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Demutualization in Developing and Developed Country Stock Exchanges

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Abstract

This study considers seven different stock exchanges in order to measure the impact of demutualization announcements on stock market return volatility. This is measured based on the daily index prices of all seven indices: the Toronto Stock Exchange (TSX) in Canada, the FTSE 100 in the UK, the Straits Times Index (STI) in Singapore, the Nikkei 225 in Japan, the Kuala Lumpur Composite Index (KLCI) in Malaysia, the SENSEX in India, and the Hang Seng Index (HSI) in Hong Kong, China. A dummy variable is used to differentiate between pre- and post-event data. We use the augmented Dickey–Fuller test, the ARCH LM test and GARCH (1, 1) methodology to measure return volatility due to demutualization announcements. The results show that the decision to demutualize did not affect the UK, Singapore, and Indian stock markets, where volatility is explained by other factors. It did, however, affect the Canadian, Japanese, Hong Kong, and Malaysian stock markets. Moreover, the Canadian and Malaysian market swere negatively affected, while the Hong Kong and Japanese markets reacted positively to the demutualization announcements.

Keywords: Demutualization, stock market, GARCH.

JEL classification: G150, G170, C220.

1. Introduction

Conventionally, stock exchanges have worked as a "club of brokers" under a mutual operating system, who enjoy the rights of ownership and decision-making. Stock exchanges have faced a number of challenges in recent years due to technological advancements and improvements, growing competition and globalization. Consequently, many stock exchanges are now rethinking their investment decisions, regulatory reforms and aggressive environment. The challenge for stock

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exchanges is to find new opportunities in the present environment, while surviving new threats.

The different forms of demutualization have become a widespread reality with growing demand in emerging markets (Elliott, 2002). In this context, stock exchanges have developed new business models and governance structures to counter their competition, transforming from members' associations to for-profit organizations; this is the process of demutualization. Exchange demutualization begins when the members of a traditional nonprofit organization that operates a stock exchange reorganizes it as a for-profit institution. It concludes when the exchange goes public and becomes listed.

Exchange demutualization is the process of converting a mutually owned association into a limited company by share. In this conversion, decision-making rights are transferred from the members' association to the number of shares issued (the shareholders). Demutualization is important if, in a competitive environment, the exchange shifts its focus from working in the best interests of its members or brokers to working to maximizes hare holder equity by providing services to its customer, i.e., investors and brokers. The Stockholm Stock Exchange was the first exchange to be demutualized in 1993. By 1999, 11 others had also been demutualized. By2002, almost 21 exchanges had been demutualized and listed (see also Table A1 in the Appendix).

Citing a survey conducted by BTA Consulting to determine the objectives behind exchange demutualization, Scullion (2001) highlights the following: (i) attracting new investors to meet the capital requirements for modifying a trading system, (ii) creating an unbiased business environment, (iii) controlling the cost of transactions, and (iv) creating a competitive and flexible environment that promotes efficiency. The impact of exchange demutualization is often studied in the context of how it affects the structure of an organization. Our aim, however, is to look at its impact on the financial market in terms of efficiency, profitability, and governance structure and to determine whether this structural change affects security prices.

Specifically, we will measure the impact of demutualization announcements on a sample of seven stock exchanges in different developed and developing countries. We will examine whether, and to what extent, stock market volatility rises or falls in these countries after demutualization is announced. The study is limited to seven demutualized exchanges and spans a 12-year sample period.

Earlier studies have used different indicators to measure the impact of demutualization on stock exchange liquidity (e.g., Krishnamurti, Sequeira, & Fangjian, 2003; Treptow, 2006), efficiency (e.g., Serifsoy, 2008), and cost and trading volume (e.g., Hazarika, 2004). Krishnamurtiet al. (2003) and Hazarika (2004) conduct a comparative analysis of ownership structure for two stock exchanges. Mendiola and O'Hara (2003) use five measures of performance—return on assets, financial leverage, return on equity, profitability, and asset turnover—applied to eight stock exchanges. Morsy and Rwegasira (2010) carry out a pre- and post-event analysis of the impact of demutualization on stock exchange performance, based on a sample drawn from the World Federation of Exchanges. Worthington and Higgs (2005) determine the market risk of four stock exchanges, but focus mainly on the post-demutualization period.

In this context, the present study aims to contribute to the literature by using the event of demutualization announcements to measure volatility in the stock market. Having identified trends in volatility pre-and post-demutualization, we then analyze the performance of developed and developing country stock markets. On the basis of these results, the study makes recommendations for Pakistan's stock market, which is in the process of demutualization. To our knowledge, this is the first study to measure the impact of demutualization on stock exchanges using stock exchanges indices as a measure of market performance.

2. Literature Review

This section presents an overview of the empirical and theoretical studies that measure the impact of demutualization on stock exchanges.

Hart and Moore (1996) observe that, in an environment of relatively high competition, outsider-owned structures are socially preferable to mutually owned structures. Schmiedel (2001) uses a parametric stochastic frontier model to estimate cost efficiency in a sample of European stock exchanges during 1985–99. The regression analysis indicates that demutualization has a positive effect on cost efficiency. Schmiedel (2002) uses a nonparametric model to estimate stock exchange efficiency during 1993–99, but observes no clear link between liquidity and demutualization.

Krishnamurti et al. (2003) compare the market quality of the demutualized National Stock Exchange and the mutually owned Bombay

Stock Exchange (BSE) in India. Using the Hasbrouck measure (to compute the variance of the pricing error) of market quality, they conclude that the National Stock Exchange provides a better-quality market than the BSE. Treptow (2006) studies securities that are listed simultaneously on two markets and finds that demutualization has a significant and positive effect on the liquidity of demutualized exchanges. Moreover, post-demutualization, their turnover and liquidity gap increases.

Ahmed, Butt, and Rehman (2011) examine the benefits of demutualization in Pakistan based on the literature available; these include better corporate governance, access to economic and human capital, enhanced listings, and international alliances. Islam and Islam (2011) study the implications of demutualization and conclude that its benefits are not applicable in the context of Bangladesh.

Karmel (2000) finds that, when stock exchanges become for-profit organizations, their governance structure and market capitalization improves. After the demutualization of the Stockholm Stock Exchange in 1993, many other stock exchanges followed suit in the form of mergers and issued shares to become for-profit companies (Serifsoy, 2008). Hazarika (2004) studies the impact of demutualization on cost and trading volume for the London stock exchange with respect to high competition and for the Borsa Italiana, which was mutualized by the government. The study shows that stock exchanges that were demutualized due to competition are better off, but that exchanges that were demutualized for reasons other than competition are worse off.

Mendiola and O'Hara (2003) carry out a performance analysis of publicly listed and other listed companies using their respective share prices. They find that listed stock exchanges generally outperform both the stocks on their market and the IPOs listed on these exchanges. Hence, there is a positive link between stock exchange performance and the fraction of equity sold to other investors. Worthington and Higgs (2005) study the market risk of four demutualized and self-listed stock exchanges. They estimate the time-varying beta using a bivariate generalized autoregressive conditional heteroskedastic (GARCH) model for a sample of stock exchanges that were demutualized and listed by7 June 2005. Their results indicate significant beta volatility.

Morsy and Rwegasira (2010) study the impact of demutualization on stock exchange performance by incorporating 16 different market measures.[1] They find that demutualization leads to an improvement in only seven of these measures (the number of listed companies, total transactions, capitalization of the domestic market, total value of share trading, new capital raised by IPOs, and velocity of turnover).

3. Data

The data used in this study comprises the daily index returns of seven selected stock exchanges, all of which are members of the World Federation of Exchanges. We employ six years of data, pre- and post-demutualization, to capture volatility trends. For the sample of developed countries (Canada, the UK, Singapore, and Japan), we use the Toronto Stock Exchange (TSX), the FTSE 100, the Straits Times Index (STI), and the Nikkei 225, respectively. The indices for the developing countries or economies selected (Malaysia, India, and Hong Kong, China) are the Kuala Lumpur Composite Index (KLCI), the BSE SENSEX, and the Hang Seng Index (HSI), respectively.

The study has employed only those stock exchanges that had been demutualized by2004 and for which at least six years' pre- and post-demutualization data were available. This particular sample will enable us to comment on the demutualization of Pakistan's stock exchange (9 May 2012) in the light of other developed and developing country exchanges.

4. Methodology

The unit of analysis in this study is the stock market. We carry out a descriptive analysis to determine the temporal or stochastic properties of the data. The daily returns of each stock exchange are calculated as follows:

$$Y_t = \ln(\frac{P_t}{P_{t-1}})$$

Generally, financial time series contain a unit root, i.e., they are nonstationary, which can yield dubious regression results. Therefore, in order to obtain a representative result, it is necessary that the time series should be stationary. Both the augmented Dickey–Fuller (ADF) test and Philips–Perron test can be used to determine stationarity, but the ADF

[1]Number of listed companies, total transactions, capitalization of domestic market, capital raised by domestic companies, value of bonds listed, total value of share trading, new capital raised by IPOs, turnover velocity of domestic shares, market capitalization of newly listed shares, number of bonds issuers, number of bonds listed, average value of transactions, capital raised by bonds, and value of bonds trading.

test is considered more reliable in the case of time-series data because it ensures a white-noise residual in the regression (Patra & Poshakwale, 2006). We reject the null hypothesis of a unit root when the value of the t-statistic is significant:

H_0: There is a unit root (nonstationary) in the time series

H_1: The series is stationary

The first step is to check the unit root of the series to establish the order of integration. This is done using the GARCH methodology to measure changes in the structure (conditional variance) and level of volatility (unconditional variance in error term).

Homoskedasticity or the constant variance of an error term is a basic assumption of ordinary least squares. The violation of this assumption forms the basis of the autoregressive conditional heteroskedastic (ARCH) model: only those time series are heteroskedastic that's how signs of time-varying variance or volatility. The ARCH condition implies that, in a time-series analysis, the variance of the error term in a specific period is dependent on the variance of the error term in the preceding period.

The main function of the ARCH models introduced by Engle (1982) was to model and forecast the conditional variance. Subsequently, the ARCH model was generalized by Bollerslev (1986) as the GARCH model. The general GARCH (p, q) model comprises a p term, which indicates the number of autoregressive lags, and a q term, which h indicates the number of moving average lags. The GARCH (1, 1) model shows the first-order ARCH term and first-order GARCH term.

The GARCH model has two specific equations: a conditional mean equation and a conditional variance equation. The conditional mean equation is written as

$$Y_t = a + by_{t-1} + \varepsilon_t \tag{1}$$

where $\varepsilon_t \sim N(0, h_t)$

The conditional variance equation is:

$$h_t = \omega + \alpha\varepsilon_{t-1}^2 + \beta h_{t-1} \tag{2}$$

where $\omega > 0$, $\alpha > 0$, $\beta \geq 0$

The conditional variance equation comprises three terms: (i) a constant, ω,(ii) the volatility of the previous period, $\alpha\varepsilon_{t-1}^2$ (the ARCH term), and (iii) the forecasted variance from the previous period, βh_{t-1} (the GARCH term).

The coefficients of the GARCH model are easy to interpret and capture the propensity for volatility clustering (Joshi &Pandya, 2008), which arises in financial data because any new information leads to a change in volatility (Engle& Ng, 1993). This makes it important to determine the effect and tendency of security return dispersion due to new and old information.

Samanta and Samanta (2007) observe that the GARCH model measures the persistency of market volatility because it has two effects on the market: that of recent news (the ARCH effect) and that of old news (the GARCH effect). The volatility due to current news is determined through the variation in the results of these effects. In financial data, the ARCH effect captures the persistency of shocks in the short run, while the GARCH effect captures the long-run persistency of volatility due to shocks (Morimune, 2007). $(\alpha + \beta) < 1$ is a sufficient condition for variance stationarity. If the combined value of α and β is closer to 1,this indicates volatility clustering in the data. If, in extreme cases, $(\alpha+ \beta) =1$ or $(\alpha+ \beta) =0$, this indicates that the shock is permanent or will die out soon, respectively.

A dummy variable is used to divide the data into pre- and post-demutualization data, where 1indicates pre-demutualization data and 0, post-demutualization data.

5. Results and Discussion

Table 1 gives the results of the ADF test for all series. All seven series are stationary in levels with absolute significant values:–35.65, 47.74, 42.43, 41.33, 27.22, 50.60, and 24.01 for the UK, Singapore, Canada, Japan, Hong Kong, India, and Malaysia, respectively. The p-value is less than 0.05, which implies that we can reject the null hypothesis of a unit root.

Table 1: Results of ADF test

Market		Level	t-stat	Prob.*
UK	ADF test statistic		-35.65185	0.0000
	Test critical values	1%	-3.432319	
		5%	-2.862296	
		10%	-2.567216	
Singapore	ADF test statistic		-47.74135	0.0001
	Test critical values	1%	-3.432329	
		5%	-2.862300	
		10%	-2.567219	
Canada	ADF test statistic		-42.43039	0.0000
	Test critical values	1%	-3.432245	
		5%	-2.862263	
		10%	-2.567199	
Japan	ADF test statistic		-41.33271	0.0000
	Test critical values	1%	-3.432376	
		5%	-2.862321	
		10%	-2.567230	
Hong Kong	ADF test statistic		-27.22248	0.0000
	Test critical values	1%	-3.432364	
		5%	-2.862315	
		10%	-2.567227	
India	ADF test statistic		-50.67885	0.0001
	Test critical values	1%	-3.432358	
		5%	-2.862313	
		10%	-2.567226	
Malaysia	ADF test statistic		-24.01416	0.0000
	Test critical values	1%	-3.432370	
		5%	-2.862318	
		10%	-2.567228	

Source: Authors' calculations.

Next, we check forheteroskedasticity in the time series, which is one of the conditions for testing the GARCH (1, 1) model (Table 2). All series for the selected indices are heteroskedastic and the presence of the ARCH effect indicates time-varying volatility. These results imply that we should use the GARCH model to estimate the volatility of returns. Tables A2 to A8 in the Appendix show the auto correlation of all seven data series.

Table 2: Results of heteroskedasticity test for ARCH

Market	Statistic	Value	Statistic	Value
UK				
	F-statistic	170.378	Prob. F(1,3029)	0.000
	Obs. *R-squared	161.412	Prob. chi-square(1)	0.000
Singapore				
	F-statistic	177.211	Prob. F(1,3013)	0.000
	Obs. *R-squared	167.478	Prob. chi-square(1)	0.000
Canada				
	F-statistic	343.627	Prob. F(1,3137)	0.000
	Obs. *R-squared	309.900	Prob. chi-square(1)	0.000
Japan				
	F-statistic	27.6316	Prob. F(1,2950)	0.000
	Obs. *R-squared	27.3938	Prob. chi-square(1)	0.000
Hong Kong				
	F-statistic	486.478	Prob. F(1,2968)	0.000
	Obs. *R-squared	418.252	Prob. chi-square(1)	0.000
India				
	F-statistic	123.645	Prob. F(1,2973)	0.000
	Obs. *R-squared	118.788	Prob. chi-square(1)	0.000
Malaysia				
	F-statistic	1,568.65	Prob. F(1,2961)	0.000
	Obs. *R-squared	1,026.11	Prob. chi-square(1)	0.000

Source: Authors' calculations.

The ARCH and GARCH terms for all seven series emerge as highly significant after estimating the GARCH model. There turn series indicate persistent volatility clustering. If α (the ARCH term) and β (the GARCH term) are close to 1,this indicates the persistence of volatility shocks in the market. If they are less than 1, this implies that the volatility shocks will decrease over time. If the value of $\alpha+\beta$ is greater than 1, this indicates that the intensity of the shock will increase overtime (Chou, 1988). The significant result obtained for the dummy variable reflects the impact of the event (the demutualization announcement) on the return series.

Table 3 gives the GARCH results for the UK stock market, where α= 0.07 and β=0.92; both these values are significant. The ARCH and GARCH results indicate persistent volatility shocks to stock returns in this market. The dummy variable is, however, insignificant, implying that the volatility that exists is not due to the news received (the demutualization announcement). In other words, the demutualization of the FTSE 100had no impact on market movements in the UK.

Table 3: GARCH results for UK stock market

Variable	Coefficient	SE	z-statistic	Prob.
C	6.90E-07	2.30E-07	2.999335	0.0027
RESID(-1)^2	0.071671	0.008320	8.614570	0.0000
GARCH(-1)	0.920959	0.008710	105.7425	0.0000
DF	2.56E-07	2.09E-07	1.225630	0.2203

Source: Authors' calculations.

Table 4presents the results for the Singapore market: both $\alpha$and $\beta$are significant with values of 0.12 and 0.87, respectively. The ARCH and GARCH terms confirm the persistence of volatility in the market's stock returns. The dummy variable is, however, insignificant, implying that the volatility that exists is not due to the demutualization announcement. Thus, the demutualization of the STI had no impact on market movements in Singapore.

Table 4: GARCH results for Singapore stock market

Variable	Coefficient	SE	z-statistic	Prob.
C	2.53E-06	4.18E-07	6.046118	0.0000
RESID(-1)^2	0.121282	0.008320	14.58639	0.0000
GARCH(-1)	0.870308	0.007330	118.7655	0.0000
DF	-1.14E-07	4.09E-07	-0.277770	0.7812

Source: Authors' calculations.

Table 5yields significant values for α and β 0.068 and 0.92, respectively. The ARCH and GARCH terms thus indicate the persistence of volatility in returns for the Canadian stock market. The significant dummy variable implies that the demutualization announcement contributed significantly to this volatility. However, its negative coefficient means that the demutualization of the TSX decreased the volatility of returns.

Table 5: GARCH results for Canadian stock market

Variable	Coefficient	SE	z-statistic	Prob.
C	1.32E-06	2.41E-07	5.473677	0.0000
RESID(-1)^2	0.068120	0.005000	13.61245	0.0000
GARCH(-1)	0.924697	0.004790	193.0636	0.0000
DF	-5.89E-07	2.14E-070	-2.756470	0.0058

Source: Authors' calculations.

Table 6gives an ARCH term value of 0.084 and a GARCH term value of 0.89,both of which are significant. These confirm the presence of volatility clustering and persistence in the Japanese stock market. The significant dummy variable indicates that the decision to demutualize the Nikkei 225 contributed significantly to creating this volatility. Moreover, the impact of the information shock is likely to persist in the long run and decline slowly.

Table 6: GARCH results for Japanese stock market

Variable	Coefficient	SE	z-statistic	Prob.
C	3.09E-06	6.95E-07	4.443187	0.0000
RESID(-1)^2	0.084450	0.009080	9.304344	0.0000
GARCH(-1)	0.897107	0.011110	80.71619	0.0000
DF	2.04E-06	6.96E-07	2.935295	0.0033

Source: Authors' calculations.

Table 7yields significant ARCH and GARCH term values of 0.07 and 0.92, respectively. The value of $\alpha+\beta$ is equal to 1, indicating volatility clustering and persistence in the Hong Kong stock market. The significant dummy variable reflects the impact of the demutualization announcement for the HSI. Thus, the information shock is persistent and likely to decline slowly.

Table 7: GARCH results for Hong Kong stock market

Variable	Coefficient	SE	z-statistic	Prob.
C	1.32E-06	3.91E-07	3.378125	7E-040
RESID(-1)^2	0.070921	0.006350	11.17693	0.0000
GARCH(-1)	0.922996	0.006920	133.3740	0.0000
DF	1.14E-06	4.21E-07	2.701895	0.0069

Source: Authors' calculations.

Although the ARCH and GARCH terms in Table 8areboth significant with values of 0.13 and 0.84, respectively, the insignificant dummy variable indicates that the decision to demutualize the SENSEX did not affect Indian stock market returns. The volatility does not, therefore, incorporate the impact of the event, although there are signs of persistent volatility in the data.

Table 8: GARCH results for Indian stock market

Variable	Coefficient	SE	z-statistic	Prob.
C	6.48E-06	9.24E-07	7.020530	0.0000
RESID(-1)^2	0.133962	0.009000	14.88253	0.0000
GARCH(-1)	0.847536	0.008930	94.89060	0.0000
DF	1.02E-07	8.90E-07	0.114621	0.9087

Source: Authors' calculations.

Table 9indicatesvolatility clustering and persistence in the case of the Malaysian stock market. Both the ARCH and GARCH terms (0.13 and 0.80, respectively) are significant. The dummy variable is also significant, implying that the decision to demutualize the KLCI had a negative effect on the volatility of this market. Thus, the volatility of stock returns decreased after the demutualization was announced, although it still incorporates the impact of the announcement.

Table 9: GARCH results for Malaysian stock market

Variable	Coefficient	SE	z-statistic	Prob.
C	1.57E-05	4.02E-07	38.97273	0.0000
RESID(-1)^2	0.131271	0.006760	19.42109	0.0000
GARCH(-1)	0.807440	0.004720	170.9136	0.0000
DF	-6.83E-06	5.87E-07	-11.62340	0.0000

Source: Authors' calculations.

6. Conclusion

We have used a sample of seven stock exchanges to measure the impact of demutualization announcements on market volatility. On applying the GARCH (1, 1) methodology, the results show that the Canadian, Japanese, Hong Kong, and Malaysian markets were able to incorporate the effect of demutualization announcements in their return volatility. However, post-event, the volatility of the Canadian and Malaysian markets was negative while that of the Japanese and Hong Kong markets was positive. The volatility of returns in these markets increased after demutualization was announced and the corresponding shock persisted in the long run, increasing overtime. In addition, the volatility of the previous period contributed to the volatility of the present period.

In the case of the other three stock markets in the UK, Singapore, and India, the impact of the demutualization announcements was insignificant, although volatility clustering and persistence remained significant. This implies that these markets, while volatile, did not incorporate the impact of demutualization. Their volatility is, therefore, due to other factors. Janakiramanan and Lamba (1998) report that similar locations and investor behavior can cause such markets to affect one another. Thus, a weak market in one country may be strongly influenced by a strong market in a neighboring country. This would imply that Asian markets such as Hong Kong and Japan might exercise a spillover effect on closer markets such as Pakistan, and we might expect demutualization in the latter to lead to volatility in the future.

In a country such as Pakistan where the demutualization of stock exchanges is still a relatively new practice, it would be advisable to manage the change effectively. Other countries where the process is underway are, for example, required to conduct market and geographical analyses before implementing the decision to demutualize.

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Appendix

Table A1: Demutualization of major stock exchanges

Stock exchange	**Year of demutualization**	**IPO listing date**	**Domestic market capitalization**	**Major capitalization**
London Stock Exchange	2000	20Jul 2001	2,865,243	Equity
Euronext	2000	10Jul 2001	2,441,261	Equity; equity, currency, commodity and interest rate derivatives
Deutsche Börse	2000	5Feb 2001	1,194,517	Equity; equity and interest rate derivatives
BME Spanish Exchanges	2001	No plan	940,673	Equity; equity and interest rate derivatives
Swiss Exchange	2002	No plan	826,041	Equity
BorsaItaliana	1997	No plan	789,563	Equity and equity derivatives
OMX Group	1993	1Jan 1993	715,779	Equity; equity and interest rate derivatives
Oslo Børs	2001	28May 2001	141,624	Equity and equity derivatives
Hellenic Stock Exchange	1999	28Jul 2000	121,921	Equity
Tokyo Stock Exchange	2001	2006	3,557,674	Equity and equity derivatives
Osaka Stock Exchange	2001	2Apr 2004	2,287,048	Equity and equity derivatives
Hong Kong Stock Exchange	2000	27Jun 2000	861,463	Equity; equity and interest rate derivatives
Singapore Stock Exchange	1999	16Nov 2000	217,618	Equity; equity and interest rate derivatives
Bursa Malaysia	2004	18Mar 2005	181,624	Equity; equity and interest rate derivatives
New Zealand Stock Exchange	2003	4Jun 2003	43,731	Equity

Source: Hughes and Zargar (2006).

Table A2: Series of exchange indices for theUK

Autocorrelation	Partial correlation		AC	PAC	Q-stat	Prob.
| |	| |	1	0.002	0.002	0.0121	0.912
| |	| |	2	-0.034	-0.034	3.4235	0.181
*| |	*| |	3	-0.094	-0.094	30.271	0.000
| |	| |	4	0.031	0.031	33.247	0.000
| |	| |	5	-0.035	-0.041	36.886	0.000
| |	| |	6	-0.043	-0.050	42.455	0.000
| |	| |	7	-0.018	-0.015	43.426	0.000
| |	| |	8	0.049	0.038	50.708	0.000
| |	| |	9	0.032	0.025	53.898	0.000
| |	| |	10	-0.046	-0.045	60.211	0.000
| |	| |	11	0.008	0.017	60.431	0.000
| |	| |	12	-0.010	-0.013	60.740	0.000
| |	| |	13	0.037	0.030	64.888	0.000
| |	| |	14	-0.024	-0.015	66.682	0.000
| |	| |	15	0.032	0.033	69.822	0.000
| |	| |	16	-0.018	-0.017	70.839	0.000
| |	| |	17	-0.006	-0.013	70.934	0.000
| |	| |	18	-0.043	-0.032	76.461	0.000
| |	| |	19	-0.030	-0.034	79.209	0.000
| |	| |	20	0.001	-0.002	79.210	0.000
| |	| |	21	-0.028	-0.039	81.662	0.000
| |	| |	22	0.042	0.037	87.027	0.000
| |	| |	23	-0.039	-0.044	91.703	0.000
| |	| |	24	0.012	0.000	92.142	0.000
| |	| |	25	0.006	0.014	92.237	0.000
| |	| |	26	0.030	0.017	94.970	0.000
| |	| |	27	-0.016	-0.006	95.797	0.000
| |	| |	28	0.023	0.022	97.462	0.000
| |	| |	29	-0.003	0.003	97.491	0.000
| |	| |	30	0.028	0.024	99.969	0.000
| |	| |	31	-0.048	-0.040	107.03	0.000
| |	| |	32	0.011	0.020	107.39	0.000
| |	| |	33	-0.035	-0.038	111.14	0.000
| |	| |	34	0.030	0.026	113.94	0.000
| |	| |	35	-0.005	-0.007	114.00	0.000
| |	| |	36	0.006	0.004	114.11	0.000

Notes: Date = 01/06/2013,time = 12:18
Sample period =04/05/1994 to 04/03/2006, included observations = 3,032.

Table A3: Series of exchange indices for Singapore

Autocorrelation	Partial correlation		AC	PAC	Q-stat	Prob.
|*|	|*|	1	0.139	0.139	58.032	0.000
| |	| |	2	0.013	-0.006	58.531	0.000
| |	| |	3	0.020	0.020	59.747	0.000
| |	| |	4	0.007	0.002	59.893	0.000
| |	| |	5	-0.011	-0.012	60.255	0.000
| |	| |	6	-0.032	-0.030	63.443	0.000
| |	| |	7	-0.004	0.005	63.492	0.000
| |	| |	8	-0.008	-0.007	63.664	0.000
| |	| |	9	-0.021	-0.018	65.008	0.000
| |	| |	10	0.037	0.043	69.088	0.000
| |	| |	11	0.035	0.024	72.763	0.000
| |	| |	12	0.009	0.001	73.012	0.000
| |	| |	13	0.053	0.051	81.481	0.000
| |	| |	14	-0.000	-0.018	81.482	0.000
| |	| |	15	-0.011	-0.010	81.875	0.000
| |	| |	16	-0.003	0.001	81.899	0.000
| |	| |	17	0.007	0.009	82.056	0.000
| |	| |	18	0.005	0.005	82.145	0.000
| |	| |	19	-0.027	-0.024	84.439	0.000
| |	| |	20	-0.013	-0.007	84.945	0.000
| |	| |	21	-0.061	-0.062	96.102	0.000
| |	| |	22	-0.009	0.011	96.339	0.000
| |	| |	23	0.033	0.030	99.559	0.000
| |	| |	24	0.050	0.042	107.17	0.000
| |	| |	25	-0.000	-0.013	107.17	0.000
| |	| |	26	0.017	0.016	108.10	0.000
| |	| |	27	0.007	-0.003	108.25	0.000
| |	| |	28	0.028	0.027	110.61	0.000
| |	| |	29	0.017	0.013	111.48	0.000
| |	| |	30	0.003	-0.001	111.50	0.000
| |	| |	31	0.003	0.006	111.52	0.000
| |	| |	32	-0.035	-0.029	115.26	0.000
| |	| |	33	0.022	0.032	116.72	0.000
| |	| |	34	0.037	0.033	120.95	0.000
| |	| |	35	-0.001	-0.012	120.95	0.000
| |	| |	36	-0.008	-0.012	121.13	0.000

Notes: Date = 01/01/2013,time = 10:32
Sample period = 12/01/1993 to 12/01/2005,included observations = 3,016.

Table A4: Series of exchange indices for Canada

Autocorrelation	Partial correlation		AC	PAC	Q-stat	Prob.
| |	| |	1	-0.029	-0.029	2.5759	0.109
| |	| |	2	-0.053	-0.054	11.493	0.003
| |	| |	3	0.027	0.024	13.830	0.003
| |	| |	4	-0.002	-0.003	13.843	0.008
*| |	*| |	5	-0.073	-0.071	30.566	0.000
| |	| |	6	-0.010	-0.016	30.901	0.000
| |	| |	7	0.018	0.010	31.903	0.000
| |	| |	8	0.020	0.023	33.111	0.000
| |	| |	9	-0.017	-0.015	34.070	0.000
| |	| |	10	0.026	0.021	36.174	0.000
| |	| |	11	0.012	0.009	36.612	0.000
| |	| |	12	-0.043	-0.038	42.513	0.000
| |	| |	13	0.041	0.042	47.722	0.000
| |	| |	14	-0.005	-0.009	47.794	0.000
| |	| |	15	-0.008	-0.000	48.001	0.000
| |	| |	16	0.011	0.010	48.394	0.000
| |	| |	17	-0.051	-0.056	56.625	0.000
| |	| |	18	0.013	0.015	57.194	0.000
| |	| |	19	-0.005	-0.009	57.273	0.000
| |	| |	20	0.005	0.009	57.359	0.000
| |	| |	21	0.018	0.015	58.413	0.000
| |	| |	22	0.015	0.013	59.167	0.000
| |	| |	23	0.027	0.030	61.541	0.000
| |	| |	24	-0.046	-0.047	68.139	0.000
| |	| |	25	0.024	0.032	69.989	0.000
| |	| |	26	0.050	0.044	77.879	0.000
| |	| |	27	-0.012	0.000	78.356	0.000
| |	| |	28	0.040	0.049	83.302	0.000
| |	| |	29	0.006	-0.007	83.435	0.000
| |	| |	30	-0.043	-0.031	89.412	0.000
| |	| |	31	0.057	0.059	99.542	0.000
| |	| |	32	-0.035	-0.036	103.54	0.000
| |	| |	33	0.035	0.046	107.46	0.000
| |	| |	34	-0.024	-0.032	109.27	0.000
| |	| |	35	-0.008	-0.005	109.46	0.000
| |	| |	36	0.035	0.028	113.34	0.000

Notes: Date = 01/04/2013,time = 17:21
Sample period =01/03/2000 to 06/27/2012,included observations = 3,140.

Table A5: Series of exchange indices for Japan

Autocorrelation	Partial correlation		AC	PAC	Q-stat	Prob.
| |	| |	1	-0.042	-0.042	5.1943	0.023
| |	| |	2	-0.051	-0.053	12.914	0.002
| |	| |	3	0.036	0.032	16.836	0.001
| |	| |	4	-0.041	-0.041	21.909	0.000
| |	| |	5	0.018	0.018	22.825	0.000
| |	| |	6	-0.017	-0.021	23.683	0.001
| |	| |	7	-0.003	0.001	23.703	0.001
| |	| |	8	-0.007	-0.012	23.838	0.002
| |	| |	9	-0.014	-0.012	24.428	0.004
| |	| |	10	0.033	0.030	27.710	0.002
| |	| |	11	0.007	0.009	27.856	0.003
| |	| |	12	0.002	0.006	27.869	0.006
| |	| |	13	-0.001	-0.002	27.870	0.009
| |	| |	14	-0.010	-0.008	28.197	0.013
| |	| |	15	0.003	0.001	28.229	0.020
| |	| |	16	-0.047	-0.047	34.770	0.004
| |	| |	17	0.020	0.017	35.930	0.005
| |	| |	18	0.027	0.024	38.162	0.004
| |	| |	19	-0.010	-0.002	38.468	0.005
| |	| |	20	-0.013	-0.017	38.991	0.007
| |	| |	21	0.005	0.005	39.080	0.010
| |	| |	22	-0.018	-0.020	40.059	0.011
| |	| |	23	-0.018	-0.019	41.031	0.012
| |	| |	24	0.031	0.027	43.848	0.008
| |	| |	25	0.021	0.023	45.144	0.008
| |	| |	26	-0.017	-0.010	46.005	0.009
| |	| |	27	-0.009	-0.011	46.259	0.012
| |	| |	28	0.025	0.022	48.198	0.010
| |	| |	29	0.006	0.007	48.312	0.014
| |	| |	30	0.002	0.005	48.328	0.018
| |	| |	31	-0.003	-0.003	48.359	0.024
| |	| |	32	0.001	0.002	48.362	0.032
| |	| |	33	-0.001	0.001	48.369	0.041
| |	| |	34	0.006	0.007	48.463	0.051
| |	| |	35	-0.038	-0.042	52.782	0.027
| |	| |	36	-0.009	-0.014	53.051	0.033

Notes: Date = 01/01/2013,time = 10:16
Sample period = 11/01/1995 to 11/01/2007,included observations = 2,953.

Table A6: Series of exchange indices for Hong Kong

Autocorrelation	Partial correlation		AC	PAC	Q-stat	Prob.
| |	| |	1	0.032	0.032	2.9868	0.084
| |	| |	2	-0.039	-0.040	7.5483	0.023
|*|	|*|	3	0.086	0.089	29.687	0.000
| |	| |	4	-0.048	-0.056	36.556	0.000
| |	| |	5	-0.049	-0.038	43.760	0.000
| |	| |	6	0.018	0.010	44.753	0.000
| |	| |	7	-0.014	-0.010	45.338	0.000
| |	| |	8	0.002	0.009	45.348	0.000
| |	| |	9	0.016	0.008	46.152	0.000
| |	| |	10	0.012	0.014	46.613	0.000
| |	| |	11	0.026	0.025	48.604	0.000
| |	| |	12	0.009	0.005	48.836	0.000
| |	| |	13	0.032	0.034	51.906	0.000
| |	| |	14	0.010	0.006	52.234	0.000
| |	| |	15	-0.003	0.002	52.255	0.000
| |	| |	16	-0.038	-0.041	56.601	0.000
| |	| |	17	0.005	0.010	56.684	0.000
| |	| |	18	-0.013	-0.013	57.207	0.000
| |	| |	19	-0.022	-0.014	58.636	0.000
| |	| |	20	0.024	0.019	60.389	0.000
| |	| |	21	0.008	0.003	60.572	0.000
| |	| |	22	-0.014	-0.010	61.130	0.000
| |	| |	23	0.005	-0.003	61.194	0.000
| |	| |	24	-0.029	-0.032	63.698	0.000
| |	| |	25	-0.020	-0.013	64.876	0.000
| |	| |	26	0.001	-0.003	64.878	0.000
| |	| |	27	0.003	0.008	64.905	0.000
| |	| |	28	0.006	0.006	64.999	0.000
| |	| |	29	0.031	0.031	67.938	0.000
| |	| |	30	-0.049	-0.053	75.077	0.000
| |	| |	31	0.005	0.011	75.152	0.000
| |	| |	32	0.010	0.000	75.425	0.000
| |	| |	33	-0.007	0.006	75.579	0.000
| |	| |	34	0.023	0.020	77.126	0.000
| |	| |	35	0.008	0.002	77.321	0.000
| |	| |	36	-0.016	-0.008	78.055	0.000

Notes: Date = 01/01/2013,time = 10:19
Sample period =03/01/1994 to 03/08/2006,included observations = 2,971.

Table A7: Series of exchange indices for India

Autocorrelation	Partial correlation		AC	PAC	Q-stat	Prob.
| |	| |	1	0.073	0.073	15.891	0.000
| |	| |	2	-0.035	-0.041	19.596	0.000
| |	| |	3	-0.011	-0.006	19.978	0.000
| |	| |	4	0.015	0.015	20.650	0.000
| |	| |	5	-0.035	-0.038	24.321	0.000
| |	| |	6	-0.053	-0.047	32.789	0.000
| |	| |	7	0.024	0.029	34.443	0.000
| |	| |	8	0.044	0.036	40.230	0.000
| |	| |	9	0.037	0.033	44.343	0.000
| |	| |	10	0.023	0.021	45.858	0.000
| |	| |	11	-0.019	-0.024	46.984	0.000
| |	| |	12	-0.001	0.002	46.990	0.000
| |	| |	13	0.016	0.019	47.717	0.000
| |	| |	14	0.036	0.039	51.608	0.000
| |	| |	15	-0.009	-0.010	51.844	0.000
| |	| |	16	0.010	0.012	52.120	0.000
| |	| |	17	0.046	0.038	58.356	0.000
| |	| |	18	-0.006	-0.014	58.460	0.000
| |	| |	19	-0.037	-0.028	62.467	0.000
| |	| |	20	-0.044	-0.037	68.189	0.000
| |	| |	21	0.002	0.001	68.197	0.000
| |	| |	22	0.008	0.004	68.371	0.000
| |	| |	23	0.020	0.021	69.617	0.000
| |	| |	24	0.014	0.006	70.190	0.000
| |	| |	25	0.025	0.018	72.067	0.000
| |	| |	26	0.002	-0.005	72.084	0.000
| |	| |	27	0.007	0.011	72.227	0.000
| |	| |	28	-0.000	0.006	72.227	0.000
| |	| |	29	-0.034	-0.029	75.783	0.000
| |	| |	30	-0.015	-0.011	76.502	0.000
| |	| |	31	0.002	-0.003	76.510	0.000
| |	| |	32	-0.004	-0.006	76.556	0.000
| |	| |	33	0.000	0.003	76.556	0.000
| |	| |	34	-0.018	-0.021	77.493	0.000
| |	| |	35	0.019	0.017	78.552	0.000
| |	| |	36	-0.024	-0.026	80.360	0.000

Notes: Date = 01/01/2013,time = 10:24
Sample period: 05/19/1999 to 05/20/2011,included observations = 2,976.

Table A8: Series of exchange indices for Malaysia

Autocorrelation	Partial correlation		AC	PAC	Q-stat	Prob.
*| |	*| |	1	-0.093	-0.093	25.625	0.000
| |	| |	2	0.025	0.017	27.549	0.000
| |	| |	3	0.024	0.028	29.256	0.000
*| |	*| |	4	-0.092	-0.088	54.356	0.000
|*|	|*|	5	0.093	0.076	79.841	0.000
| |	| |	6	-0.020	-0.002	80.997	0.000
| |	| |	7	0.014	0.012	81.553	0.000
| |	| |	8	0.006	-0.003	81.658	0.000
| |	| |	9	0.004	0.019	81.706	0.000
| |	| |	10	0.018	0.010	82.618	0.000
| |	|*|	11	0.069	0.076	96.690	0.000
| |	| |	12	0.011	0.020	97.032	0.000
| |	| |	13	-0.042	-0.043	102.37	0.000
| |	| |	14	0.060	0.051	112.94	0.000
| |	| |	15	-0.011	0.010	113.29	0.000
| |	*| |	16	-0.058	-0.071	123.26	0.000
|*|	|*|	17	0.105	0.088	156.10	0.000
| |	| |	18	-0.056	-0.024	165.37	0.000
| |	| |	19	-0.022	-0.045	166.81	0.000
| |	| |	20	0.035	0.022	170.49	0.000
| |	| |	21	0.011	0.043	170.87	0.000
| |	| |	22	0.026	-0.002	172.85	0.000
| |	| |	23	-0.012	-0.008	173.31	0.000
| |	| |	24	0.017	0.027	174.18	0.000
| |	| |	25	0.055	0.052	183.08	0.000
| |	| |	26	-0.024	-0.019	184.79	0.000
| |	| |	27	0.025	0.028	186.64	0.000
| |	| |	28	0.004	-0.003	186.68	0.000
| |	| |	29	-0.001	0.004	186.68	0.000
| |	| |	30	0.022	0.029	188.09	0.000
| |	| |	31	0.005	-0.002	188.16	0.000
| |	| |	32	0.012	-0.002	188.61	0.000
| |	| |	33	-0.005	0.012	188.69	0.000
| |	| |	34	0.020	0.007	189.88	0.000
| |	| |	35	0.021	0.016	191.21	0.000
| |	| |	36	0.016	0.020	191.93	0.000

Notes: Date = 01/01/2013,time = 10:27
Sample =04/13/1998 to 04/14/2010,included observations = 2,964.