

Aktham I. Maghyereh

The Hashemite University,
Jordan

LIBERALIZATION AND MARKET VOLATILITY: EVIDENCE FROM THE JORDANIAN STOCK EXCHANGE

Key Words

*Liberalization;
Volatility; GARCH;
Jordanian Stock
Exchange.*

Abstract

This paper examines the impact of market liberalization on the pattern of volatility of stock prices in the Jordanian Stock Exchange, utilizing the GARCH statistical technique. The results suggest that a freely open market to foreigners leads to increased volatility, but that the nature of volatility does not change post-liberalization. The finding of price changes being integrated pre-liberalization, but being stationary post-liberalization, implies that the market liberalization improves the speed and quality of information flowing to the market.

Introduction

The issue of stock market volatility has received great attention in the finance literature. A high level of volatility can lead to a negative future for stock markets in that it can undermine the financial system as a whole. Volatility also discourages risk-averse investors and savers, and stock market fluctuations may raise the cost of capital to corporations¹ and may also increase the value of the “option wait” hence delaying investments. Volatility

would also tend to discourage firms from seeking a stock market listing or attempting to raise funds by new issues. Thus, a high level of market volatility impedes investment and slows overall economic growth (De Long *et al.*, 1989). Garner (1988) and Starr-McCluer (1998) also argue that stock price volatility may adversely affect real economic activity through several possible channels. It may adversely affect consumer spending through wealth and consumer confi-

Submitted January 2002, accepted November 2002.

¹ See for example Bekaert and Wa (2000), Singh (1992a, 1996, 1997a, 1999), Glen, *et al.*, (2000); Singh, *et al.*, (2000) and Kim and Singal (2000).

dence changes. Furthermore, if extreme stock price volatility causes a financial system crisis, financial intermediation could break down, causing monetary and credit problems in the economic system².

The year 1997 is considered a remarkable year in the deregulation of the capital market in Jordan. The deregulations aimed at completely liberalizing the capital market. There are several benefits of opening of stock markets to foreign investors. The process represents an important opportunity to attract foreign capital to finance economic growth. It also hastens the development of equity markets which, as Boyd and Smith (1998) and Levine and Zervos (1998) show, is positively related to long run economic growth. Furthermore, standard international asset pricing models (IAPMs) predict that stock market liberalization may reduce the liberalizing country's cost of equity capital by allowing for risk sharing between domestic and foreign agents (Stulz, 1999). The evidence presented by Bekeart *et al.*, (2000) provides convincing evidence in favor of the above implications. In a cross-country study of the determinants of GDP growth, they find that liberalization of capital markets leads to an increase in capital investment as a proportion of GDP

with a decrease in the cost of capital. They conclude that liberalization of capital markets leads to a 1.5% increase in real GDP growth.

However, there are other potential implications of capital market liberalization. Policy makers, in particular, are often concerned with the volatility of capital market returns. Does liberalization and move towards greater capital markets' integration increase local equity volatility? It is widely believed that foreign fund flows are very sensitive to changes in the short term economic outlook in emerging economies; making the unrestricted capital flows very volatile. This may increase the volatility of stock markets. In addition, market liberalizing means an exposure to foreign influence. If foreign stock prices are, for some reasons, more volatile, domestic prices may become more volatile too. A greater volatility in stock prices would make investors averse to holding stocks and demand a higher risk premium, which implies a higher cost of capital and less investment. In addition, it might be the case that capital market liberalization positively affects trading volume and interest by new investment analysts making markets more informational efficient. As a result, these stocks tend to react faster to relevant information

2 This argument is also mentioned by Singh *et al.*, (2000).

and hence their prices might reflect greater volatility. Ross (1989), for example, shows that variance of price changes is related directly to the flow rate of information. On the other hand, there is an argument that shows that financial integration is often accompanied or preceded by economic integration. As firms trade their goods and services in world markets, they become less susceptible to shocks or economic fluctuations from the local economy. That is, world trade provides a natural economic hedge. Less sensitivity to the local economy can reasonably be translated into lower volatility of equity returns.

The evidence presented in Bekaert and Harvey (1997, 2000) suggests that there is no significant impact on volatility. Market liberalization sometimes leads to higher volatility and sometimes leads to lower volatility; it depends on the country. This conclusion is consistent with our argument that this issue is very much country-specific, and there is a need for case-by-case studies that take into consideration each country's unique characteristics. Consequently, this paper investigates the impact of market liberalization on the pattern of volatility of stock returns in the Jordanian Stock Exchange (JSE), following its introduction in June 1997, utilizing the Generalized Autoregressive Conditional Heteroscedastic (GARCH) family of statistical techniques. Specifi-

cally, this paper tries to answer the following two questions. First, does the liberalization in itself have any effect on volatility? Second, and perhaps more important, if the liberalization does affect volatility, how does it, that is, what is the relationship between information and volatility following the freely opening stock market to foreign investors?

The results suggest that opening the market to foreigners has led to increased volatility, but that the nature of volatility has not changed considerably during the post-liberalization. In other words, the market continued to have a long-memory for volatility shocks and the effect of shocks on volatility tends to decay within a few time lags (i.e., the duration of a shock is typically few days). The finding that price changes being integrated pre-liberalization, but being stationary post-liberalization, implies that the market liberalization process has improved the speed and quality of information flowing to the market. These results are consistent with the theoretical arguments put forward by Ross (1989).

The paper proceeds as follows. The next section provides a description of the methodology adopted in the paper. The following section presents and discusses the results. A short concluding summary is provided in the final section.

Methodology

In this paper we study the impact of market liberalization on the pattern of volatility of stock returns in the JSE. The majority of studies of volatility patterns have concentrated upon unconditional measures. We believe that investigations of unconditional return variance could be misleading if the full structure of return volatility is not considered. To this end, we derive the conditional estimates of daily return volatility using a Generalized Autoregressive Conditional Heteroscedasticity (GARCH) process, as proposed by Bollerslev (1986). The advantage of a GARCH model is that it captures the characteristics of leptokurtosis and volatility clustering observed in emerging stock markets.

Nonsynchronous trading in the stocks that constitute indices is known to result in significant serial dependence in their returns (Scholes and Williams, 1977; and Lo and MacKinlay, 1990). We allow for any potential serial correlation by imposing an MA specification to model the level of the returns. The volatility specification takes the form:

$$y_t = \eta_0 + \sum_{i=1}^p \eta_i \varepsilon_{t-i} + \nu_t, \quad \nu_t / \psi_{t-1} \\ \sim N(0, h_t) \quad (1a)$$

$$h_t = \alpha_0 + \sum_{i=1}^p \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^q \beta_j h_{t-j} \quad (1b)$$

where (1a) is the conditional mean equation and (1b) is the conditional

variance equation. ψ_{t-1} is the information set.

For a GARCH process to be well-defined it is necessary that both α_i and β_j are non-negative. Engle and Bollerslev (1986) put forward the integrated GARCH (I-GARCH) as an extension of the GARCH model. With I-GARCH, the model specification is characterized by non-stationary variables, such that any shock to the variance of a process is permanent. For a process to be identified as I-GARCH the parameters α_i and β_j in Eq. (1b) must together sum to unity. This implies the presence of an approximate unit root in the autoregressive polynomial. Where an approximate unit root is present, current information remains important for forecasts of the conditional variances for all horizons.

In analyzing the impact of market liberalization on the pattern of volatility of stock returns, there are two issues that need to be addressed. First, does the liberalization in itself have any effect on volatility? Second, and perhaps more important, if the liberalization does affect volatility, how does it, that is, what is the relationship between information and volatility following the open stock market to foreign investors? To address the first issue, we augment the conditional variance equation with a dummy variable taking the value zero pre-liberalization and one post-liberalization. Thus, Eq. (1b) becomes:

$$h_t = \alpha_0 + \sum_{i=1}^p \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^q \beta_j h_{t-j} + \gamma D \quad (2)$$

where D is the dummy variable. If the dummy is statistically significant then the liberalization has had an impact on market volatility. To address the second issue, the period under investigation is partitioned into two sub-periods relating to before and after market liberalization. GARCH models of the form (1a) and (1b) are estimated for both sub-periods, thereby allowing a comparison of the nature of volatility before and after the onset of liberalization. In searching for the best specification, models of various orders for the MA(p) and GARCH(p,q) components are estimated. Among the models satisfying standard statistical assumptions (i.e. independence and homoskedasticity), model selection is based on the Schwartz information criterion and Log likelihood ratio tests.

Results

Daily closing price index data from the JSE for the period January 1994 to December 2000 are used. This index is prepared by the JSE and started on January 1993. It is a capitalization-weighted index of registered stocks, and includes companies that represent each sector in the market. During the period under investigation the number of stocks included has not changed and is equal to 60. These stocks accounted for more than 90% of the total market capitalization during this period. It is therefore very comprehensive, indicating the patterns of return for the vast majority of equities traded on the JSE. Daily stock returns, R_t , are calculated using first differences of the logarithmic price index, i.e. $R_t = \ln(p_t) - \ln(p_{t-1})$ where P is the price index, the t , $t-1$ represent the current and immediately preceding days. After excluding non-trading days the daily time series consists of 1715 observations.

Chart 1
Time Series Plot of Price Index

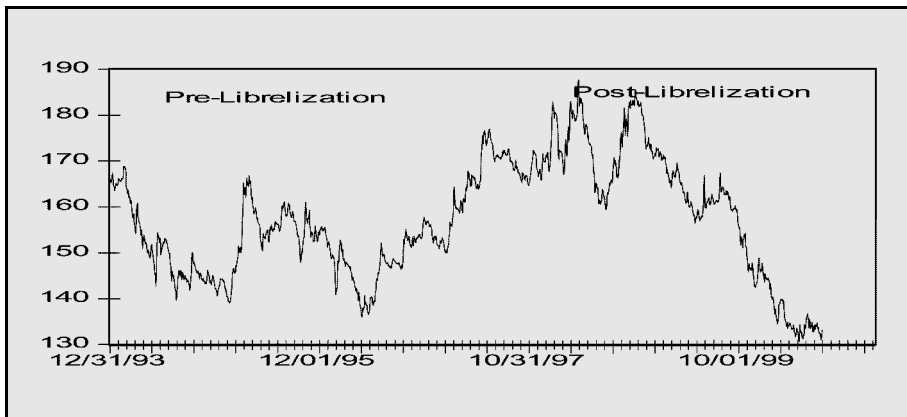


Chart 2
Time Series Plot of Returns

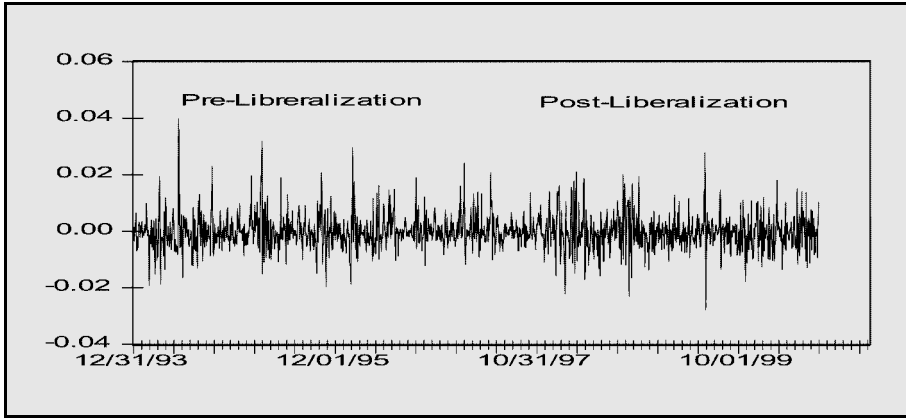


Table 1 summarizes the basic statistical characteristics the JSE daily returns. We run a chow test to ascertain the actual break in the data set, and the Chow F-test result confirms June 1997 as a possible structural break in the data set. Thereby, we divided the sample into two sub-periods: the pre- and the post-liberalization periods. For all series the evidence indicates that they are significantly flatter tails than does the stationary normal distribution. The coefficients of skewness indicate that all series typically have asymmetric distributions skewed to the right. This departure from normality is also confirmed especially by the highly significant of Jarque-Bera test statistics for normality. From the Ljung-Box test statistics for twelfth-order serial correlation for the levels, we find significant serial correlations and this strongly suggests the presence of time-varying volatility. This is the so-

called stylized fact of volatility clustering in return series.

Thus, the JSE index shows positive skewness, excess kurtosis and deviation from normality. These observations are consistent with the findings of other countries. Fama (1965) showed that the distribution of both daily and monthly returns of Dow Jones and NYSE indices depart from normality, and are skewed, leptokurtic, and volatility clustered. Bekaert *et al.*, (1998) provide evidence that 17 out of 20 emerging countries examined (including Jordan) had positive skewness and 19 of 20 had excess kurtosis, so normality was rejected for majority of the sample countries.

The descriptive statistics also suggest that, on average, the JSE offered significantly higher returns during the pre-liberalization period, however it under performed during the post-liberalization period. The negative average return in JSE during the post-

Table 1
Summary Statistics for Return Series

Period ^a	No.	Mean	Median	Std.Dev	Skewness	Kurtosis	JB	Q(12)
All	1715	0.00019	0.00060	0.0074	0.566	7.329	1431.0*	353.8*
Pre-liberalization	875	0.00036	0.00060	0.0069	0.833	8.885	1520.2*	96.1*
Post-liberalization	841	-0.00023	0.00061	0.360	0.0079	5.899	275.5*	42.7*
Equality tests ^b		861.96 ^{*c}	1268.62 ^{*d}	9.88 ^{*e}				

Notes: JB represents the Jarque-Bera (1980) normality test, which follows a chi-squared distribution, with two degrees of freedom. Q(12) represents the Box-Pierce-Ljung Portmanteau Test for Auto-correlation. ^a excluding Holidays and other non-trading days. ^b tests for statistical differences between equality of mean and median returns and standard deviation. ^c mean equality test (ANOVA test-statistic). ^d median equality test (Mann-Whitney U-test statistic). ^e variance equality test (Siegel-Tukey test statistic). * correspond to significance level of 1%.

liberalization period is could be seen as a reaction to the slow down of the Jordanian economy since 1997. From Table 1 we can also notice the higher skewness (positive) and kurtosis in the pre-liberalization period suggesting that the distribution is flatter and has fat tails. This due mainly to the fact that JSE during this period exhibits big price changes and the large price increases was more frequent than a large price decreases (see Chart 1).

Using the standard deviation of the stock returns as a measure of unconditional volatility, the Table clearly shows that the post-liberalization sample volatility is significantly higher than the pre-liberalization sample volatility, contradicting the hypothesis put forward by the proponents of market liberalization. These findings, however, suffer from two main shortcomings. First, the uncon-

ditional volatility test assumes normality of returns, whereas the unconditional distribution of returns has fatter tails than the normal distribution and characterized by time-dependent conditional volatility. Second, the findings are based on the comparison of the sample variance of two periods with significantly different characteristics. Since it is well documented that volatility and the change in log prices are positively correlated³, the change in volatility may be due to the negative returns in the second sub-period (post-liberalization).

As shown in the Table 1 the standard deviation of daily return changes is higher during the post-liberalization period. However, inferences cannot be drawn from this figure and further investigation is required. In what follows, we use GARCH models to

³ See for example, Karpoff (1987).

Table 2
Full Sample Results with Dummy Variable

$$R_t = \eta_0 + \eta_1 \varepsilon_{t-1} + \nu_t,$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1} + \gamma D$$

η_0	η_1	α_0	α_1	β_1	γ
-0.583 ^a	4.724	1.09 ^b	0.3520	0.4377	0.501 ^b
(-2.277)**	(2.832)*	(10.810)*	(11.099)*	(12.371)*	(5.037)*

^a coefficients are multiplied by 10^3 for readability. ^b coefficients multiplied by 10^5 for readability. Figures in parentheses are t-statistics. * and ** correspond to significance levels of 5% and 1% respectively.

investigate liberalization effects on JSE volatility. MA(p) and GARCH (p,q) equations are estimated for all combinations of $p = 1, 2, 3, 4, 5$ and $q = 1, 2, 3, 4, 5$.

$$R_t = \eta_0 + \sum_{i=1}^p \eta_i \varepsilon_{t-i} + \nu_t, \quad \varepsilon_t / \psi_{t-1} \sim N(0, h_t) \quad (3a)$$

$$h_t = \alpha_0 + \sum_{i=1}^p \alpha_i \varepsilon_{t-i}^2 + \sum_{j=1}^q \beta_j h_{t-j} + \gamma D \quad (3b)$$

where R_t is the daily stock market returns and D is a dummy with value 0 for the pre-liberalization and 1 for the post-liberalization period.

Both the Schwartz information criterion and Log likelihood ratio tests indicate that MA (1) and GARCH (1,1) are the most parsimonious representation of the variance for all periods considered⁴.

Table 2 shows the equation estimated and results for the whole period. All parameters included are statistically significant at the 5% level or better. The significant of α_1 para-

meter in the model indicated the tendency of the shock to persist. The measure of volatility persistence $\alpha_1 + \beta_1$ coefficients is less than unity. This indicates that the tendency for a volatility response to shocks to display a short memory. The positive coefficient on the dummy variable, γ , suggests that fully opening the market to foreign investors' results in increased stock market price volatility. While market price volatility may have increased as a result of the market liberalization, the analysis thus far does not enable us to examine the reason for this change.

The increased volatility suggested in Table 2 is investigated further by examining the behavior of the parameters in the GARCH equations for the two sub-periods. Table 3 reports results for the two sub-periods. For both pre- and post liberalization the GARCH parameters are significantly different from zero at the 5% level or better.

4 In the interests of brevity, these results are not reported here. They are available from the author upon request.

The first point to note when we compare the before and after liberalization results is the observation that the nature of volatility has not changed. The large increase in α_0 post-liberalization together with the changes in α_1 and β_1 indicate that there has been an increase in the unconditional variance. The unconditional variance, given by $\alpha_0/(1-\alpha_1-\beta_1)$, is 5.955 pre-liberalization and 6.953 post-liberalization. This is consistent with more information being transmitted to the market a result of the full liberalized the market.

Similarly, the value of α_1 has increased post-liberalization, again suggesting an increase in volatility. α_1 is the coefficient relating to the lagged squared error term. In the context of this analysis, the lagged error term relates to changes in the price on the previous day which is attributable to market-specific factors, i.e., non-market-wide factors. Assuming that the market is efficient, these price changes are due to the arrival in the market of items of information which are specific to the pricing of the market. Given that this relates to the arrival of information yesterday, α_1 can thus be viewed as a “news” coefficient, with a higher value implying that recent news has a greater impact on price changes. Thus the increase in α_1 post liberalization suggests that information is being impounded in prices

more quickly due to the market reform.

Just as α_1 reflects the impact of recent news, β_1 can be thought of as reflecting the impact of “old news”. β_1 is the coefficient on the lagged variance term and as such is picking up the impact of price changes relating to days prior to the previous day and thus to news which arrived before yesterday. The increase in the rate of information flows due to the market liberalization is expected to lead to a reduction in uncertainty regarding previous news. This in turn will lead to a fall in the persistence of information. In other words, “old news” will have less impact on today’s price changes. This view is confirmed by the fall in the value of β_1 post-liberalization.

This conclusion is given further support by the fact that the pre-liberalization model is a candidate for I-GARCH, whereas the post-liberalization model is not obviously so. Pre-liberalization α_1 and β_1 sum to 0.90, compared to 0.70 post-liberalization. This indicates that the opening up of the stock market increase time-varying risk and volatility persistence over time.

All the above findings regarding changes in GARCH parameters suggest that the market is more volatile post-liberalization, but that this is the result of an increase in the rate of flow of information to the market. These results are consistent with the theore-

Table 3
Two Sub-Sample Results

$$R_t = \eta_0 + \eta_1 \varepsilon_{t-1} + \nu_t,$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$$

	η_0	η_1	α_0	α_1	β_1
Pre-liberalization	-0.630 ^a	11.883	0.613 ^b	0.298	0.599
n = 875	(-2.169)**	(1.928)**	(8.072)*	(9.449)*	(20.843)*
Post-liberalization	-0.785 ^a	2.651	2.14 ^b	0.403	0.290
n = 841	(-1.945)**	(2.121)**	(7.927)*	(6.235)*	(4.286)*

^a coefficients are multiplied by 10^3 for readability. ^b coefficients multiplied by 10^5 for readability. Figures in parentheses are t-statistics. * and ** correspond to significance levels of 5% and 1% respectively.

tical arguments of Ross (1989) and the view that freely open market to foreigners increases the flow of information to the market.

However, the abnormal volatility during the period of the sad and somewhat expected death of King Hussein (October 1998-February 1999) as well as the Middle East peace negotiation news and violence (during the full sample period) may be influential in determining the size and significance

of the reported results. To see how the results are affected by periods of “extreme volatility”, we re-estimate the model after removing from each sub-sample observations that exceed the mean return by more than four times the standard deviation. Table 4 reports the results of the estimation for both sub-samples. As can be seen, the results are very similar to the results reported in Table 3.

Table 4
Two Sub-Sample Results Excluding “Outliers”

$$R_t = \eta_0 + \eta_1 \varepsilon_{t-1} + \nu_t,$$

$$h_t = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 h_{t-1}$$

	η_0	η_1	α_0	α_1	β_1
Pre-liberalization	-0.894 ^a	10.642	0.822 ^b	0.248	0.599
n = 854	(-1.020)	(3.321)*	(4.136)*	(6.875)*	(14.505)*
Post-liberalization	-0.282 ^a	2.229	7.072 ^b	0.369	0.399
n = 810	(-0.963)**	(3.432)**	(4.412)*	(5.255)*	(3.166)*

^a coefficients are multiplied by 10^3 for readability. ^b coefficients multiplied by 10^5 for readability. Figures in parentheses are t-statistics. * and ** correspond to significance levels of 5% and 1% respectively.

Since our data cover a relatively long period of time, one concern may be that the estimated of γ from the full sample may be picking up effects of structural changes. More specifically, different regulatory regimes may coincide with different structural regimes where volatility may differ due to reasons other than the liberalization. To explore this possibility, the GARCH estimates are run again with the dummy variable liberalization specification excluded. Using the parameters estimate, the conditional volatility is computed and plotted in Chart 3. In the right side of the chart we plot the conditional volatility which has been predicted using full sample, whereas in the left we plot predicted conditional volatility using the sample which excludes the “abnormally” volatile outliers. A striking feature of the conditional volatility, revealed by these graphs, is that there

is some variation in pattern of conditional volatility across pre- and post-liberalization periods.

For a more formal test of the effect of the liberalization process on both the level and trend of the JSE volatility, we regress the time-paths of the conditional volatility coefficients estimated from the full sample on a constant and a time trend. We allow the constant and the time trend of the conditional volatility coefficients to shift by including a dummy variable both by itself and in interaction with the trend. The intercept and interaction dummies are zero before the date of liberalization and unity otherwise and hence measure the likely effect of the liberalization on the constant and slope components of the conditional volatility coefficients. The estimated equation is given as follows:

$$V_t = \varphi_0 + \varphi_1 T_t + \varphi_2 D_t + \varphi_3 (T_t D_t) + K_t \quad (4)$$

Chart 3
Predicted Conditional Volatility

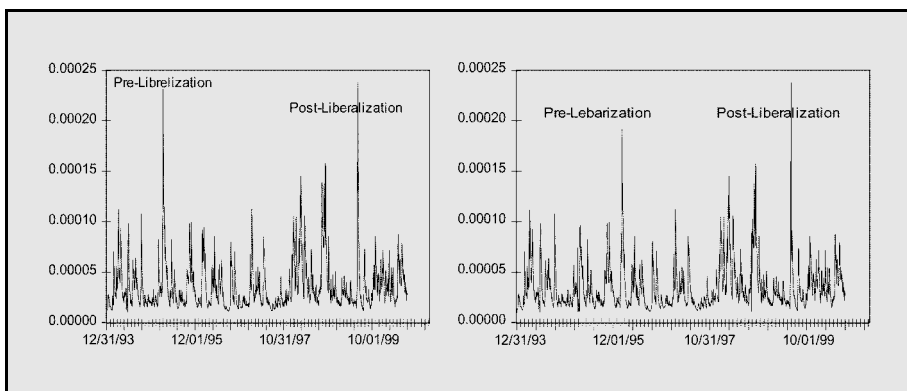


Table 5
Modeling the Time-Paths of Conditional Volatility
as a Function of the Market Liberalization

φ_0	φ_1	φ_2	φ_3	R^2
3.78 ^a	0.70 ^a	0.053 ^a	- 0.001 ^a	
(17.68)*	(2.19)**	(2.09)**	(2.42)*	0.697

Note: Figures in parentheses are t-statistics. * and ** correspond to significance levels of 5% and 1% respectively. coefficients multiplied by 10^5 for readability.

where v_t is the conditional volatility; η_0 is the constant; T_t is the time trend; D_t is the liberalization dummy, which takes zero before June, 1997 and unity otherwise; $(T_t D_t)$ is the interaction variables; and K_t is the error term.

The results of this regression using the OLS method are reported in Table 5. As can be seen, the regression has a reasonable explanatory power with R^2 around 43 per cent. The regressors are all significant at the 1% and 5% levels; the intercept (φ_0) is significant and positive, the trend term (φ_1) is small, but positive. Moreover, there is clear evidence of a break in June 1997 in both the trend and the intercept, with the shift in the trend (φ_3) being positive and significant. In sum, these results are highly consistent with the previous conclusion and provide further evidence that the liberalization has increased the volatility of the JSE.

Conclusions

This paper investigated the impact of market liberalization on the pattern of volatility of stock returns in the

Jordanian Stock Exchange (JSE), following its introduction in June 1997, utilizing the Generalized Autoregressive Conditional Heteroscedastic (GARCH) family of statistical techniques. Specifically, this paper tries to answer the following two equations. First, does the liberalization in itself have any effect on volatility? Second, and perhaps more important, if the liberalization does affect volatility, which form does it take? In other words, what is the relationship between information and volatility following the freely open stock market to foreign investors?

The results presented in this paper suggest there has been an impact of market liberalization on the pattern of the Jordanian Stock Exchange volatility. In particular, the variance of price changes pre-liberalization was integrated, suggesting shocks (i.e. items of news) have a permanent effect on price changes, whereas the post-liberalization sample is stationary. The results suggest that market liberalization has probably improved the qual-

ity and speed of information flow to the market.

Based on the results of this paper, it would be interesting to analyze the market reaction to some particular

events, such as the announcement of earnings, during the pre and post liberalization periods. Indeed, the results of such research would either complement or contradict the findings of this paper.

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الملخص

التحرير وشدة التغير في السوق: دلائل من البورصة الأردنية

أكثم عيسى مغايرة
الجامعة الهاشمية

هدفت هذه الدراسة إلى اختبار تأثير تحرير السوق على نمط شدة التقلب في أسعار الأسهم في البورصة الأردنية، وذلك باستخدام التقنية الإحصائية GARCH. وقد بينت نتائج الدراسة أن فتح السوق إلى المستثمرين الأجانب أدى إلى زيادة شدة التقلب في أسعار الأسهم الأردنية، غير أن طبيعة هذا التقلب لم تتغير بعد تحرير السوق. وبما أن النتائج أيضا أشارت إلى أن تغير الأسعار كانت متكاملة من قبل تحرير السوق، وأصبحت غير متكاملة بعد التحرير، فإن من الممكن استنتاج أن تحرير السوق أدى إلى تحسين المعلومات المتدفقة إلى السوق من حيث السرعة والتنوعية.

Aktham I. Maghyreh (Ph.D. in Finance and Banking, University of Durham, U.K. 2001). Assistant Professor, Department of Finance and Banking Sciences, The Hashemite University-Jordan. His Research Focuses on Emerging Markets, Corporate Finance Practices, Markets Integration, Market Efficiency, Market Microstructure, Financial liberalization and Financial Development, and Applied Econometrics.