruff and Senchack (1988) document a positive correlation between price reaction speed to earnings announcements and the size of the earnings price reaction. Mech (1993) reports that larger announcement effects are more rapidly incorporated into stock returns.

Methodology, Research Design, and Data

The Amihud and Mendelson's (1987), Damodaran's (1993) partial adjustment with noise model and Theobald and Yallup's(2000,2004) ratios of auto covariance and the ARMA processes provides the framework for the analysis of this study.

The Auto-covariance Ratio estimator

The partial adjustment with noise model (Amihud and Mendelson, 1987) specifies stochastic processes for logarithmic observed price series and intrinsic value series. Observed prices are assumed, for example, to incompletely adjust towards their equilibrium or fundamental values and the extent of adjustment is being reflected in the Time to equilibrium coefficient. The equilibrium value is assumed to follow a random walk process, i.e. equilibrium values fully (efficiently) adjust to information shocks. The observed price and intrinsic value series are specified as:

$$\Delta P(t) = \pi\{(V(t) - P(t-1)\} + u(t) \tag{1}$$

$$\Delta V(t) = \mu + e(t) \tag{2}$$

where P(t) is the observed price at time t, ΔP(t) is the change in the actual (or observed) price (with Δthe change operator), expressed in natural logarithms, π, the time to equilibrium coefficient (assumed stationary), which will be within the range of [0,2] for non-explosive processes, V(t) is the intrinsic value at time t and u(t) is the noise due to the valuation and interpretational errors. u(t) has been interpreted as white noise with zero mean and finite variance $\boldsymbol{\sigma}^2$. Based on equation (2), the ΔV(t) is the change in logarithmic intrinsic values, μthe mean of the intrinsic value random walk process and e(t) the innovations in logarithmic intrinsic values which will be serially uncorrelated in efficient markets. The Time to equilibrium coefficient, π; will equal one when prices have fully adjusted to a new equilibrium while it will be greater (less) than unity where over (under) reactions occur.

Abstracting from noise /spread effects, it would appear to be intuitively plausible that under or overreactions would induce autocorrelations into return series. That is, when prices under-react, with a consequent sluggish adjustment to information, positive autocorrelations would occur (Barberis et al. (1998) demonstrate how a ‘‘conservatism bias’’ will lead to investors under-reacting). The auto-covariance for lags one and two can be derived as:

Lag one $$= Cov[R(t), R(t-1) = \frac{\pi}{2-\pi}[(1-\pi)var\{e(t)\} - var\{u(t)\}] \quad (3a)$$

(Amihud and Mendelson (1987)),

and lag two $$= Cov\{R(t), R(t-2)\} = \frac{\pi(1-\pi)}{2-\pi}[(1-\pi)var\{e(t) - var\{u(t)\}] \quad (3b)$$

assuming that the innovation and noise processes {u(t), e(t)} are stationary stochastic processes and that cross-covariance between these two processes are zero at all lags, with cov, the covariance operator, and var, the variance operator.

Taking ratios,

$$1-\pi = \frac{Cov\{R(t), R(t-2)\}}{Cov\{R(t), R(-1)\}}$$

Where by $$\pi = \frac{Cov\{R(t), R(t-2)\}}{Cov\{R(t), R(t-1)\}} - 1 \quad (4)$$

In taking the ratio 3(a) / 3(b), the common spread impacts due to bid-ask price bounces cancels out in the numerator and denominator; that is the spread effect reflected by var{u(t)} cancels out via the common [(1-π)var{e(t)} – var {u(t)}] terms in equations 3(a) and 3(b). The π measures the price equilibrium for any given differencing day.

Delays in Time to equilibrium may also arise due to thin trading effects rather than a sluggish adjustment towards new equilibrium values. These two effects are distinct phenomena. Their differing impacts within a stochastic process specification are demonstrated in Theobald and Yallup (2000). That is, autocorrelations can be induced by non-trading (see Miller et al., 1994; Scholes and Williams, 1977); however, if trade to trade prices are used, the autocorrelations will vanish in an efficient market corresponding to the full adjustment of these prices in efficient market settings. The estimator provided by Eq. (4) will be inconsistent in the presence of such trading effects; however, in this case, a consistent estimator of 1 - π will be given by

$$1-\pi = \frac{Cov\{R(m,t), R(m,t-2-q)\}}{Cov\{R(m,t), R(m,t-1-q)\}} \quad (5)$$

where R(m,t) is the observed returns variable subject to thin trading and q is the longest lag in ‘‘true’’ returns that impacts upon R(m,t). That is, for example, with the consecutive trades assumption (Scholes and Williams, 1977; Miller et al., 1994), a consistent estimator of 1 - π is provided by the ratio of the lag three-sample auto-covariance to the lag two sample auto-covariance

The ARMA estimator

The estimator at equation (1) can be related to a linear stochastic process. If R (t) is second-order stationary then the estimator at equation (1) will equal the ratio of the lag two to lag one-autocorrelation coefficients. If R(t) is modeled as an Autoregressive AR(1) process, the coefficient on the AR(1) term will equal the ratio of the lag two and lag one autocorrelation coefficients. Since the ratio of the lag three to lag two autocorrelations will also be equal to the coefficient on the AR(1) term, this estimator will also be appropriate in the presence of thin trading.

An alternative time series estimator may be derived by noting that equation (1) may be re-expressed, after first differencing and rearranging, as

$$R(t) = (1-\pi)R(t-1) + \pi\Delta V(t) + \Delta u(t) \tag{6}$$

and by substituting for ΔV(t) from equation (10), equation (14) becomes

$$R(t) = \pi\mu + (1-\pi)R(t-1) + \pi e(t) + u(t) - u(t-1) \tag{7}$$

Again, then, within this modeling structure, the autocorrelations induced by under/ overreactions are reflected as an ARMA(1,1) process. Effectively, the price adjustment effects manifest themselves within the AR(1) coefficient which will provide estimates of the speed of adjustment coefficient. When adjustment is ''full'' (i.e. $\pi = 1$), the process will be an MA (1) process; that is, ''noise'', such as bid-ask prices bounces, drives the return process. The autoregressive component will be stationary provided that $|1 - \pi| < 1$, i.e. $0 < \pi < 2$, which corresponds to the conditions imposed by Amihud and Mendelson (1987) to ensure that prices were finite when developing their model. When non-synchronicities are present Eq. (7) modifies to

$$R(m,t) = \pi\mu + (1-\pi)R(m,t-1) + \sum_{i=0}^{q} w(i)L^{i}\{\pi e(t-i) - u(t-1-i)\} + (1-(1-\pi)L)r(t) \tag{8}$$

where L^i is the lag operator for i steps back. That is effectively an ARMA (1, q+1) process. Again, then, the autoregressive coefficient provides an estimator for $(1 - \pi)$; the moving average component, which captures the thin trading effects, is now of a higher order. For the case of consecutive trades considered previously, the appropriate process is an ARMA (1,2) process. [An ARMA (p,q) approach to modeling non-synchronicities only was also used in Stoll and Whaley (1990) and Miller, Muthuswamy and Whaley (1994)].

Since, as previously discussed, both estimators may be related directly to the lag one autocorrelation coefficient, the most general insights into the behavior of the estimators with intervalling can be generated by an analysis of the intervalling properties of the autocorrelation coefficient.

Equation (8) is of a similar nature to the ARMA (1,1) model used in Amihud and Mendelson (1987), although the model was used in a different context (to test weak form efficiency) and they did not indicate that the AR(1) coefficient provided an estimate of $1-\pi$. Note that the ARMA(1,1) process is under-specified in the presence of non-synchronicities. Their results, for a sample of 30 stocks, indicated that at the opening on the NYSE stocks significantly overreacted, on average, while using closing prices the reaction was unbiased, i.e. full. Roll (1994) used the AR(1) coefficient to estimate speed of adjustment factors for Indonesian stocks. Hasbrouck and Ho (1987) developed an ARMA (2,2) return generating process for transaction returns from which an estimate of the speed of adjustment factor could be generated; they did not, however, estimate speeds of adjustment.

The observed returns were not adjusted for transactions costs as these effects, will be subsumed in the noise term of the partial adjustment process (Barber et al., 2001). The observed returns expressed in natural logarithms were combined over the years of observation for each relevant company and the covariance of R(t) and R(t-2) were obtained for lag two covariance than the process was repeated to obtain the covariance of R(t) and R(t-1) which is lag one covariance for all the 30 days time frame. The lag two-covariance output was divided by the lag one covariance output to obtain the $(1 - \pi)$ figures, which later subtracted from 1 to derive the just πas the coefficient for the speed of price adjustment.

Research Design

From an efficient markets perspective, an important question is whether the Time to equilibrium of observed market prices to full information prices is complete (i.e. $\pi = 1$) and, if not so, how rapidly the equilibrium process becomes complete with an increasing differencing interval. The investigations of over and under reactions are conducted simultaneously in this research in the spirit of Fama (1998), who argued that in an efficient market where expected abnormal returns are zero, anomalies such as under and overreactions would be split on a random basis. Accordingly, the statistical significance of the cross-sectional average *time to equilibrium* is investigated.

As per the objective of this study, the *time to equilibrium* is estimated for the market microstructure changes in effort to determine the effects of such changes. As the Malaysian stock market experienced several key market microstructure changes from the year of 1990 onwards, the study measures the *Time to equilibrium* based on all announcements at the end of 1993, 1995, 1997, 1999 and 2001. The time to equilibrium coefficients were estimated at the end of the above said years mainly to allow the key market microstructure change to be implemented and operationalized in the market for a reasonable period of time.

However, in this study the response of The Time to equilibrium coefficients were determined for individual sample stocks, based on all information announcements. The all information announcements is a combinations of firm specific and market wide announcements which were made at specific dates between 1990 to 2001 by individual companies which are grouped in their sectors as listed in the main board of Bursa Malaysia. This study used five firm specific announcements based on the post-announcement stock price reactions. The five announcements are: (i) Final Dividend Announcement, (ii) The Rights Issues Announcement, (iii) Bonus Issues Announcement, (iv) Chief Executive Officers' Changes, (v) Employee Share Option Scheme (ESOS) Announcement. The Market-wide Announcements are: (i) The National Annual Budget Announcement (ii) The National General Elections Announcement. (iii) The Appointment of Deputy Prime Minister (DPM) Announcement (iv) The National Capital and Exchange Control Announcements.

The Empirical Tests

The empirical tests in this study will be conducted in two distinctive Time to equilibrium coefficient methods. Firstly, using the auto covariance ratio estimator (equation (4), without adjusting for thin trading), the Time to equilibrium is determined in terms of the cross-sectional mean of the Time to equilibrium coefficient π, and standard deviation of the adjustment coefficient π for the differencing period of + 30 days from the day of the information being publicly available. The investigations of over and under reactions are conducted simultaneously to determine the reactions of market participants to various different announcement types in different sectors.

Secondly, the earlier tests (the auto-covariance ratio without adjustment for thin trading) are determined again using the ARMA processes. Theobald and Yallup (2002 ,2004) used ARMA (1,2) based on equation (7) to determine the speeds of price adjustment besides the Auto covariance Ratios. They found that the Auto-covariance Ratio and ARMA estimators were broadly very similar in terms of both biases and mean square errors. With high noise to innovation ratios the ARMA (1,1) based estimator tended to perform the strongest, both in terms of the bias and mean square error criteria. In this study the ARMA (1,2) estimator is used for its properties of suitability to an emerging market microstructure. The ARMA (1,2) which is of a higher order of MA, that is effectively an ARMA (1, q+1) process where autoregressive coefficient provides an estimator for ($1-\pi$) the moving average component, which captures the thin trading effects, is now of a higher order.

Data

The data sets used in this study are the daily closing prices of stocks from the Security Clearing Automated Network Services (SCANS) issued by the Bursa Malaysia. The sample comprises all companies that are continuously listed in Bursa Malaysia's main board for a period of 11 years from January 1990 to December 2001. There are four categories of data collected for this study, the Daily closing stock prices of the test samples from SCANS, Bursa Malaysia Daily, The Announcement Date of the involved corporate announcements based on the e date when the announcement is filed at the Bursa Malaysia and recorded in the daily diary is taken as the appropriate date of announcement. Announcement dates of market-wide announcements are obtained from local Daily Newspapers such as News Straits Times and the Star as well as in the web sites of the Ministry of Finance for National Budget Announcements and Capital and Currency Control and web site of Prime Ministers Department for the announcements of the Appointment of Deputy Prime Minister and announcements of the National General Elections. Key market microstructure changes implementations dates are obtained from the Bursa Malaysia media center archives, Bursa Malaysia web site's history records at www.bursamalaysia.com and the press release in main local newspapers.

The sample companies for this study were selected subject to the criteria that only pure corporate announcements, uncontaminated by other events during the test window period over 0 and + 30 days around the announcement date were finally selected to ensure that the results are not contaminated by other confounding information effects. Sample with two or more over lapping announcements within the window period of the said 30 days were dropped off. It is valid that the stock price movements are subjected to many other determinants. In this study any other events other then the analyzed corporate or corporate related events are considered to be **noise**. The companies should have recorded trade prices 70 percent of the time. The company must be Malaysian domiciled.

The Empirical Findings

Based on the empirical findings in the previous studies, this study uses the Auto covariance ratio estimator and the ARMA (1,2) estimator to determine the Time to equilibrium coefficients on the effects of the market microstructure changes. The number of days taken for each category of announcement are determined through the Time to equilibrium coefficient, π. The day on which the $\pi = 1$ (statistically significantly not different from one at 0.05 significance level) the price in terms of daily returns is considered to have fully adjusted or achieved a new information induced equilibrium price. Together with the number of days taken by the share prices to fully adjust to new information, the degrees of over or under-reaction of the prices were also investigated and reported.

According to the World Bank statistics in 1998, there are about 67 emerging markets all together, which accounts for 20 percents of the world capitalization. The Bursa Malaysia is probably an example of a market among the more experienced, and institutionally (disclosure standards, investor protection, accounting standards, etc.) experienced then other emerging markets. Therefore the findings in this study is highly unlikely to be generalized to all emerging markets until further research of more markets are attempted.

Table 1: Key Market Microstructure Changes to Corresponding Years and it's time to equilibrium.

Years	Key Market Microstructure Changes	Days to Equilibrium Auto Covariance Ratio	Days to Equilibrium Arma (1,2)
1990to 1993	• Implementation of SCORE • Implementation of CDS • Establishment of Securities Commission • Introduction of FDSS • Increase of 90 minutes in trading time	15 days Under-reaction	14 days Under-reaction
1994 to 1995	• Implementation of WinSCORE • System of Graduated Commission • Trading in smaller board lots of 200 shares	13 days Under-reaction	13 days Under-reaction
1996 to 1997	• Approval for listing foreign companies • Approved foreign stock exchange of Australian Securities Commission • Increase in paid up capital requirement • Implementation of T+5 rolling settlement • Launch of MESDAQ • Increase of 30 minus in trading time	12 days Under-reaction	10 days Under-reaction
1998 to 1999	• Institution of incisive measures • Allocation of ISIN • Launching of Syariah Index • Affiliate member of IOSCO • Introduction of ISS	11 days Under-reaction	9 days Under-reaction
2000 to 2001	• MoU to consolidate COMMEX • Launch of Technology sector • New brokerage rates • Implementation of T+3 Settlement • Revamped listing requirement • Launch of Capital Market master plan	11 days Under-reaction	9 days Under-reaction

The findings of this study reveal that the stock market microstructure changes over a period of time does have a positive effect on the Time to equilibrium. It is evident that the market microstructure changes implemented by the Bursa Malaysia reduced the Time to equilibrium, which is determined here by the Time to equilibrium coefficients through the two main estimators, that is the Auto covariance ratio and the ARMA (1,2) estimator. The major market microstructure changes implemented by Bursa Malaysia since the early 1990 to 2001 have improved the market efficiency in terms of the number of days taken to reflect all information into is prices.

Figure 2: Time to equilibrium Against Market Microstructure Changes Graph

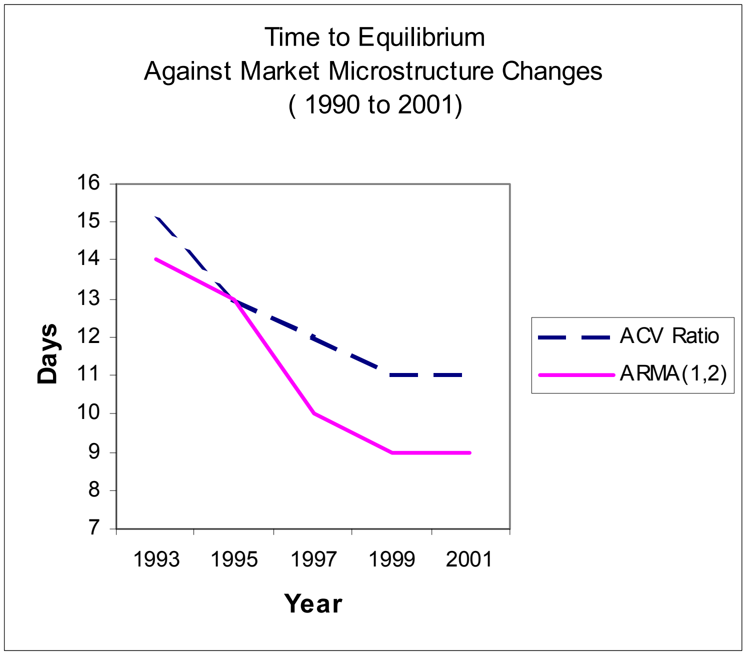


Figure 2, show that the Time to equilibrium for all information was 14 days (based on ARMA (1,2) reporting) in 1993 and the number of days taken to fully reflect all information in its prices have substantially reduced to nine days in 2001. The Auto-covariance ratio estimator show a steady decline in the Time to equilibrium while the ARMA (1,2) shows a steep decline in number of days to adjust new information between 1995 and 1997(which show a decline of three days). However both estimators show that the reduction of the Time to equilibrium stabilized during the last two observations between 1999 and 2001.

The findings presented in this study also reveal that the prices of the Bursa Malaysia generally under-react for the first nine days from the day announcements is made publicly available. This is consistent with the findings in the developed stock markets such as NYSE/AMEX in the US that on an average stocks exhibited a π lower than one for at least first four days of the information arrival suggesting under reaction (Marisetty 2003). The nine days time to fully adjust all information is very much fast for an emerging market when compared to the findings in Bombay Stock Exchange which reports 19 days of over-reaction. This also suggests that the stock market is not at strong form efficiency as the stock prices have signs of under-reaction even on the very first day of the information dissemination. The persistence of under-reaction implies that the stock market is near semi-strong form efficient but the nine days time to converge to their full information values make it also to be near weak form efficient. However it can be concluded that consistent with the previous findings (Annuar and Shamsher, 1991), (Annuar, Ariff,.and Shamsher, 1994) the Bursa Malaysia is in between near semi-strong form and near weak form efficient.

References

[1] Amihud, Y. and Mendelson, H. (1987), Trading mechanisms and stock returns: an empirical investigation, Journal of Finance, 42, pp533-553.

[2] Amihud, Y., H. Mendelson and M. Murgia, M.,(1990), Stock Market Microstructure and Return Volatility: Evidence from Italy, Journal of Banking and Finance, 14(2-3), 423-40.

[3] Amihud, Y. and Mendelson, H., (1991), "Volatility, efficiency and trading: Evidence from the Japanese stock market", Journal of Financial Economics, Vol. 46, pp. 1765-1789.

[4] Amihud, Y., Mendelson, H. and Lauterbach, B.,(1997), "Market Microstructure and Securities Values: Evidence from Tel Aviv Stock Exchange", Journal of Financial Economics, Vol. 45, pp. 365-390.

[5] Annuar M.N. (1991), The Efficient Market Hypothesis and The Thinly Traded Kuala Lumpur Stock Exchange : Tests with Appropriate Refinements., PhD Dissertation, Universiti Putra Malaysia.

[6] Annuar,M.N., Ariff,.M.,and Shamsher,M..,(1994), Is Kuala Lumpur's Emerging Share Market Efficient? Journal of International Financial Markets, Institutions and Money, 4(2), :89-100

[7] Barberis, N., Vishny, A. and Schleifer, R. (1998), A model of investor sentiment, Journal of Financial Economics, 49, pp307-343.

[8] Bernard, V. and Thomas, J. (1989), Post-earnings announcement drift: delayed response or risk premium? , Journal of Accounting Research, 27, pp1-36.

[9] Blennerhassett, M. and Bowman, R.G., 1998, "A change in market microstructure: the switch to electronic screen trading on the New Zealand stock exchange", Journal of International Financial Markets, Institutions and Money, Vol. 8, pp.261-276.

[10] Chang, R.P., Hsu, S., Huang, N. and Rhee, S.G., 1999, "The Effects of Trading Methods on Volatility and Liquidity: Evidence from Taiwan Stock Exchange", Journal of Business Finance and Accounting, Vol. 26, Nos. 1&2, pp. 137-170.

[11] Coughenour, J. and Shastri,K., (1999), Symposium on Market Microstructure: A Review of the Empirical Evidence, Financial Review.

[12] Damodaran, A. (1993), A simple measure of price adjustment coefficients, Journal of Finance, 48, pp387-399.

[13] DeBondt, W. and Thaler, R,. (1987), Further evidence on investor overreaction and stockmarket seasonality, Journal of Finance, 42, pp557-581.

[14] Demsetz, H., (1968), The Cost of Transacting, Quarterly Journal of Economics, 82, 33-53.

[15] Fama, E. (1991), Efficient capital markets II, Journal of Finance, 46, pp1575-1618.

[16] Fama, E., (1998). Market efficiency, long term returns and behavioural finance. Journal of Financial Economics 49, 283–306.

[17] Hasbrouck, J., Ho, T., (1987), Order arrival, quote behaviour and the return-generating process. Journal of Finance 42, 1035–1048.

[18] Jennings, R., Starks, L., 1985. Information content and the speed of stock price adjustment. Journal of Accounting Research 23, 336-350.

[19] Keim, Donald B., and Ananth Madhavan, 1998, The Costs of Institutional Equity Trades: An Overview, Financial Analysts Journal 54, 50-69.

[20] Kim, E. H. and Singal, V., 2000, "Stock Market Openings: Experience of Emerging Economies", Journal of Business, Vol. 73, No. 1, pp. 25-66.

[21] Lyons, R., (1999), The Microstructure Approach to Exchange Rates, MIT Press.

[22] Madhavan, A., 2000, "Market microstructure: A survey ", Journal of Financial Markets, Vol. 3, pp. 205-258.

[23] Majnoni, G. and Massa, M., 2001, "Stock Exchange Reform and Market Efficiency: The Italy Experience", European Financial Management, Vol. 7, No. 1, pp. 93-115.

[24] Marisetty,V.B.(2003), Measuring productive efficiency of stock exchanges using price adjustment coefficients, : Working Paper, Monash Univeristy, Clayton, Australia.

[25] Masulis,R. and Shivakumar, L. (2001), Price Reaction Speed to Stock Offering Announcements: A NYSE/AMEX and NASDAQ Comparison,: Working Paper Vanderbilt University Nashville.
[26] Masulis, R. and V. Ng, (1995), “Overnight and Daytime Stock-return Dynamics on the London Stock Exchanges: The Impacts of ‘Big Bang” and the 1987 Stock-market Crash,” Journal of Business Economics and Statistics, 13, 365-378.
[27] Mech, T. “Portfolio Return Autocorrelation.” Journal of Financial Economics, 34 (1993), 307-344.
[28] Michaely, R., Thaler, R. and Womack, K. (1995), Price reactions to dividend initiations and omissions: overreaction or drift?, Journal of Finance, 50, pp573-608.
[29] Miller, M., Muthuswamy, J. and Whaley, R. (1994), Mean reversion of Standard and Poor's 500 index basis changes: arbitrage induced or statistical illusion?, Journal of Finance, 49, pp479-514.
[30] Ngugi, R.W., Murinde, V. and Green, C.J., 2002a, "Does the revitalisation process really enhance stock market microstructure? Evidence from the Nairobi stock exchange", The African Finance Journal, Vol. 4, Part 1, pp. 32-63.
[31] Ngugi, R.W., Murinde, V. and Green, C.J., 2002b, "How have the emerging stock exchanges in Africa responded to market reforms?", Journal of African Business, Vol. 3, No. 1.
[32] Richards, A.J., (1996), "Volatility and Predictability in National Stock Markets: How do Emerging and Mature Markets Differ?" IMF Staff Papers, Vol. 43, No. 3, pp. 461-501.
[33] Roll, R., (1984), A simple implicit measure of the effective bid–ask spread. Journal of Finance 39, 1127–1139.
[34] Scholes, M., and J. Williams. “Estimating Betas from Nonsynchronous Data,” Journal of Financial Economics, 5 (1977), 309-327.
[35] Stoll, H.,(1999), Microstructure: The organization of trading and short term price behaviour, Volumes I and II, Cheltenham, Edward Elgar.
[36] Stoll, H. and R. Whaley, “Stock Market Structure and Volatility,” Review of Financial Studies, (Spring 1990) 3, No. 1, 37-71
[37] Theobald, M and P. Yallup. 2000. Price Adjustment Processes in Financial Markets, The Current State of Business Disciplines, Spellbound Publications, 3, 971-980.
[38] Theobald, M and P. Yallup, 2004, Determining Security Speed of Adjustment Coefficients, Journal of Financial Markets, 7, 75-96
[39] Woodruff, C.S and A.J. Senchack , Jr. “Intradaily Price-Volume Adjustments of NYSE Stocks to Unexpected Earnings” Journal-of-Finance, 43 (1988),467-91.

Appendix

Table 1: Estimated Time to equilibrium **Coefficient** tested for All Announcements from 1990 to 1993.

	π By Ratios Of Autocovariances			π By ARMA 1,2		
Days	**Mean π**	**Stdev. π**	**t-value**	**Mean π**	**Stdev. π**	**t-value**
1	0.8820	0.7976	-2.553	0.9796	0.0999	-3.541
2	0.8928	0.6589	-2.809	0.9779	0.1038	-3.694
3	0.8695	0.7059	-3.191	0.9801	0.0855	-4.030
4	0.8990	0.7213	-2.416	0.9798	0.0900	-3.880
5	0.8474	0.6760	-3.895	0.9826	0.0869	-3.470
6	0.8658	0.7044	-3.288	0.9781	0.1362	-2.785
7	0.8579	0.7154	-3.427	0.9825	0.1264	-2.398
8	0.8418	0.7639	-3.574	0.9800	0.1415	-2.446
9	0.8546	0.7083	-3.542	0.9797	0.1482	-2.371
10	0.8980	0.7137	-2.468	0.9803	0.1471	-2.325
11	0.9065	0.6778	-2.382	0.9854	0.1272	-1.990
12	0.9141	0.7044	-2.104	0.9864	0.1185	-1.983
13	0.8820	0.7262	-2.805	0.9850	0.1314	-1.971
14	0.8925	0.7268	-2.552	0.9883	0.1030	-1.963
15	0.9065	0.7230	-2.233	0.9917	0.1035	-1.382*
16	0.9587	0.6783	-1.050*	0.9955	0.0809	-0.955
17	1.0172	0.7161	0.414	0.9979	0.0710	-0.512
18	1.0279	0.6938	0.695	0.9988	0.0416	-0.514
19	1.0217	0.7261	0.516	1.0011	0.0290	0.634
20	1.0148	0.7782	0.328	1.0012	0.0512	0.405
21	1.0072	0.7106	0.175	0.9991	0.0862	-0.186
22	0.9989	0.7694	-0.025	1.0001	0.0453	0.021
23	0.9966	0.6994	-0.085	0.9993	0.0917	-0.131
24	1.0005	0.7512	0.011	0.9990	0.0885	-0.200
25	1.0056	0.6907	0.139	0.9993	0.0486	-0.259
26	1.0213	0.7006	0.524	0.9994	0.0892	-0.112
27	1.0200	0.7554	0.456	0.9979	0.0439	-0.835
28	0.9688	0.7142	-0.753	0.9980	0.0363	-0.933
29	1.0343	0.7550	0.783	0.9972	0.0443	-1.080
30	0.9932	0.7217	-0.164	1.0000	0.0672	0.010

Critical t-value = ± 1.96 at 0.05

Table 2: Estimated Time to equilibrium **Coefficient** tested for All Announcements from 1990 to 1995.

	π By Ratios Of Autocovariances			π By ARMA 1,2		
Days	**Mean π**	**Stdev. π**	**t-value**	**Mean π**	**Stdev. π**	**t-value**
1	0.9013	0.7817	-3.041	0.9840	0.1015	-3.806
2	0.9068	0.6839	-3.280	0.9828	0.1027	-4.034
3	0.9253	0.7042	-2.555	0.9843	0.0818	-4.632
4	0.9283	0.7208	-2.395	0.9858	0.0870	-3.927
5	0.9244	0.6966	-2.612	0.9870	0.0842	-3.718
6	0.9240	0.6910	-2.649	0.9838	0.1157	-3.376
7	0.9202	0.7174	-2.680	0.9863	0.1069	-3.089
8	0.9208	0.7645	-2.496	0.9863	0.1156	-2.860
9	0.9307	0.7180	-2.325	0.9902	0.1125	-2.090
10	0.9354	0.7020	-2.217	0.9901	0.1154	-2.059
11	0.9372	0.6761	-2.236	0.9907	0.1123	-2.004
12	0.9435	0.6915	-1.968	0.9917	0.0993	-2.024
13	0.9447	0.6804	-1.956	0.9914	0.1042	-1.977
14	0.9834	0.6947	-0.576	0.9975	0.0341	-1.782
15	0.9908	0.7232	-0.306	1.0011	0.0363	0.754
16	0.9911	0.6670	-0.320	1.0001	0.0551	0.034
17	1.0014	0.7021	0.049	0.9994	0.0424	-0.325
18	1.0009	0.6953	0.030	0.9981	0.0388	-1.197
19	1.0000	0.7364	0.000	1.0008	0.0284	0.676
20	1.0072	0.7628	0.227	0.9986	0.0416	-0.786
21	0.9964	0.7156	-0.122	1.0019	0.0316	1.423
22	0.9957	0.7482	-0.138	0.9982	0.0374	-1.152
23	1.0010	0.6962	0.034	1.0028	0.0474	1.429
24	1.0021	0.7504	0.068	1.0017	0.0468	0.866
25	0.9952	0.7032	-0.164	0.9990	0.0462	-0.539
26	1.0075	0.6939	0.261	1.0026	0.0449	1.378
27	1.0031	0.7673	0.097	0.9977	0.0468	-1.203
28	0.9926	0.7392	-0.241	0.9976	0.0379	-1.540
29	0.9979	0.7384	-0.070	0.9986	0.0448	-0.753
30	1.0117	0.7294	0.385	1.0022	0.0390	1.334

Critical t-value = ± 1.96 at 0.05

Table 3: Estimated Time to equilibrium **Coefficient** tested for All Announcements from 1990 to 1997.

	π By Ratios Of Autocovariances			**π By ARMA 1,2**		
Days	**Mean π**	**Stdev. π**	**t-value**	**Mean π**	**Stdev. π**	**t-value**
1	0.9224	0.7884	-2.978	0.9929	0.1120	-2.320
2	0.9257	0.6872	-3.271	0.9938	0.1131	-2.010
3	0.9378	0.7320	-2.572	0.9940	0.0927	-2.382
4	0.9326	0.7367	-2.771	0.9942	0.0930	-2.286
5	0.9333	0.7242	-2.789	0.9934	0.0853	-2.845
6	0.9380	0.7180	-2.614	0.9951	0.0878	-2.035
7	0.9416	0.7188	-2.460	0.9953	0.0750	-2.272
8	0.9381	0.7690	-2.434	0.9959	0.0675	-2.246
9	0.9464	0.7275	-2.228	0.9953	0.0812	-2.121
10	0.9500	0.7162	-2.111	0.9951	0.0844	-2.128
11	0.9550	0.6843	-1.991	0.9989	0.0430	-0.950
12	0.9520	0.7109	-2.043	1.0000	0.0441	-0.025
13	0.9975	0.6921	-0.111	0.9997	0.0350	-0.338
14	1.0034	0.7171	0.143	0.9993	0.0316	-0.762
15	1.0050	0.7370	0.204	1.0000	0.0444	0.004
16	1.0000	0.6667	0.000	1.0005	0.0488	0.395
17	1.0004	0.7006	0.018	1.0001	0.0365	0.119
18	0.9899	0.7213	-0.426	0.9991	0.0349	-0.983
19	0.9942	0.7461	-0.236	0.9997	0.0262	-0.393
20	0.9929	0.7558	-0.284	0.9992	0.0385	-0.738
21	0.9974	0.7284	-0.108	1.0002	0.0500	0.135
22	0.9944	0.7336	-0.232	0.9990	0.0365	-0.995
23	0.9963	0.7116	-0.157	1.0005	0.0515	0.321
24	0.9936	0.7568	-0.258	1.0006	0.0615	0.348
25	0.9889	0.7257	-0.464	0.9993	0.0401	-0.645
26	0.9920	0.6960	-0.348	1.0010	0.0583	0.608
27	0.9938	0.7862	-0.239	0.9986	0.0367	-1.388
28	0.9768	0.7407	-0.948	0.9989	0.0310	-1.296
29	0.9859	0.7411	-0.575	0.9991	0.0414	-0.836
30	1.0175	0.7541	0.704	1.0001	0.0446	0.042

Critical t-value = ± 1.96 at 0.05

Table 4: Estimated Time to equilibrium **Coefficient** tested for All Announcements from 1990 to 1999.

π By Ratios Of Autocovariances				**π By ARMA 1,2**		
Days	**Mean π**	**Stdev. π**	**t-value**	**Mean π**	**Stdev. π**	**t-value**
1	0.9412	0.8050	-2.666	0.9934	0.1129	-2.3818
2	0.9262	0.6828	-3.941	0.9932	0.1163	-2.3651
3	0.9476	0.7351	-2.599	0.9941	0.0990	-2.4235
4	0.9409	0.7431	-2.900	0.9931	0.0992	-2.8428
5	0.9460	0.7193	-2.741	0.9943	0.0914	-2.5550
6	0.9476	0.7319	-2.614	0.9948	0.0941	-2.2607
7	0.9563	0.7353	-2.167	0.9948	0.0793	-2.6468
8	0.9519	0.7950	-2.208	0.9963	0.0743	-2.0050
9	0.9593	0.7377	-2.014	0.9965	0.0552	-2.6145
10	0.9603	0.7284	-1.988	1.0006	0.0530	0.4300
11	0.9624	0.6985	-1.965	1.0009	0.0722	0.5293
12	0.9657	0.7193	-1.742	1.0001	0.0432	0.0907
13	1.0006	0.7050	0.032	1.0005	0.0459	0.4055
14	0.9975	0.7262	-0.125	0.9995	0.0375	-0.5496
15	1.0048	0.7369	0.239	1.0006	0.0364	0.7136
16	1.0051	0.6795	0.272	1.0009	0.0575	0.6398
17	1.0015	0.7143	0.077	0.9997	0.0360	-0.3595
18	0.9914	0.7195	-0.435	1.0005	0.0456	0.4253
19	0.9945	0.7482	-0.266	0.9995	0.0289	-0.6667
20	0.9945	0.7684	-0.262	0.9997	0.0369	-0.2994
21	1.0027	0.7418	0.132	1.0002	0.0323	0.2377
22	0.9967	0.7515	-0.162	0.9999	0.0409	-0.0527
23	0.9991	0.7157	-0.047	1.0013	0.0419	1.2966
24	0.9967	0.7692	-0.157	1.0011	0.0482	0.9609
25	0.9896	0.7129	-0.533	1.0003	0.0417	0.3244
26	0.9902	0.7093	-0.506	1.0008	0.0428	0.7565
27	0.9943	0.7923	-0.263	1.0002	0.0403	0.1938
28	0.9929	0.7430	-0.349	0.9996	0.0325	-0.4678
29	0.9846	0.7516	-0.749	0.9998	0.0391	-0.2438
30	1.0073	0.7531	0.354	1.0008	0.0323	1.0177

Critical t-value = ± 1.96 at 0.05

Table 5: Estimated Time to equilibrium Coefficient tested for All Announcements from 1990 to 2001.

π By Ratios Of Autocovariances				π By ARMA 1,2		
Days	**Mean π**	**Stdev. π**	**t-value**	**Mean π**	**Stdev. π**	**t-value**
1	0.9293	0.8005	-3.432	0.9920	0.1191	-2.988
2	0.9330	0.6842	-3.806	0.9922	0.1255	-2.773
3	0.9477	0.7348	-2.769	0.9924	0.1135	-2.986
4	0.9447	0.7362	-2.922	0.9927	0.1088	-2.990
5	0.9580	0.7113	-2.292	0.9923	0.1047	-3.257
6	0.9538	0.7294	-2.461	0.9936	0.1035	-2.739
7	0.9628	0.7371	-1.964	0.9961	0.0782	-2.216
8	0.9577	0.7920	-2.075	0.9963	0.0832	-1.997
9	0.9693	0.7392	-1.615	0.9972	0.0632	-1.979
10	0.9607	0.7288	-2.095	1.0016	0.0522	1.360
11	0.9647	0.6931	-1.978	1.0009	0.0746	0.518
12	0.9911	0.7167	-0.482	1.0002	0.0446	0.236
13	0.9997	0.7023	-0.017	1.0008	0.0478	0.737
14	1.0016	0.7202	0.085	0.9987	0.0359	-1.660
15	1.0065	0.7336	0.346	1.0011	0.0358	1.349
16	1.0019	0.6793	0.106	1.0015	0.0570	1.203
17	1.0039	0.7085	0.215	0.9994	0.0350	-0.717
18	0.9965	0.7150	-0.192	1.0001	0.0408	0.112
19	0.9962	0.7463	-0.196	0.9995	0.0294	-0.745
20	0.9941	0.7616	-0.301	0.9994	0.0328	-0.867
21	0.9984	0.7360	-0.082	1.0012	0.0293	1.896
22	0.9941	0.8967	-0.256	0.9991	0.0383	-1.030
23	0.9961	0.7104	-0.213	1.0021	0.0391	2.384
24	0.9931	0.7665	-0.348	1.0033	0.0426	3.394
25	0.9890	0.7076	-0.605	0.9994	0.0472	-0.570
26	0.9932	0.7024	-0.376	1.0012	0.0396	1.383
27	0.9968	0.7867	-0.159	0.9989	0.0343	-1.428
28	0.9878	0.7426	-0.640	1.0002	0.0324	0.284
29	0.9906	0.7517	-0.486	0.9981	0.0295	-2.814
30	1.0119	0.7479	0.619	1.0005	0.0312	0.731

Critical t-value = ± 1.96 at 0.05