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Crisis Effect on the Relationship between Stock Returns and Volatility in Iran

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Abstract

The main object in this is to evaluate the possibility of any changes might have happened due to the crises in Tehran Stock Market, concerning the relationship between stock return and the volatility. We have estimated the relationship between Tehran stock market returns and conditional volatility concerning pre and post crises data and for the whole period. Using parametric–GARCH-in mean model has shown positive and significant relationship from 1997 to 2007. But this relationship have been affected by crisis. There is negative (significant) relationship before crisis and positive (but not significant) after crisis.

Key word: Tehran Stock Market, Volatility, Parametric GARCH.

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1- Introduction

In the recent years Tehran stock market has experienced a savior crisis. The total price index of market has dropped from 13418 in 2005/January to 9804 in 2005/October and has continued to fall to 9097 in 2006/July. The market has lost 23% of its value during the period. One could name several reasons that caused the crisis; such as president election, Iranian energy dispute and economic sanction effects. The main purpose in this paper is not about the reasons of the crisis. This paper tries to estimate the relationship between Tehran stock market returns and volatility and also will try to specify the change in the relationship due to the crisis. Table 1 summarizes the data concerning the pre and post crises periods, indicating the crises.

Table 1: Summary Statistic for Daily Stock Prices of Tehran Market

Period		Mean	Standard Deviation	Kurtosis	Skewness	Min.	Max.
Whole Sample	1996-Sep. 07	6978.826	3962.927	1.485230	0.047193	1520.000	13882.39
Pre-crisis	1996-04/Aug/5	4640.287	3212.619	3.315374	1.243343	1520.000	13882.39
Post-crisis	2004/Aug/5 Sep. 2007	10639.01	1494.403	2.302881	0.955426	9066.220	13882.39

The relationship between the mean and volatility of returns is a central issue in finance and it has been extensively explored in finance literature, but there is no solidarity around these important issues. Traditional asset-pricing models assumed that there is a positive relationship between a stock portfolio's expected returns and the risk. They have used conditional variance of return as a proxy of risk. For example in Sharpe (1964) and Merton (1980) a positive relationship between expected returns and conditional volatility is a principle assumption. Campbell (1993) illustrates that a positive relationship between a stock portfolio's expected returns and conditional variance may not be necessarily.

Empirical studies usually use time series volatility-in-mean models to examine the relationship of returns and volatility through time. Unfortunately the findings of this relationship are mixed. French, Schwert

and Stambaugh (1987), Campbell and Hentschel (1992) and Kim, Morley and Nelson (2004) estimated a positive correlation, while Turner, Startz, and Nelson (1989), Nelson (1991), Glosten, Jagannathan, and Runkle (1993), Beakert, and Wu (2000) have found the relation to be negative. Often the coefficient linking volatility to returns is statistically insignificant. Some Studies like Baillie and DeGennaro (1990), Theodossiou and Lee (1995) and Li and Hsiao (2003) reported a positive but insignificant relationship.

Compare to a large empirical literature on developed markets, there are a few studies that examine this relationship in emerging markets: Choudhry (1996) on 6 emerging markets, De saints and Imrohoroglu (1997) on 14 emerging markets and Shin (2005) on 14 emerging markets are some of these researches that examine the relationship between returns and conditional volatility in emerging markets. All these studies are based on the parametric GARCH-M model. Their results indicate that there are positive but insignificant relationships in most emerging markets. According to Abounoori and Motameni (2007) unanticipated volatility has negative effect on the Tehran stock returns, the anticipated volatility has no direct effect on the stock returns. Two main questions in this research have been as follows:

1- Is there a positive relationship between the stock price return and the volatility in TSE?
2- Has the market crisis in August 2004 affected the relationship?

This study includes two steps: first, finding the relationship between Tehran stock market returns and conditional variance in recent years and second, testing the effect of the crisis on this relationship.

2- Data

This paper uses Tehran stock market daily price index (TEPIX) data from 1997/November up to 2007/January, addressed www.irbourse.com that includes 2227 daily price index. The data for the whole period is illustrated in Chart 1.

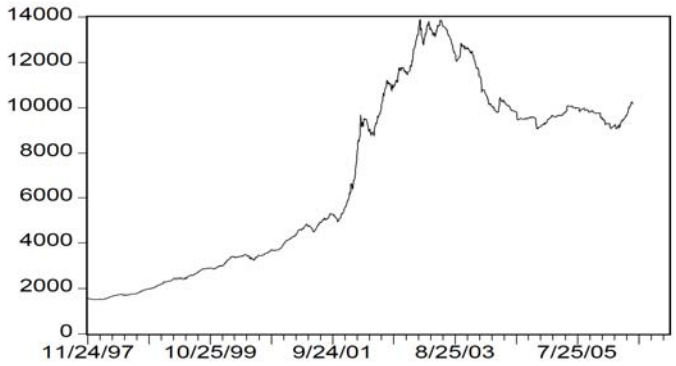

Chart 1: TSE Total Index 1997- 2007

As it is shown in Chart (1), the peak of the stock price is more than 13000 in 2003 after which the market has experienced the market crisis, during which the market index has fallen to about 9000.

This paper uses three sets of panel data. 1) The whole data during 1997-2007. 2) Pre-crisis data, and 3) the post-crisis data. Although it is difficult to specify a specific day as the starting point of the crisis, but we use the day after the maximum price indexes as the dividing point between pre-crisis and post-crisis panels. The maximum price index occurred in 2003/Aug/5. Thus we have around 1300 observations corresponding to pre-crisis and about 1000 observations for post-crisis. The time series of Tehran stock market daily return is shown in Chart 2. The mean of returns is close to zero (0.0006) with standard deviation of about 0.0046. It is similar to random walk series.

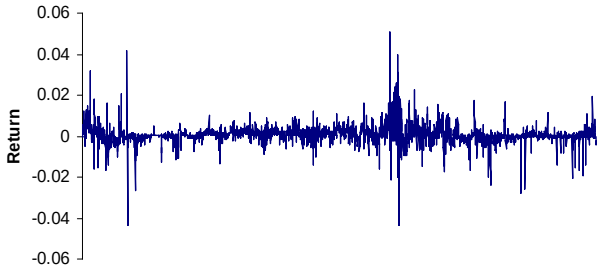

Chart 2: Tehran Stock Market Daily Returns 1996-2007

3- Methodology

Parametric GARCH-M is used to examine the relationship between stock market returns and the volatility. The model is a simple parametric type of GARCH-M model that is defined in Engle, Lillian and Robins (1987). The parametric method in this study is based on an AR(1)-GARCH (1, 1)-M model specified as follows:

$$P_t = \mu + \lambda P_{t-1} + \delta\sigma_t^2 + \varepsilon_t \qquad (1)$$

$$\varepsilon_t \perp \Omega_{t-1} \sim N(0, \sigma_t^2) \qquad (2)$$

$$\sigma_t^2 = \omega + \alpha\,\varepsilon_t^2 + \beta\sigma_{t-1}^2 \qquad (3)$$

P_t is the stock market price, ε_t stands for a Gaussian innovation with zero mean and a time-varying conditional variance σ_t^2. The parameter δ is the parameter which has been considered in this research. The sign and significance of δ indicate the quality of relationship between the stock returns and volatility. According to Shin (2005) a significant positive estimate of δ implies that investors who trade stocks are compensated with higher returns for bearing higher levels of risk. Contrary, a significant negative estimate indicates that investors are penalized for bearing higher levels of risk. He estimated this parameter concerning 14 emerging markets: India, Korea, Malaysia, Philippines, Taiwan, Thailand, Argentina, Brazil, Chile, Colombia, Mexico, Venezuela, Turkey and Greece. The parameter δ has been positive but insignificant in most of the countries; it was strongly positive and significant in Argentina but weakly positive significant in Taiwan and Venezuela. In four countries (Brazil, Thailand, Colombia and Turkey) the parameter was negative and insignificant.

Parameters α and β show the GARCH effects on the market. The parameters α can be interpreted as the effect of news on the volatility. In an asymmetry model it is known as Leverage effect. The parameter β may be interpreted as the influence of previous volatility on the current (anticipated) volatility. If $(\alpha + \beta)$ were close to one, it implies that the stock volatility is highly persistent in the market, while λ is an AR parameter. After all $\lambda = 1$ is the proof of the random walk assumption.

4- Empirical Results

The AR(1)-GARCH (1, 1)-M model has been fitted on three sets of panel data, pre crisis, post crisis and the whole data series. The results are summarized in Tables 2, 3 and 4.

Table 2: Parametric GARCH-M estimation results: Whole Sample Period

	Coefficient	Std. Error	z-Statistics	Probability
δ	0.0012	0.0001	7.5618	0.0000
μ	6.4823	2.2241	2.9145	0.0036
λ	0.9988	0.0002	4328.0304	0.0000
ω	545.8665	14.2110	38.4113	0.0000
α	0.8355	0.0495	16.8476	0.0000
β	0.1118	0.0113	9.8773	0.0000

As it can be seen in table 2, during the whole sample period, the parameter δ is positive and significant but it is near to zero. $(\alpha+\beta)$ is close to one and we can assume that the market is persistent. Since $\lambda=1$, the random walk assumption is justified for the whole sample.

Table (3) shows the estimation results in pre-crisis period. Concerning this period, δ is negative and significant. $(\alpha+\beta)$ is not close to unity but λ is near to 1.

Table 3. Parametric GARCH-M estimation results: Pre-Crisis Period

	Coefficient	Std. Error	z-Statistics	Probability
δ	-0.0002	7.4100	-33.6748	0.0000
μ	-6.8684	3.2286	-2.1273	0.0334
λ	1.0038	0.0003	2658.263	0.0000
ω	854.3315	41.2659	20.7030	0.0000
α	0.8511	0.0566	15.0250	0.0000
β	-0.0219	0.0082	-2.6702	0.0076

The results corresponding to the post-crises period in table 4 show that δ is positive and insignificant. The parameter λ indicates the presence of random walk assumption but market persistency failed to exist because ($\alpha + \beta$) is less than 0.9.

Table 4: Parametric GARCH-M estimation results: Post-Crisis Period

	Coefficient	Std. Error	z-Statistics	Probability
δ	0.0009	0.0008	1.0911	0.2752
μ	50.2382	7.9349	6.3312	0.0000
λ	0.9945	0.0007	1322.900	0.0000
ω	551.0920	34.7477	15.8598	0.0000
α	0.5428	0.0549	9.8797	0.0000
β	0.2763	0.0301	9.1649	0.0000

The main results concerning pre, post and the whole panel are summarized in Table 5.

Table 5: Parameters in three panels

	δ	$\alpha + \beta$	λ
Whole Sample Panel	0.0012	0.9473	0.9988
Pre-Crisis Panel	-0.0002	0.8292	1.0038
Post-Crisis Panel	0.0009[1]	0.8191	0.9945

5- Conclusions

Tehran stock market has experienced a serious crisis since 2003. The crisis ruined more than 20 percent of the market value and led the price index to loose 4000 unit within one year period. The main purpose in this research has been to evaluate the possibility of any changes might have happened due to the crises, concerning the relationship between stock return

1- Insignificant

and the volatility. We have estimated the relationship between Tehran stock market returns and conditional volatility for three panels of data. The results concerning important parameters for three panels are summarized in table 5. It seems that λ close to one in every period indicate that crisis doesn't affect on random walk in Tehran stock market. Sum of $\alpha + \beta$ is not close to one, thus market persistency is doubtful and it is affected by crisis. Because of that volatility forecasting is difficult and GARCH models should attention this crisis. The parameter δ has been different using the three samples: Concerning the whole sample, it has been positive and significant, in pre-crisis sample it was negative and significant, and in post-crisis it has changed to positive but insignificant. Therefore, it indicates that crisis affect the relationship between return and volatility in Tehran stock market.

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