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ARCH Variance Structures and News: The Six Asian Emerging Markets

by

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ABSTRACT

Lamoureux and Lastrapes (1990) suppose that a current information flow produces a variance of return. A current information flow is expressed by the AR process. Hence, the current variance can be characterized by the AR process of the past variance. Based on their supposition, this paper infers that the unexpected current information flow from the AR process (i.e., "News") produces an unpredicted variance. The ARCH process proves useless for the news-full markets. After empirical analysis of the Six Asian emerging markets index returns during Jan 1995- Apr 2000, this paper finds this inference is plausible. From the findings, this paper concludes that while the ARCH process prevails in the advanced countries, it is not useful in the less-advanced countries, i.e., news-full markets such as Thailand and Indonesia.

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1. Introduction

The empirical distributions of stock returns display fat tail, spiked peaks, and a persistence in the variance structure. The auto-regressive-conditional-heteroskedasticity (ARCH) process of Engle (1982) provides a good approximation to the stock return series. The more advanced model, the generalized ARCH (GARCH) of Bollerslev (1986) and an exponential GARCH (EGARCH) of Nelson (1991), belong to the ARCH family. Najand and Yung (1991), Locke and Sayers (1993), and Sharma, Mougoue and Kamath (1996) show the efficacy of the ARCH process in the advanced country markets.

So far, most of arguments call for extensions of the ARCH or GARCH capturing asymmetric movements of return volatility: the Threshhold ARCH and GARCH by Zakoian (1994) and Glosten, Jagannathan and Runkle (1993) respectively. When making a comparison between EGARCH and Threshhold GARCH, Engle and Ng (1993) found that the EGARCH gave too much weight to extremely large shocks when using the US stock data. However, Watanabe (1997) drew the opposite conclusion, by using the Japanese data. All of them agreed that the ARCH characterizes the variance persistence by an auto-regression (AR) process of the past variance. The AR process has been seen as the kernel of the ARCH process, and therefore only the fringe structures around it have been revised and developed.

Among the previous researchers, only Lamroureux and Lastrapes (1990, pp. 222-223) questioned the AR process of the ARCH. Put simply, they perceived that a large current information flow per day produces a large volatility. A current information flow is expressed by the AR process. Hence, the current variance can be characterized by the AR process of the past variance. If this explanation is correct, the unexpected current information flow from the AR process (i.e., "News") causes an unpredicted volatility in the AR process. Therefore, the ARCH process produces serious inaccuracies for the news-full markets and is therefore useless. In this sense, previous research concentrating on the fringe structures around the AR of the ARCH has tried to capture the "News". However, the previous research did not explicitly deal with the "News" and hence did not investigate the relation between the efficacy of the ARCH and news-full markets.

The purpose of this paper is to investigate the following: (i) Whether or not the ARCH process can fully capture the current information flow, and if it cannot, precisely what in the current information flow can it capture? (ii) If it cannot capture the "News", does the news-full market correspond to the market where the ARCH cannot capture the current information flow. (iii) If the ARCH process cannot capture the "News", how accurate is the prediction by ARCH. (iv) Which country market is news-full; (we use the Six Asian emerging markets index returns during Jan 1995- Apr 2000).

The findings of the paper are that the ARCH process cannot capture the news and hence it reduces the accuracy of predictions in news -full markets. The news-full markets are the Thai and the Indonesian market. Recent rapid financial deregulation in the Asian emerging markets has promoted a great deal of share trading and has attracted international investors. For the emerging markets, evaluating the popular ARCH that prevails in the advanced country markets will provide useful information for international investors.

Section 2 provides the EGARCH model, the prediction for returns, return volatility, the definition of "News", and testable hypotheses. Section 3 describes the data and the Asian emerging markets. Section 4 discusses the empirical results. Section 5 contains concluding remarks.

2. Methodology

2-1. An EGARCH Model

The EGARCH model overcomes the main drawbacks in ARCH and GARCH: (1) the nonnegativity constraints on the coefficients and on the variables, which are imposed to ensure that variance remains nonnegative for all t periods with probability one; (2) only the magnitude and not the positivity or negativity of unanticipated excess returns determines future variance. Therefore, the EGARCH can capture the ARCH effects better than can the ARCH and GARCH models combined.

We restrict our attention to an EGARCH(1,1) since it has been shown to be a parsimonious representation of conditional variance that adequately fits many financial time series.

This specification can be expressed as: [1]

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[1] First, equation (1) is expressed by an AR(1), following (Najand and Yung:1991; Locke and Sayers:1993; Sharma, Mougoue and Kamath:1996). Though some research checks the lag length by using SBIC and AIC, the statistical nature of their criteria is unknown for the ARCH-type model. Second, if there exists a correlation between volatility and expected return, equation (1) may be explained by time-varying risk

$$r_t = b_0 + b_1 r_{t-1} + \varepsilon_t \quad : t=1,2,\ldots,T \tag{1}$$

$$\varepsilon_t \,|(V_t, \varepsilon_{t-1}, \varepsilon_{t-2}, \ldots) \sim N(0, \sigma_t^2) \tag{2}$$

$$\log\sigma_t^2 = \alpha_0 + \alpha_1 \log\sigma_{t-1}^2 + \alpha_2 z_{t-1} + \alpha_3 (|z_{t-1}| - E(|z_{t-1}|)) + \alpha_4 \log V_t \tag{3}$$

$$\varepsilon_t \equiv \sigma_t z_t : \quad z_t \sim N(0,1) \tag{4}$$

where r_t is the rate of return ($\log P_t - \log P_{t-1}$: P_t is a stock price), b_0 is the constant, and V_t is the daily trading volume which is used as a proxy variable for the information flow to the market.[2] If we set $\alpha_4 = 0$, ignoring the trading volume, the above equations represent an EGARCH (1,1).

In the EGARCH, the persistence of variance is measured by the magnitude of α_1: the more the magnitude approaches unity, the greater is the persistence of shocks to volatility. The positivity or negativity of unanticipated excess returns determines future variance, which is measured by α_2 and α_3 : α_3 represents a magnitude effect. For $\alpha_3 > 0$, the innovation in $\log \sigma^2$ is then positive (negative) when the magnitude of Z_{t-1} is larger (smaller) than its expected value. The α_2 represents a sign effect. For $\alpha_2 < 0$, the innovation in conditional variance is positive (negative) when returns innovations are negative (positive).

The conditional probability density function for the single time period t under the model can be expressed as:

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premium, as proposed by Engle, Lilien and Robins (1987). However, we focus on the typical EGARCH.

2 We have to be cautious in interpreting the results due to the possible existence of a simultaneity bias pointed out by Lamoureux and Lastrapes (1990). The trading volume may be endogenous to our system. Thus, the estimation procedures based on the likelihood function obtained by conditioning on these variables would prove inappropriate. If the volume is correlated with the disturbances in the stochastic part of the model, the estimating procedures are likely to yield inconsistent estimations of the parameters. Lamoureux and Lastrapes (1990), and Najand and Yung (1991), try to resolve this problem and to use a lagged trading volume. Although that trial alters the nature of the underlying model, statistically it is not sure that lagged trading volumes and the stochastic part are not correlated. See Najand and Yung (1991), Tauchen and Pitts (1983), and Andersen (1996).

$$f(\varepsilon_t)=\frac{1}{\sqrt{2\pi}\sqrt{\sigma_t^2}}\exp\left\{-\frac{\varepsilon_t^2}{2\sigma_t^2}\right\} \tag{5}$$

We can write the log likelihood function logL and can determine the parameter θ (α_0, α_1, α_2, α_3, or α_4) to maximize it :

$$Max \quad \log L(\theta)=-\frac{T}{2}\log 2\pi-\frac{1}{2}\sum_{t=1}^{T}\log\sigma_t^2-\frac{1}{2}\sum_{t=1}^{T}\frac{\varepsilon_t^2}{\sigma_t^2} \tag{6}$$

Maximizing equation (6) should be considered as Quasi-Maximum Likelihood Estimation (QMLE), since the true error term distribution is unknown. That is, the QMLE supposes this error term to be normal, maximize equation (6), and then the estimated $\hat{\theta}_T^{QML}$ will be consistent and asymptotically normal with the so-called sandwich covariance matrix, see e.g.,Bollerslev and Wooldridge (1992, Theorem 2.1,pp.148-149):

$$\sqrt{T}(\hat{\theta}_T^{QML}-\theta)\rightarrow N(0,A^{-1}BA^{-1}) \tag{7}$$

$$A=-\frac{1}{T}\sum_{t=1}^{T}E\left(\frac{\partial^2\ln f(\varepsilon_t)}{\partial\theta\partial\theta'}\right) \quad B=-\frac{1}{T}\sum_{t=1}^{T}E\left(\left[\frac{\partial\ln f(\varepsilon_t)}{\partial\theta}\right]\left[\frac{\partial\ln f(\varepsilon_t)}{\partial\theta}\right]'\right)$$

where *E(.)* is actually the matrix of the partial derivatives on $\ln f(\varepsilon_t)$ by the QMLE estimates at time t. Therefore, the traditional inference procedures are immediately available. We use the QMLE in this paper.

2-2. Prediction for return volatility and returns

Following West and Cho (1995), we give the predictor $\log h_t$ for $\log\sigma_t^2$ in (3), depending on all data:

$$\log h_t=\hat{\alpha}_0+\hat{\alpha}_1\log\hat{\sigma}_{t-1}^2+\hat{\alpha}_2\hat{z}_{t-1}+\hat{\alpha}_3(|\hat{z}_{t-1}|-\sqrt{2/\pi}) \tag{8}$$

where the QMLE estimates,i.e., $\hat{\alpha}_t$, $\log\hat{\sigma}^2_{t-1}$, $\hat{z}_{t-1}$ are calculated by using all data: α_4=0 in (3) for the EGARCH. We used an interpolative prediction for the sake of simplicity. In order to evaluate the prediction h_t for volatility σ^2_t, we need the true value for volatility. Pagan and Schwert (1990) and West and Cho (1995) considered ε^2_t to be its true value, since it follows from equation (1) that

$$\sigma^2_t = VAR_{t-1}(r_t) = E_{t-1}[(r_t - E_{t-1}(r_t))^2] = E_{t-1}(\varepsilon^2_t). \quad (9)$$

We calculate the squared error for variance (SEV) and return (SER):

$$SEV = (h_t - \hat{\varepsilon}^2_t)^2;\ SER = \hat{\varepsilon}^2_t: \qquad \hat{\varepsilon}_t \equiv r_t - \hat{b}_0 - \hat{b}_1 r_{t-1} \quad (10)$$

where $\hat{\varepsilon}^2_t$ is a proxy for ε^2_t and $\hat{b}_j$ in (1) are the QMLE estimates

calculated together with $\hat{\alpha}_j$ in (3) by using all data.

2-3. Definition of News

We approximate the current information flow V_t by the AR process:

$$\log(V_t) = \hat{\beta}_0 + \sum_{j=1}^{J} \hat{\beta}_j \log(V_{t-j}) + \hat{\varepsilon}_t \quad (11)$$

where the lag length is selected out of fourteen lag lengths by Schwarz's Bayesian Information Criterion (SBIC). We can separate the current information flow into two parts. The first part is predictable from the AR of the past information and the second is unpredictable $\hat{\varepsilon}_t$. We can call the unpredictable part " News", following Ito and Roley (1987, pp. 255). Hence, the current information includes " News". The squared News $\hat{\varepsilon}^2_t$ is defined to be a size of "News". The adjusted R-squared in (11) is the volume of "News".

What is information flow? It is concerned with events or rumors occurring in both the private and public sectors. How is it measured? We follow Schwert (1989), Gallant, Rossi and Tauchen (1992), Jones, Kaul and Lipson

(1994), Lamoureux and Lastrapes (1990), where the daily trading volume is used as a proxy variable for the daily information.

2-4. Testable hypotheses

First, to investigate whether the ARCH can capture fully the current information flow, this paper tests the hypothesis that $\alpha_4 > 0$ in equation (3). Furthermore, in the presence of current information flow with $\alpha_4 > 0$, α_1 is found to be smaller and statistically insignificant. That is, the current information flow explains the variance persistence represented by the ARCH effect and hence the persistence of variance explained by α_1 becomes smaller and statistically insignificant.[3] It is inferred that the current information flow includes the "News", which cannot be explained by the AR of past variances.[4] Second, to make sure of the inference, the paper investigates the correspondence between the large volume of "News" and smaller or insignificant α_1. Thus, we will ascertain that the ARCH cannot fully capture the "News".

Third, the paper examines the performance of interpolative prediction, by using such an EGARCH and by checking the correlation between SEV (SER) and the size of the "News". Thus, we will ascertain that the news-full markets worsen the performance of prediction. In addition, we identify the news-full markets, by calculating the volume of the "News".

Fourth, the paper shows that the "News" defined in the paper corresponds to the "News" that actually happened, which we usually imagine as news.

3. Data and Asian Emerging Markets

All data are the daily data purchased from the Data Base of *Nomura Research Institute JAPAN*. In the data base, the daily return r_t consisted of daily stock closing price P_t, and volume V_t (measured in 10^9 shares) represents the

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[3] The results for α_2 and α_3 were not shown in the text for the sake of space, but were relatively negligible.

[4] Unless any shocks specific only to the current trading volume can be identified in some way, then the inclusion of trading volume cannot be nested precisely against the ARCH specification and cannot be preferred. Lamroureux and Lastrapes (1990) failed to identify these shocks. They comprise the "News".

number of shares traded during the day for all common stocks in the market. The data covers the recent five years from Jan. 1, 1995 to Apr. 30, 2000 and are illustrated in the Appendix: those are the original data without logarithms and hence are not revised for rights off and dividend off. These are *Korea Composite Stock Price Index* in Korea, *Taiwan Stock Exchange Capitalization Weighted Index* in Taiwan, *Stock Exchange of Thailand Index* in Thailand, *Strait Times Index* in Singapore, *KLSE Composite Index* in Malaysia and *The JSX Composite Index* in Indonesia.[5]

Table 1 lists the country name of sample stocks, the number of samples, and the non-normality of the unconditional distribution of daily returns. The table reports the mean, standard deviation of return, the Kendall -Stuart skewness, the excess kurtosis, and their tests. The Ljung-Box Q-statistic $Q^2(20)$ are reported under the null hypothesis of nonserial correlation tests in daily squared returns. At significance levels of the 5%, the null hypotheses (skewness=0 or excess kurtosis=0) and of nonserial correlation are generally rejected respectively. Thus, the time series have the typical features of stock returns as fat tail, spiked peak, and the persistence of variance.[6] Therefore, the ARCH-type model including such features seems to be appropriate for analyzing these series.

Since the beginning of the Asian financial crisis in July 2, 1997, several countries have adopted such nonstandard interventions as the Hong Kong Special Administrative Region's equity market intervention or the use of capital controls by Malaysia. These interventions raised questions about the implications for the behavior of market participants and asset prices in the future. In addition, since the crisis, the sharp adjustments of sovereign credit ratings for many emerging markets have raised concerns about the accuracy and stability of the rating process, (see IMF (1999, pp. 169-214)). On the other hand, as shown in the Appendix, the stock prices and the trading volumes have exhibited a repeated up-and-down motion and large fluctuations since the Asian financial crisis. These point to the structural changes of the EGARCH

[5] The Malaysian data for trading volume on Dec. 7 in 1995, Feb. 2 in 1996, and Mar. 8 in 1996 are missing and hence are complemented by the trading volume data of the day before. The complete data set of PSE in Philippines and of Shanghai or Shinsen in China were not available in the Data Base of *Nomura Research Institute*.

[6] All computations in the paper have been performed with the computer package WinRATS-32 Version 4.30.

represented by (1)-(4). However, since the statistical features under structural changes are unknown in EGARCH, it is impossible to diagnose the structural change.

To escape this problem, the paper separates the whole sample period into three sub-periods: Jan 1st 1995 to April 30th 1997 before; Jan 1st 1997 to April 30th 1998 during; Jan 1st 1998 to April 30th 2000 after the Asian financial crisis. In Table 2, we examined the Augmented Dickey-Fuller tests for a unit root in the trading volume with logarithms, in order to guarantee the statistical consistency of the EGARCH with stationary variables. This test mostly rejects the null hypotheses of a unit root and statistically supports an inclusion of trading volume into the model, except for the period during the crisis. During the crisis, more detailed insight and advanced analytical methodology will be needed. However, we suppose that the trading volumes are stationary for all sub-periods and countries.[7]

4. Empirical Results

Table 3 reports the estimated coefficients and asymptotic t-statistics under the QMLE.[8] Table 3 seems to provide evidence that the daily stock returns can be characterized by the EGARCH (with $\alpha_4 = 0$) through the significant $\alpha_1 > 0$ for all countries except for Indonesia before the crisis. This evidence appears to provide support for the theory that EGARCH that can

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[7] The procedure for choosing the optimal lag length was to test between a one and fourteen-lag, by using the minimum value of Schwarz's Bayesian Information Criterion (SBIC). The residuals were then checked for whiteness. If the residuals in any equation proved to be non-white, we sequentially chose a higher lag structure until they were whitened. Phillips (1987) and Gonzalo (1994) suggest the robustness of the Johansen -Juselius procedure (i.e., the simple version is a unit root test)to heterogeneity and nonnormality. The whiteness is checked by only Ljung-Box Q tests for absence of correlation for all 20 lags at 5% significance level.

[8] Actually, arbitrary initial values for the QMLE algorithm may affect the results of estimated parameters. In Table 3, the initial values are estimated parameters by OLS for parameters in (1), 0.0 for error terms in (1), the sample variances of estimated error in (1) by OLS for variances in (3), and 0.1 for the other parameters in (3) except for α_0 (=the logarithm of the sample variances). We examine the robustness of the estimation results in Table 3. In particular, the following initial value set affected the estimation results to some degree: a different initial value is 3.0 despite that the sample variance of estimated error in (1) is about 7.0 for all countries and all periods, and the others are the same. However, the estimated results are not changed greatly.

reflect a persistence of variance.

The results from the model, (1), (2), (3), (4) with inclusion of trading volume, are also reported. The coefficient on volume, α^*_4, is significantly positive for Thailand and Indonesia, irrespective to any sub-period. In the presence of volume with $\alpha^*_4 > 0$, the magnitude of α^*_1 is smaller than α_1 or statistically insignificant, except for Thailand during the crisis. In addition, the same results appear for Korea before the crisis and for Singapore during the crisis. Thus, the current information flow explains the variance persistence represented by the ARCH effect and hence the persistence of variance explained by α_1 becomes negligible. It is inferred that the current information flow includes the "News", which cannot be explained by the AR of past variances.

In Table 4, we investigated the correspondence between the large volume of "News" and negligible or insignificant α_1. If this inference is true, this correspondence must exist. First, we consider the news-full periods. In each market, the low adjusted R^2 is in a news-full period. The news-full periods are the ones before the Asian crisis in Korea and Thailand, and the ones during the crisis in Taiwan, Singapore, Malaysia and Indonesia. The inefficacy of the ARCH (negligible or insignificant α_1) appears in the news-full periods, except for Taiwan and Malaysia.

Though it is difficult to compare the news-fullness among different country markets, we consider the news-full markets to be the ones where the adjusted R^2 is less than 0.7. The news-full markets are the first sub-period for Korea, the second and third sub-periods for Taiwan, the whole period for Thailand, the second sub-period for Singapore, the second sub-period for Malaysia, and the second and third sub-period for Indonesia. Except for the Taiwan and Malaysia markets, the news-full markets render the ARCH ineffective, as seen in the underlined parts, which indicate the inefficacy (negligible or insignificant α_1) of the ARCH in Table 3. Hence, the news-full markets correspond to the inefficiency of the model in Table 3. Thus, we have ascertained that the ARCH cannot fully capture the "News".

In Table 5, we examine the performance of interpolative prediction, by using such an ARCH and by checking the correlation of SEV (SER) and the size of "News". The table shows the correlation between the size of News ($\hat{\varepsilon}_t^2$) and the SEV or SER. The high positive correlation in each country and each period shows that the news-full markets worsen the degree of accuracy regarding an interpolative prediction performance. In particular, during the Asian financial crisis, the correlations are relatively high for each country (about 0.78 for Malaysia and about 0.27 for Thailand), compared with other periods. Thus, we have ascertained that the news-full market worsens the performance of prediction. That is, for the news-full markets as seen in Table 4, the ARCH is not effective for prediction.

In Table 6, finally, we compare the "News" defined in the paper to the "News" which actually happened (i.e. which we usually recognize as news). The table shows the top 10 big "News" items for the Thailand and Indonesia markets during Jan. 1, 1998 to Apr. 30, 2000, the date for them, and the contents of the "News" which actually happened on the same date. The biggest "News" for Thailand, Oct. 29-30, 1998, was that the Saiam commercial bank went bankrupt, requesting 1.7 billion baht of aid to the Central Bank of Thailand. This failure made people feel the systemic risks inherent in the financial system. The biggest "News" for Indonesia, May 15, 1998 is that the Central Bank stopped the settlement work of inter-bank markets and foreign exchange markets. The coincidences between big $\hat{\varepsilon}_t^2$ in (11) and big "News" which actually happened support the definition of "News" in the text.

Thus, in the news-full markets which we usually imagine, the ARCH model cannot capture the news and hence cannot obtain the good performance of prediction.

5. Conclusions

Lamoureux and Lastrapes (1990) suppose that the current information flow expressed by the AR process produces the return volatility of the ARCH. Based on their supposition, this paper infers that unexpected parts of current information by the AR, i.e., "News", make the ARCH inaccurate. The paper examines the inference. First, the paper finds that the current information flow explains the variance persistence represented by the ARCH and hence the persistence of variance explained by α_1 becomes negligible. It is inferred that the current information flow includes the "News", which cannot be explained by the AR of past variances. Second, the paper finds the correspondence between the large volume of "News" and negligible or insignificant α_1. Therefore, the ARCH cannot fully capture the "News". Third, the paper finds that the news-full markets, that is, the markets for Thailand and Indonesia, worsen the performance of prediction. Finally, the paper finds that, in the news-full markets which we usually imagine, the ARCH is not effective. From these findings, the paper concludes that although the ARCH process prevails in advanced countries, it is not useful in less-advanced countries with news-full markets.

Recent rapid financial deregulation in the Asian emerging markets has promoted a great deal of trading and attracted the international investors. However, since information from advanced countries cannot be controlled by the emerging markets, large volumes of "News" inflow in the emerging markets render the ARCH-type modelineffective. Evaluating the popular ARCH in the emerging markets provides useful information for international investors.

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Table 1. Summary Statistics for Daily Returns in Asian markets: The whole periods of Jan 1 95 to April 30 2000

country	sample	mean	t-value [a] (mean=0)	St.dev.	Skew-ness [a]	Ex-Kurt [a]	$Q^2(20)$ [b]
Korea [c]	1499	-0.0223	-0.41	2.1223	-0.01	2.69**	873.53
Taiwan	1481	0.0148	0.39	1.4744	-0.19**	2.09**	203.52
Thailand	1306	-0.0953	-1.63	2.1145	0.72**	3.56*	328.64
Singapore	1335	0.0114	0.26	1.6092	0.52**	10.77**	363.41
Malaysia	1311	-0.0058	-0.10	2.2215	0.56**	26.80**	635.46
Indonesia	1311	0.0087	0.16	2.0138	0.34**	6.98**	465.78

Notes: [a] **,* statistically significance at 1% and 5% level. [b] distributed as $\chi 2(20)$ under the null hypothesis of nonserial correlation with lags up to 20. Five percent critical value is 31.41. [c] The number of sample is different from each other, depending on the number of the holiday: Korea and Taiwan markets are open even on Saturday.

Table 2. Augmented Dickey-Fuller (ADF) tests for a unit root: In the trading volume with logarithms

country	Before: Jan 95-Apr 97		During: Jan 97-Apr 98		After: Jan 98-Apr 2000	
	sample	Level τ_μ	sample	Level τ_μ	Sample	Level τ_μ
Korea	683	-3.91(10)	390	-1.58(11)	621	-1.50(9)
Taiwan	665	-2.32(11)	371	-3.13(8)	621	-3.81(9)
Thailand	571	-4.20(8)	326	-2.71(9)	569	-3.30(9)
Singapore	580	-3.80(6)	331	-2.35(11)	584	-3.03(8)
Malaysia	571	-3.67(7)	326	-2.57(9)	572	-3.24(5)
Indonesia	573	-1.97(7)	325	-2.20(10)	570	-2.52(9)

τ_μ is the test statistics allowing for constant mean. The reported numbers in the columns are the ADF statistics. Numbers in parenthesis after these statistics indicate the appropriate lag length used in this test. First differences were stationary for all countries. The critical value for sample size 250 at the 0.05 and 0.10 significance level are -2.88 and -2.57 for τ_μ ,respectively :see Fuller (1976,Table 8.5.2). A trading volume V_t is measured in terms of 10^9 shares.

Table 3. Quasi-Maximum Likelihood Estimates of EGARCH(1,1) Model

$$\log \sigma_t^2 = \alpha_0 + \alpha_1 \log \sigma_{t-1}^2 + \alpha_2 z_{t-1} + \alpha_3 (|z_{t-1}| - E(|Z_{t-1}|)) + \alpha_4 \log V_t$$

Country	1995.1-1997.4			1997.1-1998.4			1998.1-2000.4		
	α_1	α^*_1	α^*_4	α_1	α^*_1	α^*_4	α_1	α^*_1	α^*_4
Korea	0.924**	-0.543**	1.260**	0.993**	0.986**	0.023	0.855**	0.854**	0.001
	(31.92)	(-5.60)	(5.80)	(185.30)	(70.71)	(0.57)	(14.60)	(13.83)	(0.07)
Taiwan	0.965**	0.949**	0.024	0.913**	0.876**	0.039	0.903**	0.854**	0.001
	(14.48)	(5.10)	(0.31)	(12.65)	(9.98)	(0.49)	(21.10)	(13.83)	(0.07)
Thailand	0.991**	-0.395**	1.821**	0.501**	-0.544**	1.870**	0.606**	-0.432**	1.063**
	(172.75)	(-5.64)	(8.67)	(2.77)	(-2.98)	(6.83)	(4.21)	(-5.56)	(6.23)
Singapore	0.765**	0.725**	0.052	0.981**	-0.188	1.875**	0.967**	0.967**	-0.001
	(6.79)	(3.96)	(0.51)	(52.62)	(1.58)	(6.13)	(39.35)	(39.39)	(-0.10)
Malaysia	0.975**	0.976**	-0.004	0.995**	0.995**	-0.012	0.961**	0.961**	-0.002
	(39.36)	(39.64)	(-0.28)	(77.59)	(77.62)	(-0.31)	(42.34)	(42.45)	(-0.09)
Indonesia	0.256	0.176	0.228*	0.987*	0.147	2.250**	0.889**	-0.161	0.526**
	(1.55)	(1.05)	(2.30)	(95.10)	(0.53)	(4.34)	(9.18)	(-1.02)	(4.91)

Notes: Asymptotic t-statistics for the estimated parameters under QMLE appear in parentheses. **, * Statistically significant at 1%,5%. See the notes of table 1. The α^*_1 and α^*_4 are estimated under the model in (1)-(4), while the α_1 is estimated under the model with α_4=0.

Table 4. The relation between the volume of news and the efficacy of EGARCH

- News-full markets -

Country	1995.1-1997.4		1997.1-1998.4		1998.1-2000.4	
	J	$\bar{R}^2$	J	$\bar{R}^2$	J	$\bar{R}^2$
Korea	7	<u>0.65</u>	7	0.74	7	0.92
Taiwan	5	0.78	3	0.55	3	0.67
Thailand	1	<u>0.50</u>	1	<u>0.56</u>	3	<u>0.66</u>
Singapore	1	0.71	2	<u>0.68</u>	2	0.77
Malaysia	4	0.75	1	0.64	3	0.78
Indonesia	1	<u>0.74</u>	3	<u>0.59</u>	8	<u>0.66</u>

Notes: $\bar{R}^2$ is an adjusted R-square and J is the optimal lag length based on SBIC for equation (11). The underlined figure represents the period when the EGARCH model is not effective in Table 3.

Table 5. The correlation between the size of news and the efficacy of EGARCH

- Interpolative prediction errors for variance and return -

Country	1995.1-1997.4		1997.1-1998.4		1998.1-2000.4	
	COR (SEV,News)	*COR (SER,News)*	*COR (SEV,News)*	*COR (SER,News)*	*COR (SEV,News)*	*COR (SER,News)*
Korea	0.02	0.11	0.05	0.08	0.05	0.04
Taiwan	0.12	0.02	0.01	-0.02	0.13	0.07
Thailand	0.27	0.12	0.16	0.13	0.19	0.12
Singapore	0.18	0.14	0.67	0.78	0.42	0.52
Malaysia	031	0.31	0.77	0.78	0.33	0.22
Indonesia	-0.01	0.01	0.24	0.27	0.02	0.03

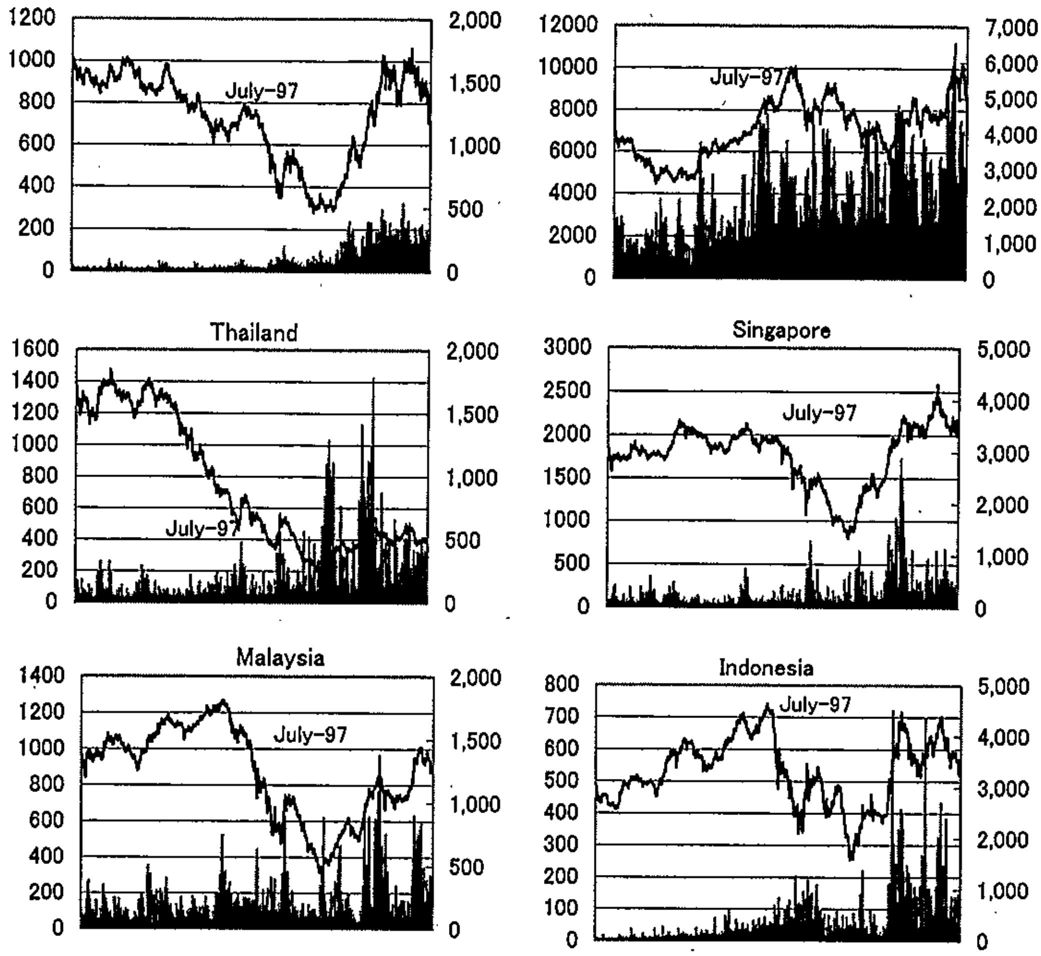
Notes: *COR (SEV, News)* or *COR (SER, News)* are correlation coefficients between the squared error for variance (*SEV*) or return (*SER*) and the squared News (*News*).

Table 6. The top 10 the big "News" from Jan. 5, 1998 to Apr. 28, 2000 for Thailand and Indonesia

No	$\hat{\varepsilon}_t^2$	Dates	"News" that actually happened
			Thailand : Average $\hat{\varepsilon}_t^2$ per day=0.15
1	4.5	10/29/1998	Saiam Commercial Bank requests 1.7 billion baht of aid to the Central Bank of Thailand. (10/30/1998)
2	4.2	10/30/1998	Saiam Commercial Bank requests 1.7 billion Thai bahts of aid to the Central Bank of Thailand
3	1.5	4/16/1999	The Cabinet approved 860 billion bahts of budget for the next year.
4	1.0	9/7/1998	A revision of the land and housing tax law is approved in the Cabinet.(9/8/1998)
5	0.9	7/15/1998	The Committee approves foreign labor in five special industries.
6	0.9	7/2/1999	The social behavioral party breaks away from the government party.
7	0.8	12/27/1999	The Committee announces the continuation of "Action on Encouragement for Investment".
8	0.8	1/5/1999	The Cabinet approves Saiam Commercial Bank requests for 1.7 billion baht of aid.
9	0.8	3/29/1999	The Cabinet determines the second policy for economic recovery.(3/30/1999).
10	0.8	8/20/1999	Prevention Act for money laundering comes into effect.
			Indonesia: Average $\hat{\varepsilon}_t^2$ per day=0.3
1	27.5	5/15/1998	The Central Bank stops settlement work of inter-bank markets and foreign exchange markets.
2	3.4	5/18/1998	The four political parties request President Suharto to resign.
3	3.1	10/20/1999	Wahid becomes the new president of Indonesia.
4	2.1	10/19/1999	The nomination to President for Wahid is accepted by NU executive committee.
5	1.9	2/16/1999	Any company with assets more than 50 billion rupiah is obliged to offer financial statements. (2/18/1999)
6	1.6	11/16/1998	The political leaders are suspected of and investigated for the crime of overturning nation.
7	1.5	5/20/1998	Demonstrations against Suharto are staged in many cities and 40,000 solders are called out.
8	1.5	2/22/1999	--- ---
9	1.4	9/24/1999	The Public Peace Act is concluded. The demonstrations against the Act are staged in several cities.
10	1.4	2/10/2000	President Wahid disposes WIlliant minister due to the problems of East Timor. (2/13/2000)

Notes: Notes: The unit for the squared-News $\hat{\varepsilon}_t^2$ is 10^9 shares. The source for the "News" was the "Important Dairy" in the Asia Dōko Nippon (in Japanese)), published by The Institute of Developing Economies, JAPAN. Where parentheses follow the "News", the date in the parentheses shows the date the news was released, which is the previous trading day for the date in the date column. The '—'denotes that we cannot find any big "News".

Appendix: Graphs of the Observed Data Series:Jan 11995–Apr 30 2000.



Notes: The left and right axes are respectively stock prices index and trading volumes in a million share. The columns and the lines denote respectively the trading voumes and stock prices index. The data runs from Jan 1 1995 to Apr 30 2000.