Return and Volatility in Tehran Stock Exchange

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Abstract: The aim of this paper is considering the relationship between return and volatility in Tehran Stock Exchange. We have used the daily data of price index of TSE during 2009-2010. The data are available on website of TSE. We have estimated ARMA (1, 1)-GARCH (1, 1) model for estimation volatility of Tehran stock exchange. Results indicate that there is a negative relationship between volatility and rate of return in TSE. The correlation coefficient between volatility and return is -0.00182. The hypothesis of “return does not Granger Cause volatility” has rejected. Also, the hypothesis of volatility does not Granger because return has not rejected.


Keywords: Return, Volatility, Tehran Stock Exchange

1. Introduction

There are many studies about Tehran Stock Exchange (TSE) as Fasanghari, M., & Montazer, G. A. (2010), Fasanghari, M., & Montazer, G. A. (2010), Foster, K. R., & Kharazi, A. (2008), Albadvi, A., Chaharsoghi, S. K., & Esfahanipour, A. (2007), Ebrahimipour, R., Nikoo, H., Masoumnia, S., Yousefi, M. R., & Ghaemi, M. S. (2011) and Yahyazadehfar, M., Abounoori, E., & Shababi, H. (2006). Rahmani, Sheri & Tajvidi (2006) have tested Beta for the prediction of stock return in order to recognize the variables which are better capable of predicting the stock return in Tehran Stock Exchange (TSE). Independent variables were tested against the dependant variable (return) on an annual basis for the years 1997-2003. [Rahmani, Sheri & Tajvidi (2006)]. Further, multi-variable models were tested, both annually and pooled cross sectional. In single variable tests, a significant relationship was observed between the stock return and sale-to-price ratio, earnings-to-price ratio and size (stock market value) in 4 consecutive years. [Rahmani, Sheri & Tajvidi (2006)]. The book-to-market ratio demonstrated great dispersion in results. However, since the results of different years varied greatly, no stable relationship was observed between Beta and stock return as predicted in the CAPM model. Further, no relation was observed between debt-to-equity ratio and the stock return. Considering the potential effect of statistical models on the findings, complementary tests were carried out in portfolio level based on Beta and book-to-market ratio variables. [Rahmani, Sheri & Tajvidi (2006)]. Three portfolios were formed taking into consideration the magnitude of each variable. The findings of these tests substantiated that, in the years 2000, 2002 and 2003, portfolios with higher Beta proved to have higher return compared to the ones with lower Beta. With respect to the portfolios formed on the basis of book-to-market ratio, the findings proved compatible with the regression models [Rahmani, Sheri & Tajvidi (2006)]. Seyyed, Abraham and Al-Hajji (2005) have used a GARCH specification and data for the Saudi Arabian stock market – now the largest stock market in the Muslim world – they have documented a systematic pattern of decline in volatility during Ramadan, implying a predictable variation in the market price of risk. An examination of trading data showed that this anomaly appears to be consistent with a decline in trading activity during Ramadan. Evidence of systematic decline in volatility during Ramadan has significant implications for pricing of securities especially option-like products and asset allocation decisions by investors in the Islamic countries [Seyyed, Abraham and Al-Hajji (2005)]. Dey (2005) has studied how growth affects liquidity of global stock exchanges and how liquidity determines cross-sectional returns on those stock exchange index portfolios [Dey (2005)]. He measured portfolio liquidity by turnover ratio computed as value of shares traded over the market capitalization. He obtained data from FIBV, an association of global stock exchanges. In a multiple regression model for turnover ratio, he found age, size, type of exchange, competition for order flow, and growth rate to be significant determinants of portfolio liquidity; however, exchange- and time-specific effects are more appropriate for modeling portfolio liquidity [Dey (2005)]. The time effects yield to three distinct regimes, while the exchange-specific effects are surrogates for the legal systems, English common law, and Civil laws of the countries [Dey (2005)]. He estimated the parameters of a multiple regression model in a two-stage GLS framework in which index return is a function of turnover [Dey (2005)]. The GLS method is preferable since a turnover ratio may have a non-stationary, random component. The significant determinants of
index return are turnover and volatility, although some of the volatility effect may be a spillover from a January effect [Dey (2005)]. Investors expect higher return from high turnover markets. However, the positive turnover expected return relation was true only in emerging markets; in developed markets expected return was a function of volatility [Dey (2005)]. Its result confirmed existing empirical evidence that high turnover stock portfolios generate superior returns and further the sources and pricing of risk in emerging and developed markets were different [Dey (2005)]. Shoghi & Talaneh (2010) have analyzed the volatility behavior of Tehran Stock Exchange returns. Since volatility is an important factor in portfolio selection, asset pricing, and risk management, the main purpose of our study is to model and forecast the returns volatility of the Tehran Stock Exchange (TSE). [Shoghi & Talaneh (2010)] Using primary index data of TSE for 2003-2008, they investigated the appropriateness of several potential models of autoregressive (AR), moving averages (MA), and autoregressive moving averages (ARMA). The ARMA (2, 1) has been chosen as the best process for modeling the conditional means [Shoghi & Talaneh (2010)]. They have used EGARCH and TGARCH models to capture asymmetries in terms of negative and positive shocks and the leverage effect. The ARMA (2, 1)-TGARCH (1, 1) model was the best process to fit the data [Shoghi & Talaneh (2010)]. They have found no evidence of the presence of the leverage in the news; nor does the bad news have a larger effect on the volatility of returns than the good news. Of the three forecast performance measures, the TGARCH (1, 1) was the best model to forecast the volatility [Shoghi & Talaneh (2010)]. Abounoori & Nademi (2011) have used daily data from the Tehran stock exchange (TSE) to illustrate the nature of stock market volatility in an emerging stock market. They have estimated GJR models with both Gaussian innovations and fat-tailed distributions, such as the Student’s t and the GED [Abounoori & Nademi (2011)]. Their results indicate that leverage effect exists in Tehran Stock Exchange, because in GJR models with t-student and GED distributions, the effects of bad news on volatility (α1) is larger than the effects of good news on volatility (λ) [Abounoori & Nademi (2011)]. P-Value LR Test for Leverage Effect indicates that the differences between the α1 and λ coefficients is not significant for GJR-N model but it is significant at 5% confidence level for GJR models with t student and GED distributions [Abounoori & Nademi (2011)]. Korkmaz, Çevik & Atukeren (2012) have examined the return and volatility spillovers between the CIVETS countries. The contemporaneous spillover effects are found to be generally low. They have found the presence of intra-regional return interdependence effects. The inter-regional volatility interdependence effects were also determined [Korkmaz, Çevik & Atukeren (2012)]. The aim of this paper is considering the relationship between return and volatility in Tehran Stock Exchange. This paper is organized by 4 sections. The next section is devoted to research method, section 3 shows empirical results and in final section, we conclude.

2. Material and Methods

We have used a GARCH model for estimation volatility, also we have calculated rate of return as following:

\[ r_t = 100 \left( \log R_t - \log R_{t-1} \right) \]

Where \( R_t \) is stock price index of TSE?

Let \( R_t \) be the rate of return of a stock, or a portfolio of stocks from time \( t-1 \) to \( t \) and \( \Omega_{t-1} \) be the past Information set containing the Realized value of all relevant variables up to time \( t-1 \). So the conditional mean and variance are

\[ y_t = E(R_t | \Omega_t), h_t = \text{var}(R_t | \Omega_t) \]

respectively. Given this definition, the unexpected return at time \( t \) is \( \epsilon_t = R_t - y_t \). In order to model the effect of \( \epsilon_t \) on returns we present ARCH models. ARCH models were Introduced by Engle (1982) and generalized as GARCH models by Bollerslev (1986). In developing GARCH (p, q) we will have to provide mean and variance Equation

\[ R_t = x'_t \gamma + \epsilon_t \]

\[ h_t = \omega + \sum_{i=1}^{p} \alpha_i \epsilon_{t-i}^2 + \sum_{j=1}^{q} \beta_j h_{t-j} \]

Where \( \omega, \alpha_i, \beta_j, \gamma \) are constant parameters and \( x_t \) contains exogenous and predetermined repressors. As \( h_t \) is variance it must be nonnegative which impose the following conditions: \( \omega > 0, \alpha_1, \ldots, \alpha_p \geq 0 \) and \( \beta_1, \ldots, \beta_q \geq 0 \). The conditional variance under ARCH (p) model reflects only information from time \( t-1 \) to \( t-1 \) with more importance being placed on the most recent innovation implying \( \alpha_i < \alpha_j \) for \( i > j \). To avoid long lag lengths on \( \epsilon_t \) in ARCH (p) and difficulty in selecting the optimal length p, and ensuring the non-negativity of coefficients of conditional variance equation (2), Bollerslev (1986) present GARCH(P, q). A common parameterization for the GARCH model that has been adopted in most applied studies is the GARCH (1, 1) specification under which the effect of a shock to

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volatility declines geometrically over time. One problem with ARCH (p) and GARCH (p, q) is that good news and bad news with some absolute size have the same effect on \( h_t \). This fact is symmetric effect. However, the market may react differently to good and bad news. It is important, to be able to test for and allow asymmetry in the ARCH type specification. Nelson (1991) proposes the exponential GARCH (EGARCH) model as a way to deal with this problem. Under the EGARCH (1, 1) the \( h_t \) is given as:

\[
\log(h_t) = \alpha + \beta \frac{e_{t-1}}{\sqrt{h_{t-1}}} + \gamma e_{t-1} \sqrt{h_{t-1}} \tag{3}
\]

The EGARCH news Impact differs from the GARCH new Impact in four ways: (1) it is not symmetric. (2) Big news can have a much greater impact than in the GARCH model. (3) Log construction of Equation 3 ensures that the estimated \( h_t \) is strictly positive, thus non-negativity constraints used in the estimation of the ARCH and GARCH are not necessary. (4) Since the parameter of \( \gamma \) typically enters equation 3 with a negative sign, bad news generates more volatility than good news. The Component GARCH (CGARCH) model by Engle and Lee (1993) decomposes returns uncertainty into a short-run and a long-run component by permitting transitory deviations of the conditional volatility around a time-varying trend, \( q_t \), modeled as:

\[
\begin{align*}
\sigma^2_t - q_t &= \alpha(e_{t-1}^2 - q_{t-1}) + \beta(\sigma^2_{t-1} - q_{t-1}) \\
q_t &= \omega + \rho(q_{t-1} - \omega) + \phi(e_{t-1}^2 - \sigma^2_{t-1})
\end{align*} \tag{4, 5}
\]

Here \( \sigma^2 \) is still the volatility, while \( q_t \) takes the place of \( \omega \) and is the time varying long run volatility. The first equation describes the transitory component, \( \sigma^2_t - q_t \), which converges to zero with powers of \( (\omega + \phi) \). The second equation describes the long run component \( q_t \), which converges to \( \omega \) with powers of \( \rho \). Typically \( \rho \) is between 0.99 and 1 so that \( q_t \) approaches \( \omega \) very slowly. We can combine the transitory and permanent equations and write [Engle and Lee (1993)]

3. Results

We have used the daily data of price index of TSE during 2009-2010. The data are available on website of TSE.

1.3. Empirical Results

We have estimated ARMA(1,1)-GARCH(1,1) model for estimation volatility of tehran stock exchange. Table 1 indicates the estimation results.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Coefficient</th>
<th>Std. Error</th>
<th>z-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>-0.129048</td>
<td>0.071332</td>
<td>-1.809104</td>
<td>0.0704</td>
</tr>
<tr>
<td>AR(1)</td>
<td>0.958277</td>
<td>0.015238</td>
<td>62.88824</td>
<td>0.0000</td>
</tr>
<tr>
<td>MA(1)</td>
<td>-0.687631</td>
<td>0.026081</td>
<td>-26.36564</td>
<td>0.0000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variance Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
</tr>
<tr>
<td>RESID(-1)^2</td>
</tr>
<tr>
<td>GARCH(-1)</td>
</tr>
</tbody>
</table>

Table 1. The estimation results.

Dependent Variable: R
Method: ML - ARCH (Marquardt) - Normal distribution
Date: 01/01/13 Time: 16:57
Included observations: 755 after adjustments
Convergence achieved after 55 iterations
MA Backcast: 7/30/2007
Presample variance: backcast (parameter = 0.7)
GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)

Results indicate that the model is significance. All of the parameters are statistically significant.

Results from Table 2 indicate that there is a negative relationship between volatility and rate of return in TSE. The correlation coefficient between volatility and return is -0.00182.

Table 3 and 4 indicate Tabulation of volatility and return and pairwise Granger Causality tests respectively. Results indicate that

✓ The hypothesis of RETURN does not Granger Cause VOLATILITY has rejected
The hypothesis of VOLATILITY does not Granger Cause RETURN has not rejected.

Figure 1 and 2 indicate volatility and return series respectively. In the next step we have calculated correlation between volatility and return as in Tables 2, 3, 4.
4. Discussions

The volatility of financial markets has been the object of numerous developments and applications over the past two decades, both theoretically and empirically. Portfolio managers, option traders and market makers all are interested in the possibility of forecasting volatility, with a reasonable level of accuracy. That is so important, in order to obtain either higher profits or less risky positions. In this respect, the most widely used class of models is that of GARCH models (see e.g. Bollerslev, Engle, and Nelson (1994) for an overview). The aim of this paper is considering the relationship between return and volatility in Tehran Stock Exchange. We have used the daily data of price index of TSE during 2009-2010. The data are available on website of TSE. We have estimated ARMA(1,1)-GARCH(1,1) model for estimation volatility of Tehran stock exchange. Results indicate that there is a negative relationship between volatility and rate of return in TSE. The correlation coefficient between volatility and return is -0.00182. The hypothesis of RETURN does not Granger Cause VOLATILITY has rejected. Also, the hypothesis of VOLATILITY does not Granger because RETURN has not rejected.

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References


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