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The Sources of Stock Market Volatility in Jordan

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Abstract

This study examines the sources of the Amman Stock Exchange (ASE) price index volatility, using monthly data between 1991 and 2010. The volatility returns of the ASE are estimated through utilizing the ARCH /GARCH model with /without dummy variable, and to measure the shocks of each variable, the Impulse Response Function (IRFs) is applied. The results of the study revealed that the ARCH (1) performs well. It also indicated that RMS2, CPI, E1, WAIR and the dummy variable have an adverse impact on the ASE returns volatility, while RGDP played a positive effect. The volatility equation shows that the mean (ω) is smaller than that of the parameter of lagged squared error term (γ). ARCH (1) (represented by γ) is positive and statistically significant at 1% level, while GARCH (1, 1), represented by δ, is negative with the dummy variable but not statistically significant. The sum of (γ +δ) is greater than unity, demonstrating that the volatility increases over time. The dummy variable (η) has an inverse influence on the ASE index returns volatility and is statistically significant at 1%. The results from the (IRFs) support the significance of dynamic association between the monthly return index and the macroeconomic variables. The findings of this study can assist policy makers in curbing the outflows of financial capital, investors in assessing the asset returns predictability during the financial crisis, financial regulators, business executives, and stock market analysts.

Keywords: Jordan stock market, macroeconomic variables, stock market return, volatility

1. Introduction

Over the last three decades, many studies have looked into the connection between asset prices and different economic variables both theoretically and empirically, and the relations between stock market volatility and macroeconomic variables have been widely studied in financial economics.

The subject of the effects of macroeconomic variables on stock returns can be dated back to the late 1970's (i.e. Ross (1976). Numerous other studies have also analyzed the sources of volatility, such as (Fama, 1981, 1990); Chen et al., (1986) , Ferson and Harvey, 1991, 1993); and Kwon and Bacon (1997).

Schwert (1989) conducted a great number of investigations on the sources of macroeconomic effect on the volatility of stock market in the United States. It was hypothesized that the volatility of stock returns increase during economic contractions and decrease during recoveries.

Bekaert and Harvey (1995) tackled the relative importance of local and world information over the change of time in both anticipated returns and conditional variance processes. Liljeblom & Stenius (1997) analyzed the impact of macroeconomic volatility on conditional stock market volatility, using GARCH estimations. Kearney and Daly (1998) analyzed the sources of stock market volatility in Australia. Morelli (2002) constructed a study regarding the causes of stock market volatility and conditional macroeconomic volatility using (ARCH) & (GARCH) models.

Rousan and Al-Khouri (2005) performed a study about the ASE volatility in Jordan using ARCH and GARCH models. Yusof and Majid (2007) employed the (GARCH)-Mean model, and GARCH (1, 1) framework jointly with VAR analysis, in order to explore the volatility which represented by the conditional variance of the error in the conventional &Islamic stock markets in Malaysia.

Al Rjoub (2011) examined the effect of the financial crisis event on the ASE returns volatility in Jordan, using the GARCH-M model and introduced dummy variables to measure the behaviour of the ASE returns volatility during the crises episode.

This study investigates the dynamic relationship between the sources of volatility returns in the ASE and macro economic variables, using a monthly data between 1991 and 2010.

This study differs from other empirical studies in at least three aspects: First, it examines the macroeconomic determinants and their effect on the stock market returns in Jordan by using different macroeconomic variables and definitions. Secondly, it conducts the (IRFs) in order to measure the dynamic interaction and the importance among macroeconomic variable and ASE return volatility. Thirdly, the study incorporates a longer time period of the latest monthly data for Jordan, in order to capture long-term movements of returns and to reduce the probability of high degree of multicollinearity. It also measures the effect of financial crisis on ASE return volatility.

The monthly data is obtained from Amman Stock Exchange (ASE) , the Central Bank(CBJ) statistical database, (IMF), (IFS) (various issues), and Department Of Statistics (DOS) (various issues) over the period 1991–2010.

This paper is divided into seven sections. Firstly: Introduction. Secondly: literature reviews. Thirdly: the methodology, econometric model and data. Fourthly: the macroeconomic variables and their definitions. Fifthly: the Descriptive Statistics. Sixthly: empirical results and its interpretation, and finally: conclusions and recommendations.

2. Literature Review

Earlier studies regarding the effect of macroeconomic factors on the returns of stock markets were initiated in the second half of 1970s. Several other researchers have concentrated on the reasons behind stock market return volatility.

Ross (1976) developed the Arbitrage Pricing Theory (APT) and links stock returns to several macroeconomic variables, and determines the nature of income volatility sources.

In the same line of research, Fama and Schwert (1977) investigated the link amongst stock market return volatility, macroeconomic and financial variables. The results showed a positive link between stock market volatility and macroeconomic volatility. At the same time, there is a dual causality between them.

An additional study carried out by Fama (1981) assured that an inverse relationship exists between stock returns and inflation, while a positive relationship is existed between stocks returns & real activity. He also argued that an increase in real activity encourages the demand for money, which in turn creates an upward relationship between stock returns & money supply.

Utilizing a multivariate (APT), Chen, Roll and Ross (1986) confirmed a strong systematic relation among the returns in stock market and the macroeconomic factors.

In the line of this, a study constructed by Schwert (1989) indicated that macroeconomic volatility partially explains the movements in stock volatility whereas financial asset volatility strongly explains the prediction of future macroeconomic volatility.

Utilizing the GARCH model, Liljeblom and Stenius (1997) presented a study about Finland's stock market volatility. Results revealed that a linkage existed between aggregate stock volatility & macroeconomic volatility. They also found an inverse link between stock market volatility and foreign trading volume growth.

Kearney and Daly (1998) investigated the causes of volatility for Australia's stock market returns. The findings showed that inflation and interest rates were positively related to the volatility of the stock market, whereas money supply, industrial production, and current account deficit were indirectly affected by the stock market volatility. The money supply is considered the strongest variable that affects the conditional volatility of the stock market.

Using ARCH/ GARCH models, Morelli (2002) presented a study about the UK stock market volatility. The results confirmed that conditional macroeconomic variables volatility do not explain the conditional stock market volatility.

Employing the (VECM), a dynamic study of the ASE market and macroeconomic variables in Jordan was conducted by Al-Sharkas (2004). The results indicated that stock prices and macroeconomics variables have a long-term equilibrium relationship.

An additional study carried out by Rousan and Al-Khouri (2005) investigated the ASE market volatility for the period between 1992 and 2004. Using ARCH/ GARCH models, empirical results indicate symmetry in volatility. This means that good or bad news have a similar degree of influence on the ASE market volatility level. Adding to this, the volatility continues in the stock market for a long period of time.

Chowdhury, Mollik and Akhter (2006) employed both the GARCH and VAR models, and showed that a significant unidirectional causality exists, namely from industrial production volatility to market return volatility and from market return volatility to inflation volatility.

In the same line of research, Yusof and Majid (2007) utilized GARCH-M and GARCH (1,1) frameworks and (VAR) analysis in order to investigate the volatilities in stock markets of Malaysia .The findings showed that the volatility of interest rate influences the traditional stock market volatility except the volatility in the Islamic stock market. However, the exchange rate has more influences on Islamic stock market volatility.

Chinzara (2010) examined the volatility of stock market in South Africa, using (GARCH), (AR-GARCH) and (VAR) models. He confirmed that insecure phenomenon in macroeconomic factors considerably affects the volatility of the stock market. Moreover, it was found that interest rates and exchange rates volatility in the short term are more important than that of inflation, gold price and oil prices. The results also indicated that financial crises raise stock market volatility.

Al Rjoub (2011) considered the impact of dummy variables on the stock returns volatility in Jordan during the financial crises, by utilizing the GARCH-M model. The results confirmed that there is an inverse link between stock returns volatility and the financial crisis. Amazingly, the findings indicated that volatility of stock returns was positively related throughout the 2004 Iraq war. Furthermore, it was concluded that the extreme fluctuates in the volatility (negative and positive shifts) may be due to the effect of news and general public expectations about the Jordanian market.

3. The Methodology and Econometric Model

This paper inspects the influences of macroeconomic factors on stock returns volatility in Jordan using different methods of estimation such as the (ARCH) and (GARCH) model.

Many empirical search papers have examined the relationship between macroeconomic variables and stock market returns volatility. Schwert (1989), Karolyi (1995), Liljeblom &Stenius (1997), Kearney & Daly (1998), Muradoglu et al. (1999), Morelli (2002), Rousan and Al-Khouri (2005), and Chowdhury et al., (2006) studied the factors that influence the volatility of stock market returns through utilizing the GARCH and Vector Autoregressive models.

The (ARCH) model was initially pioneered by Engle (1982, 1983) and Cragg and Malkiel (1982), and has now become widely used in modeling the behavior of financial time series and is commonly used for modeling the association between stock market volatility and macroeconomic variables for various markets (i.e. stocks, bonds, indices, currencies, derivative prices volatility). The main advantage of ARCH models is its ability to capture the non-linearity and volatility clustering in stock return data. Also, ARCH models study the second moment (Conditional and non-conditional) of the time series, and thus allow the variance of a series to depend on the available information set.

However, Heteroskedasticity has also been observed in time series, and can be considered a reflection of the way in which the volatility of the dependent variable varies systematically during time. Therefore, Heteroskedasticity can be considered a time varying variance (i.e. volatility). The variance of the error term (ε_t) at time (t) represents the uncertainty at that point in time. Moreover, it has been found useful in some models to treat the variance of (ε_t), as a function of prior errors.

The Autoregressive Conditional Heteroscedastic (ARCH) model can be written as follows:

$$Y_t = \beta X_t + \varepsilon_t \tag{1}$$

In this model, the mean equation is specified by an AR (p) process; the return series is regressed on its previous values. Moreover, the conditional variance is regressed on constant and lagged values of the squared error term acquired from the mean equation.

Engle and Bollerslev (1986) extended this model to the generalized version of the ARCH model, better known as the (GARCH) model, which includes the lagged values of conditional variance. The GARCH) model is therefore capable of taking the leptokurtosis, skewness, and volatility clustering in data time series. Also, GARCH is a method that takes into account past variances in explaining future variances. So, when data suffers from Heteroskedasticity, it means that the expected value of the error term is not constant.

ARCH/ GARCH models and the stochastic volatility models are of great significance for forecasting volatility, as they explain the importance of the degree of persistence of shocks to volatility in returns and macroeconomic variables. In describing the behavior of ARCH/GARCH models, we focus on the error process. In particular, we assume that the conditional mean of the errors equals zero.

The general GARCH (p, q) model for stock return (SR_t) at time (t) is represented as follows:

$$Y_t = \beta X_t + \varepsilon_t \tag{2}$$

$$SR_t = \beta_0 + \sum_{i=1}^{t} \beta_i SR_{t-i} + \varepsilon_t, \varepsilon_t / \psi_{t-1} \sim N(0, SR_t) \tag{3}$$

The conditional variance of the error ($CV_t{}^2$) is represented as follows:

$$CV_t{}^2 = \omega + \sum_{i=1}^{p} \gamma_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \delta_j CV_t{}^2{}_{t-j} \tag{4}$$

Where $p \geq 0, q \geq 0$

$\gamma_0 \geq 0, \gamma_i \geq 0 \quad i = 1,\ldots, p$

$\delta_j \geq 0 \quad j = 1,\ldots, q$

The first number between the brackets (1, 1) in the above GARCH (1, 1) model refers to the number of autoregressive lags (or ARCH terms), whereas the next number refers to the number of moving average lags which is often identified as the number of GARCH terms. Moreover, (ε_t) is characterized by a zero mean, serially uncorrelated error term, and with a normal distribution conditional on past information. As for ($CV_t{}^2$), it depends on the mean (ω), news regarding volatility from the prior period measured by the lag squared residual from the mean equation (ε_{t-1}), the ARCH term, and last periods forecast variance, ($CV_t{}^2{}_{t-1}$) (the GARCH term). Also, the estimate of (γ_i) shows the influence of current news on the conditional variance process, and the estimate of (δ_i) demonstrates the influence of old news on volatility (the persistence of volatility to a shock).

Furthermore, Engle and Bollerslev (1986) clarify the importance of the degree of persistence in shocks to volatility in determining the relationship between stock market returns and macroeconomic factors. In the case of the GARCH model process, shock persistence is measured as the sum (Σ) of the ($\gamma_i + \delta_i$), which must be equal to or less than one in order for stability to hold. Moreover, in order for the sum to have a stationary variance, it should be less than 1. However, if the sum is greater than the unity, then volatility increases over time. Therefore, for non-stationarity in the variance, the conditional variance forecasts will not meet on their unconditional value as the horizon increases.

However, the differences between the ARCH and GARCH models is that the latter is more flexible in its lag structure, as it permits all lags to exert an influence through including the previous value of the conditional variance itself ($CV_t{}^2{}_{t-1}$), (referred as GARCH term), and the previous values of the squared errors (ε_{t-i}^2) (referred to as the ARCH term), as pointed out in the above equations.

Additionally, we added the dummy variable (D) to capture the effect of the financial crisis on the stock returns volatility. (D) takes the value of one throughout the following periods: 11 September, 2001 in the US, the Iraqi war in 2003, world financial crisis in 2008 and recent political events in 2010.

Otherwise, (D) takes the value of zero.

Moreover, the conditional variance equation will be utilized as follows:

$$CV_t{}^2 = \omega + \sum_{i=1}^{p} \gamma_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \delta_j CV_t{}^2{}_{t-j} + \eta D \tag{5}$$

Also, a number of macroeconomic variables are incorporated into the mean and the conditional variance equation to evaluate the predictive power of macroeconomic variables volatility on stock market volatility. These variables are: $\mathrm{RMS2}, \mathrm{RGDP}, \mathrm{CPI}, \mathrm{E1}, \mathrm{WAIR}$.

In equation (5), if the sign of the coefficient of the dummy variable (η) is negative, then the effect of the recent financial crisis will probably affect the stock returns in a negative way. Otherwise, it suggests a positive impact.

The estimation of GARCH models in this study will be based on the Akiake's Information Criterion (AIC) and Schwarz's order Information Criterion (SIC). The AIC and SIC are functions of the maximum log-likelihood values L (θ) as well as to the numbers of the free parameters in the estimation. Moreover, the (AIC) and the (SIC) are a compute of the goodness of fit of an estimated statistical model and thus, they give us a bias towards more economical specifications due to the fact that they incorporate a penalty for a large number of parameters. Consistent with that, these criteria should provide the lowest value to fit the data.

The hypothesized model is as follows:

$$ASE = f\,\{RMS2, RGDP, CPI, E1, WAIR, Dum\} \tag{6}$$

To explore whether the above proceeded macroeconomic variables affect the ASE index returns volatility, the following model is carried out in the following form:

$$ASE_t = \beta_0 + \beta_1\, RMS2_t + \beta_2 RGDP_t + \beta_3\, CPI_t + \beta_4\, E1_t + \beta_5\, WAIR_t + Dum + \varepsilon_t \tag{7}$$

In the proceeded equation, β_0 is constant and β is the coefficient of the variables, whereas ε_t is the residual error of the regression. In the light of the literature review, the coefficient of variables; β_1, β_3, β_4 and β_5 are anticipated to be negative, while β_2 is anticipated to be positive.

In order to be able to perform a partial elasticity analysis, we take the logs of the variables in the above equation, enabling us to assess the impact of a change in the independent variables on the dependent variable while other variables remaining constant.

$$lnASE_t = \beta_0 + \beta_1\, lnRMS2_t + \beta_2\, lnRGDP_t + \beta_3\, lnCPI_t + \beta_4\, lnE1_t + \beta_5\, lnWAIR_t + Dum + \varepsilon_t \tag{8}$$

This study hypothesizes that the Amman Stock Exchange price index (ASE) is employed as a proxy for the performance of the Jordanian stock market. The ASE is an open market and known as one of the most open markets in the Middle East, and offers a suitable investment environment for the non –Jordanian investors. This openness affects the volatility of the ASE returns.

It also hypothesizes that the returns of the (ASE) are affected by macroeconomic variables namely; Real money supply (RMS2), real gross domestic product (RGDP), consumer price index (CPI), real exchange rate (E1), weighted average interest rates on loans and advances (WAIR) and a dummy variable (DUM). The study uses monthly data rather than quarterly data covering the period of 1991-2010, to maximize the number of observations, and capture the long-term movements in the ASE returns, by employing ARCH /GARCH model.

4. Macroeconomic Variables Descriptions, Definitions and Transformation

ASE_t is the monthly General Price Index of Amman Stock Exchange Market.

The index is the market value weighted average of month-end closing prices for All-stock shares listed on Amman Stock Exchange markets for the period from January, 1991 to December, 2010.

$rtr_t = (ASE_t/CPI_t)x100$, where rtr_t is the real general price indices of the Amman stock exchange at the current month (t) and the CPI_t is the consumer price index at the current month (t).

$$LRTR_t = ln(rtr_t/rtr_{t-1})x100$$

Where: $LRTR_t$ is the monthly rate of return of real General Price Indices of Amman stock exchange at the current month (t). Hence, in the sequel, the term "returns" loosely means continuously compounded returns.

rtr_t and rtr_{t-1} represent the real general price indices of Amman stock exchange at the current month (t) and previous month $(t-1)$ respectively, whereas ln is the natural logarithm. Therefore, the use of natural logarithm, rather than levels and percentage changes, is to mitigate the correlations among the variables and to smooth the data of all variables.

$RMS2_t$ is the month-end Real money supply (RMS2) (broad definition) =Nominal money supply, in JDs millions divided by CPI,

$$LRMS2_t = ln(RMS2_t/RMS2_{t-1})x100$$

Where: $LRMS2_t$ is the monthly growth rate of $RMS2_t$. $RMS2_t$ and $RMS2_{t-1}$ represent the monthly real money supply at the current month (t) and previous month $(t-1)$ respectively, while ln is the natural logarithm. GDP_t is the monthly-end gross domestic product, in JDs millions).

The month-end real gross domestic product (in JDs millions) = nominal gross domestic product, in JDs millions) divided by CPI.

$$LRGDP_t = ln(RGDP_t/RGDP_{t-1})x100$$

Where: $LRGDP_t$ is the monthly growth rate of $RGDP_t$. $RGDP_t$ and $RGDP_{t-1}$ denote the monthly real gross domestic product at the current month (t) and previous month $(t-1)$ respectively, whereas ln is the natural logarithm. However, many macroeconomic series such as GDP are normally available on annual or quarterly basis. The monthly gross domestic product series was generated using the software program EViews.6.

In order to reduce the high degree of multicollinearity, real GDP is employed in this empirical work. The choice of this variables is almost similar to Chen, Roll and Ross (1986), Darrat and Mukherjee (1987), Lee (1992), and Mukherjee and Naka (1995).

$\mathrm{CPI_t}$ is the month-end consumer price index.

$$LCPI_t = ln(CPI_t/CPI_{t-1})x100$$

Where: $LCPI_t$ is the monthly growth rate of CPI_t at current time (t). CPI_t and CPI_{t-1} represents the month-end of CPI at the current month (t) and previous month $(t-1)$ respectively, whereas ln is the natural logarithm.

Ex_t is the month-end exchange rate of U.S. dollar per Jordanian dinar.

$\mathrm{ex1_t} = \frac{1}{\mathrm{ex_t}}$ (Exchange rate of Dinar per U.S. Dollar). In general, researchers use the nominal exchange rate as a measure of the exchange rate variable. The nominal exchange rate is defined as domestic currency units per unit of US dollar. While, The authors used the real exchange rate;

$\mathrm{e1_t} = (\mathrm{ex1_t})\mathrm{x}\left(\frac{\mathrm{CPI_t}}{\mathrm{wpim_t}}\right)$, which is defined as the nominal exchange rate in terms of JDs per USD times by the ratio of domestic price level to foreign prices $(\mathrm{P_d}/\mathrm{P_f})$.

$$Le1_t = ln(e1_t/e1_{t-1})x100$$

Where: The $Le1_t$ is the monthly growth rate of real exchange rate at current time(t). $e1_t$ and $e1_{t-1}$ represent the month-end exchange rate of the JDs to US$ at the current month (t) and previous month $(t-1)$ respectively, whereas ln is the natural logarithm.

$WAIR_t$ is the monthly return on weighted average interest rates on loans and advances.

$$LWAIR_t = ln(WAIR_t/WAIR_{t-1})x100$$

Where: $LWAIR_t$ is the monthly growth rate of $(WAIR_t)$ at current time(t). $WAIR_t$ and $WAIR_{t-1}$ represent the weighted average interest rates on loans and advances at the current month time (t) and previous month $(t-1)$ respectively. ln denotes the natural logarithm.

Using an interest rate may cause problems since the interest rate is highly correlated with other macro-variables. Owing to the correlation problem between interest rates and other macroeconomic variables, the weighted average interest rates on loans and advances is used instead of the short interest rate, and because, short interest is mostly unregulated. However, the study uses the nominal interest rate rather than the real rate of interest as Gjerde et al. (1999) employed.

Dum is the dummy variable (Dum) .The purpose is to capture the effect of the recent non-macroeconomic forces on the stock returns. (Dum) takes the value of one during the following periods: 11 September, 2001 in the US, the Iraqi war in 2003, world financial crisis in 2008 and recent political events in 2010.Otherwise, (Dum) takes the value of zero.

$\boldsymbol{\varepsilon_t}$ represents the disturbance term

5. Descriptive Statistics of the Study Variables

In this section, the relationship between the rate of return of the (ASE) index and selected macroeconomic variables has been examined through various descriptive statistics analysis. It starts by analyzing whether the time series data is normally distributed, by finding the determinants of the sample normality through the skewness, and kurtosis statistics. Table (1) presents the descriptive statistics of the data. Also, the probabilities (p-values) are used in order to provide evidence whether to reject the null hypothesis of the normality for the unconditional distribution of the monthly rate of return.

Table 1. Statistics for Amman stock Price Index and macroeconomic variables namely $\boldsymbol{RMS2_t}$, $\boldsymbol{RGDP_t}$, $\boldsymbol{CPI_t}$, $\boldsymbol{EXR_t}$, and $\boldsymbol{WAIR_t}$.

	$\boldsymbol{ASE_t}$ $(\boldsymbol{RTR_t})$	$\boldsymbol{RMS2_t}$ $(\boldsymbol{RMS2_t})$	$\boldsymbol{RGDP_t}$ $(\boldsymbol{RYX_t})$	$\boldsymbol{CPI_t}$ $(\boldsymbol{CPI_t})$	$\boldsymbol{EXR_t}$ $(\boldsymbol{E1_t})$	$\boldsymbol{WAIR_t}$ $(\boldsymbol{WAIR_t})$
Mean	2103.770	4.965714	452.0521	136.8767	1.395773	10.98733
Median	1376.681	4.981162	395.7913	130.6677	1.460323	11.22000
Maximum	6012.092	5.922678	825.7001	199.8447	2.068295	13.97000
Minimum	1000.000	3.842361	212.2633	100.0000	0.738877	7.580000
Std. Dev.	1297.813	0.542207	158.6230	26.74066	0.327844	1.710810
Skewness	1.281083	-0.261175	0.957551	0.726740	-0.210054	-0.119641
Kurtosis	3.406914	2.493428	2.805582	2.649288	2.353304	1.737654
Jarque-Bera	67.30271	5.294641	37.05413	22.35602	5.947072	16.50772
Probability	0.000000	0.070841	0.000000	0.000014	0.051122	0.000260
Sum	504904.9	1191.771	108492.5	32850.40	334.9856	2636.960
Sum Sq. Dev.	4.03E+08	70.26331	6013541.	170900.0	25.68810	699.5219
Observations	240	240	240	240	240	240

Sources: 1. Central Bank of Jordan. 2. Amman Stock Exchange.

As shown in Table (1), the variables are normally distributed and highly skewed, excluding the Amman stock price index (ASE) which is significantly skewed to the right and has an excess kurtosis (deviated from 3), and the series are leptokurtic (for more details, ***see M.G. Bulmer, 1965)***. RMS2, EXR, and WAIR are skewed to the left and the less kurtosis and the series are platykurtic.

Furthermore, the normality test is applied to the data through using, the Jarque-Bera test (1980) which measures the goodness of fit that depart from normality, and take into account the sample kurtosis and skewness. However, the computed Jarque-Bera statistics and corresponding p-values are employed to check for the normality assumption. In the light of this assumption, all variables are rejected at 1% level of significance, with the only two exceptions in EXR and RMS2, at 5% and 10% respectively.

Subsequently, the descriptive statistics show mixed results regarding the normality distribution. We can see from the data that there is no randomness and the data can be heavily exposed to speculation and shows periodic change. This indicates that an investor can earn a noticeably superior profit rate from the Amman Stock Exchange Market.

In order to check the stationarity of the time series, a unit root tests is carried out. Hence, the non-stationary data produces normal properties problem. In this case, the value of Durbin-Watson (DW), t-statistics and the R^2 break down. Running regressions with such data produces questionable, invalid and spurious results. So, to remove this problem, stationarity tests must be carried out.

Before utilizing the ARCH/GARCH models, it is essential to inspect the properties of the factors by employing unit root tests. There have been many proposed techniques for implementing stationarity tests (for example, The Augmented Dickey-Fuller (ADF) ***(Dickey and Fuller, 1979; 1981)*** and Phillips-Perron (PP) ***(Phillips and Perron, 1988)***.The ADF & PP unit root tests results are presented in Table (2). The ADF test is based on the Akaike Information Criterion (AIC), to measure the goodness-of-fit of an estimated statistical model and thus, it gives us a bias towards more economical specifications due to the fact that they incorporate a penalty for a large number of parameters. Consistent with that, these criteria should provide the lowest value to fit the data. As for the PP test, it is based on the automatic selection procedure of Newey-West (1994) for Bartlett Kernel (Lag truncation: 4).

Table 2. The Results of Unit Root Test for Amman Stock Price Index and Macroeconomic Variables)

Variables	The Augmented Dickey-Fuller test **(ADF Unit Root Test)**	The Phillips-Perron test **(PP Unit Root Test)**	**Akaike Information Criterion (AIC)**	**Durbin-Watson Stat**
ASE	-5.191*	-12.725*	(-2.97)	2.0
M2	-7.389*	-19.617*	(-5.35)	2.00
GDP	-5.59*	-16.947*	(-5.10)	2.03
CPI	-5.906*	-12.859*	(-6.70)	2.00
EXR	-3.659*	-12.33*	(-4.60)	2.02
WAIR	-6.767*	-21.078*	(-4.75)	2.03

Notes: 1. Asterisk (*) shows the rejection of the null hypothesis of non-stationary at the 1% level.

2. MacKinnon (1996) critical values of ADF and PP tests Variables are at first difference in natural logarithm without Intercept and Trend. The 1%, 5% and 10% critical value for the ADF and PP tests is -2.5742 and -1.9410and -1.6164 respectively.

As shown in Table (2), the results of both tests indicate that the null hypothesis of the existence of a unit root is rejected at 1% significance level, meaning all of the series are accepted not to include unit root. In other words, the hull hypothesis of a unit root can be rejected in both the ADF and PP tests, since the values of test are more negative than the critical values, and thus the t-statistics are located in the rejection of the null area. Moreover, the Durbin-Watson statistics indicates there is no evidence of autocorrelation.

Since we deduced that all of the series are stationary, now we can proceed to modeling the effect of macroeconomic variables and their volatility on the Amman Stock Price Index, through employing the ARCH/GARCH models.

6. Empirical Results and Interpretations

The empirical outcomes show a mixture of results, which depend on the scope of the research and how the cross-market dynamics in volatility are modeled. Some of those variables could be common for all stock exchange markets. Anyhow, it is hard to generalize the outcomes because of the different conditions that surround each stock market background. Each market has its own rules and regulations, location of the country, sort of investors, and other features that offers the basis of its uniqueness.

With regards to this study; all variables indicate that they are stationary, lending continuity in the modeling process (Gujarati 2003). Therefore, the influence of macroeconomic factors on the (ASE) returns volatility is estimated using ARCH/GARCH estimation models respectively as shown in the following table. All estimations have been carried out using EViews program 6, and for the ordinary calculations Excel also used.

Table 3. The impact of macroeconomic variables on the rate of return of stock exchange price index is examined by Method: ML - ARCH (Marquardt) ARCH1/ GARCH (1) estimation for the period: (1991:01- 2010:12). Dependent Variable: LRTR

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	15.72163	0.006760	2325.782	0.0000
LRMS2	-1.811843	0.056694	-31.95847	0.0000
LRYX	0.129717	0.002401	54.03616	0.0000
LCPI	-0.494647	0.022188	-22.29302	0.0000
LE1	-0.516599	0.046878	-11.02000	0.0000
LWAIR	-1.439426	0.067902	-21.19867	0.0000
DUM	-0.218608	0.010999	-19.87506	0.0000
		Variance Equation		
C	0.002279	0.000419	5.438414	0.0000
ARCH(1)	1.064035	0.241522	4.405541	0.0000
GARCH(1)	-0.017565	0.076746	-0.228871	0.8190
R-squared	0.899979	Mean dependent var		7.497781
Adjusted R-squared	0.896065	S.D. dependent var		0.525384
S.E. of regression	0.169379	Akaike info criterion		-1.437581
Sum squared resid	6.598501	Schwarz criterion		-1.292554
Log likelihood	182.5097	F-statistic		229.9452
Durbin-Watson stat	0.198219	Prob(F-statistic)		0.000000

Table 4. The effect of macroeconomic variables on the rate of return of stock exchange price index is examined by Method: ML - ARCH (Marquardt): ARCH1 estimation for the period: (1991:01- 2010:12). Dependent Variable: LRTR

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	14.60040	0.016283	896.6577	0.0000
LRMS2	-1.755744	0.049483	-35.48165	0.0000
LRYX	0.378007	0.009253	40.85069	0.0000
LCPI	-0.712028	0.017324	-41.10109	0.0000
LE1	-0.462680	0.040720	-11.36240	0.0000
LWAIR	-1.194532	0.054655	-21.85597	0.0000
DUM	-0.228514	0.011639	-19.63270	0.0000
		Variance Equation		
C	0.001542	0.000101	15.32398	0.0000
ARCH(1)	1.161338	0.223361	5.199373	0.0000
R-squared	0.889289	Mean dependent var		7.497781
Adjusted R-squared	0.885455	S.D. dependent var		0.525384
S.E. of regression	0.177814	Akaike info criterion		-1.553006
Sum squared resid	7.303714	Schwarz criterion		-1.422482
Log likelihood	195.3607	F-statistic		231.9387
Durbin-Watson stat	0.161401	Prob(F-statistic)		0.000000

The estimated results of the effect of macroeconomic variables on the rate of return of the stock exchange price index, using ARCH/ GARCH were performed. The value related to the lagged squared error term is positive and significant at 1% level, which satisfies the specification requirement of the model. On the other hand, GARCH (1, 1) which incorporates the coefficient of the lagged variance term is found to be negative but not statistically significant. Because of the insignificancy of the coefficient of the previous variance term, the extension to a GARCH (1, 1) does not seem necessary. Therefore, the ARCH (1) does perfectly well.

However, the results of this study based on the ARCH (1) estimation as showed in table (4) indicate that money supply (M2 either in real terms) has an inverse impact on the ASE return .The negative value of the coefficient is (-1.755744) and is highly significant.

With regards to real economic activity, such as industrial production (IP) or Gross Domestic Product (GDP), the findings showed a positive relationship between Amman stock prices index and RGDP, and the coefficient is (0.378007) and highly significant.

The findings confirmed an inverse link between Amman stock prices index and inflation, where the coefficient is (-0.712028) and highly significant.

Adding to this, the findings showed a negative relationship between real exchange rate and Amman stock prices index returns, and the coefficient is (-0.462680) and highly significant.

Moreover, the study indicates that there is an inverse relationship between weighted average interest rates on loans and advances and Amman stock prices index returns and the coefficient is found to be highly significant with a magnitude of (-1.194532).

Finally, the results indicated a negative direction between Dummy Variable and Amman stock prices index returns and the coefficient is found to be important and its magnitude is (-0.228514) and is highly significant.

6.1 The Volatility of Returns in the ASE

This section examines the volatility returns of the ASE. In order to do that, we employ GARCH (1, 1), as well as ARCH (1). Moreover, a dummy variable will be incorporated, between the periods (from January, 1991 to December, 2010).

Table 5. Presents the volatility in the returns of the ASE using ARCH (1) and GARCH (1, 1) models (with/ without a dummy variable), for the period from 1991:1 to 2010:12

model	ω	γ	δ	γ + δ	η	AIC¤	SIC¤
GARCH (1, 1)	0.001598*	0.956303*	0.075695	1.032	-----------	-1.366927	-1.236403
GARCH (1, 1) With Dummy	.002279*	1.064035*	-0.017565	1.046	-0.218608*	-1.437581	-1.292554
ARCH (1)	0.000953*	1.169210*	------------		-----------	-1.483657	-1.367636
ARCH (1) With Dummy	0.001542*	1.161338*	------------		-0.228514	-1.553006	-1.422482

¤AIC is the Akiake Information Criterion, and SIC is the Schwarz's order Information Criterion. The model with the lowest criterion is considered optimal, whereas the number of optimal lag-structure of the conditional variance equations is used, and is determined according to values of (SIC, AIC).

*correspond to a claim of a statistically significant at 1% level.

In general, the value of the term (ω) relates to the mean (constant). The (γ) value relates to the lagged squared error term. In this study, the previous error is linked to the change in returns in the previous month. Assuming that the market operates efficiently (i.e. demand and supply curves are at equilibrium), the changes in returns are due to the responding to the coming of information. Therefore, (γ) can be displayed as 'current news' arrival, that recent news has a greater impact on prices changes. The coefficient (δ) reflects the impact of 'old news' on volatility. (δ) is the coefficient on the previous variance term, and captures the impact of the return changes related to the previous months.

Furthermore, the volatility equation, contains the constant term (ω) which is the time independent component of volatility; it shows evidence of the volatility measure if no ARCH (1) or GARCH (1, 1), or conditional variables are significant ($\omega = \gamma = \delta = 0$).

The impact of macroeconomic factors on the rate of return of stock exchange price index, results of volatility in the returns of (ASE) index show that the magnitude of (ω) is less than the parameter (γ), which embodies the impact of preceding surprises. ARCH (1) (represented by γ) is positive and claimed a statistically significant at 1% level, and therefore satisfies the specification requirement of the model. On the other hand, GARCH (1, 1) (represented by δ) is found to be negative with Dummy but not statistically significant. The sum of ($\gamma + \delta$) measures the volatility persistence as outlined by (Engle & Bollerslev 1986). Our results show that the sum of (γ +δ) is equal to (1.046); which is greater than unity, signifying that the models are second order stationary, and volatility increases over time. Therefore, for non- stationarity in variance, the conditional variance forecasts will not meet on their unconditional value as the horizon increases. However, due to the insignificancy of (δ), the extension to a GARCH (1, 1) does not seem necessary. The ARCH (1) does perfectly well.

To catch up the consequence of the financial crisis on the ASE index returns volatility, a dummy variable is added to the conditional variance equation. The results of the dummy variable (η) indicated a negative sign and is statistically significant at 1% level in the ARCH (1) or GARCH (1, 1) models. This suggests that the financial crisis has a negative impact on the ASE index returns volatility. However, the value of (δ) has remained insignificant and its sign changed to negative after adding the dummy variable (η) and thus, the financial crisis affect on the volatility of ASE returns was manifested in the magnitude of (γ). Consequently, this suggests that the response of the ASE volatility in returns has slightly decreased. In other words, the volatility shocks will show a sign of a long memory within the financial crisis.

6.2 Impulse Response Function

Given that the individual coefficients in the Vector Autoregressive models estimation are frequently hard to figure out, practitioners of this technique normally conduct the impulse response function (IRF). The IRF traces out the shocks reaction of the dependent variable in the Vector Autoregressive system to shocks in the error terms. Suppose error term in the $\mathrm{LRTR_t}$ equation increases by a value of one standard deviation. Such a shock or change will change $\mathrm{LRTR_t}$ in the present as well as future periods. But since $\mathrm{LRTR_t}$ appears in the R regression, the change in error term will also have an impact on R regression. The IRF traces out the impact of such shocks for several periods in the future. Although the utility of such IRF analysis has been questioned by researchers, it is the centerpiece of VAR analysis (Gujarati, 2003).

In order to obtain added perception into the short-run transmission mechanisms between the monthly return index and macroeconomic variables; the IRFs are calculated. The paper utilizes Choleski's decomposition which requires that variables in the VAR must be ordered in a particular fashion.

However, this study employs the following ordering schemes:

$$\mathrm{LRTR_t}, \mathrm{LRMS2_t}, \mathrm{LWAIR_t},\ \mathrm{Le1_t},\ \mathrm{LCPI_t},\ \mathrm{LRYX}\ \text{and}\ \mathrm{Dum}.$$

The dynamic relationship between the monthly return indexes to changes in macroeconomic variables is presented in Figures 1A-5A. However, the study ordering systems appear normal in the light of the existed information lags and the deployment of monthly data. It is also in harmony with the main goal of our assessment.

The IRFs (24 periods) from shocks of each factor are mark out by means of the simulated response of the calculated Vector Autoregressive system. Looking at impulse response graphs, it can be viewed that Monthly return index, on average, fully accommodate shocks to the other variable after 6 periods.

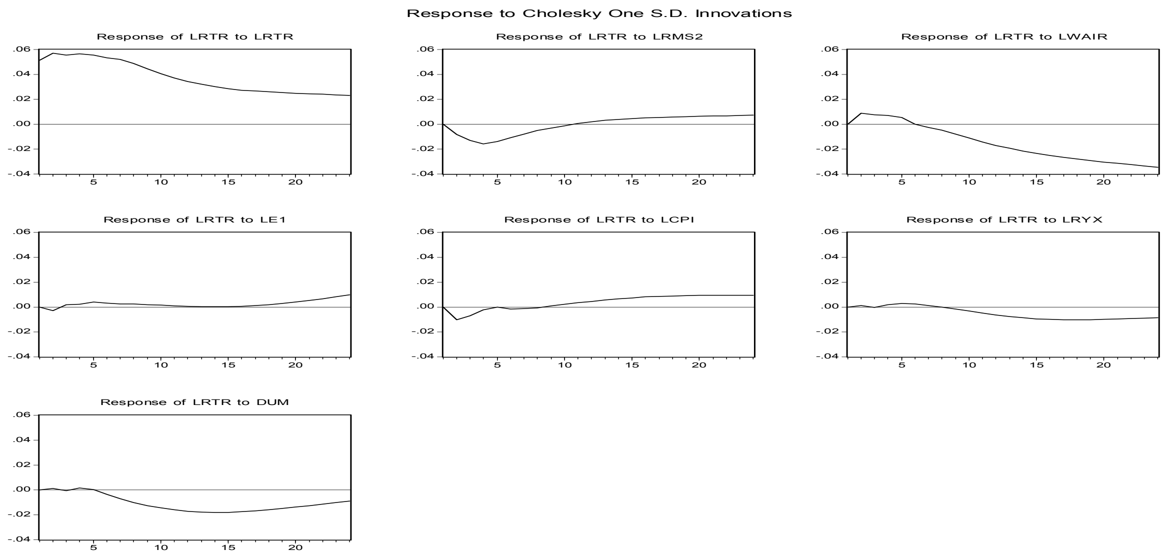

Figure 1.

From the results, we notice that the impulse response for $\mathrm{LRTR_t}$,$\mathrm{LRMS2_t}$ and $\mathrm{LCPI_t}$ appears to have negative shocks during the period (2- 8) but then starts to rise in the positive area after 10 periods. As for $\mathrm{LWAIR_t}$, it has a positive but non-significant effect at the first period but then moves into the negative region. The effect of $\mathrm{Le1_t}$ is not significant during the period. With respect to the effect of LRYX and Dum, both were negative following the periods of 8 and 4 respectively. The results from the impulse response functions support the presence of a significant dynamic relationship between monthly return index and macroeconomic variables.

7. Conclusion and Implications

This paper examines the impact of macroeconomic variables on the volatility of ASE returns in Jordan, using monthly data between 1991 and 2010. The normality test is applied to the data and unit root tests were performed for stationary purposes. As a result, all the variables proved to be stationary, lending continuity in the modeling process.

The ARCH model shows strong linkages between the stock returns and macroeconomic factors and is considered a suitable in examining the simultaneous relationships between stock returns volatility and changes in the macroeconomic factors.

The results of the ARCH (1) estimation confirmed that real money supply (RMS2), inflation, real exchange rate, change in nominal interest rates, and the dummy variable all have a negative impact on the ASE returns volatility.

In this study, the negative and positive role of macroeconomic factors on stock prices has several practical implications. The RMS2 plays a negative impact on stock returns, whereas the increase in the economic activities (RGDP) has a positive impact on ASE return. Therefore, the monetary policy should be guided to influence the stock market, and weighing up the positive impact of the economic activities.

The results also indicate that the ASE returns are inversely linked to inflation. This means that the stock returns diminish and curtail capital formation. Therefore, policy makers should pay more attention to the changes in inflation. As for the exchange rate, a negative relationship is found with the stock returns. Therefore, this implication depends on whether the economy is export dominant or import dominant. For an export leading economy, (exports companies listed on the ASE), the currency appreciation has a negative influence on ASE returns. On the contrary, the currency appreciation boosts the stock market for an import leading economy (imports companies listed in the ASE).

The stock returns react negatively to rising interest rates. Therefore, high interest rates would affect the stock market returns and subsequently causing stock prices to fall. Whenever returns on treasury securities increase, investors are likely to change out of stocks and causing a decrease in stock prices. This can be explained through the behavior of the weighted average interest rates on loans and advances

Finally, the Dummy Variable has a negative impact on the ASE return. In the light of these results, policy makers should pay more attention to the macroeconomic, non-macroeconomic and financial variables that affect stock market return.

Furthermore, with regards to the volatility, the effect of macroeconomic variables on the volatility of the ASE returns showed that the magnitude of the mean (ω) is smaller than that of the parameter of lagged squared error term (γ). ARCH (1), represented by (γ) is positive and significant at 1% level, which satisfies the specification requirement of the model. On the other hand, GARCH (1, 1), represented by (δ) is found to be negative with Dummy but not statistically significant. Our results show that the sum of $(\gamma + \delta)$ is equal to (1.046); which is greater than unity, indicating that the models are second order stationary, and volatility increases over time

However, due to the insignificancy of (δ), the extension to a GARCH (1, 1) does not seem necessary, as the ARCH (1) does perfectly well.

We add a dummy variable (η) to the conditional variance equation, and the estimation of ARCH (1) or GARCH (1, 1) model is found to have a negative value and statistically significant at 1%. This suggests that the financial crisis has a negative impact on the volatility of the ASE index returns.

Finally, the results of (IRFs) indicated that impulse response of $\mathrm{LRTR_t}$, $\mathrm{LRMS2_t}$ and $\mathrm{LCPI_t}$ have negative shocks during the period (2- 8) and then after start to rise in the positive area after 10 periods. The $\mathrm{LWAIR_t}$ has a positive effect but not significant at the first period but starts to move into the negative region thereafter. The effect of $\mathrm{Le1_t}$ is not significant during the period. With respect to the effect of LRYX and Dum, both were negative following the periods of 8 and 4 respectively. The results from the impulse response functions support the presence of significant dynamic relationship between Monthly return index and macro economic variables.

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