



Check investment risk in equity by using the var standard

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ABSTRACT

Objective: This study aims to investigate and compare the investment risk between the gold and the stock using Value at Risk (VaR) measure. It is one of the known methods to measure, forecast and manage the risk and has been of interest in recent years to financial institutions. **Methodology:** The VaR is a method for assessment and identification of risk, which makes use of standard statistical techniques applied ordinarily in other areas. **Results:** This investigation is seeking to find an appropriate solution for managing the risk of investment in the stock exchange and the precious metals (gold) and to select an optimal portfolio using the concept of VaR. **Conclusion:** In this study, offering some definitions for VaR, risk and Mont Carlo Simulation, the rate of VaR of stocks and gold with conditional heteroskedastic variance is calculated by a parametric technique using GARCH model.

1. Introduction

Among the risks faced by the financial institutions, the market risk is the most important one, which plays a very big and dramatic role in the financial distress of a company. The significance of the market risk is due to excessive diversity of its causes of occurrence (Tasche, 1999). In the recent decades, considerable progress has been achieved in measuring, controlling and managing the market risk, and the VaR models are considered presently as the most significant models for measuring the market risk in the financial institutions and banks. The JP Morgan was one of the first companies, which could provide methodology for managing the market risk based on the VaR concept (Jorion, 1997). Many factors affect the price of gold, and their resultant has acted variously during different periods (Beder, 1995). The world wars, increased unrest and geopolitical tensions have been the political factors effective in the price of gold. Among the economic factors affecting the gold price changes, we may suggest to changes in oil price, baking interests and fluctuations in the value of Dollar against all other currencies. Considering the aforementioned, the main research question is formulated as “how much is the measure and estimate of the risk level of investment in a precious metal (gold) and the stocks in Iran?”

1.1 Literature Review

Simons (2000) studied the features of long-term memory for the prices of market share of futures stock indexes. The experimental results show that FIGARCH model with skewed-t distribution is proper for explaining future transactions of Dow Jones Industry Index. However, the FIGARCH model with t-innovations has been implemented for NASDAQ and S&P futures. Boudt et al. (2008) modeled and forecasted futures prices volatility of oil derivatives, using models including Random Walk, Historical Average, Exponentially Weighted Moving Average (EWMA), Linear Regression, GARCH (1,1), TGARCH, M-GARCH, State-Space as well as tow multivariate models including Vector Autoregressive (VAR) and bivariate GARCH. The results of this study indicate that the use of TGARCH model for heating oil and natural gas and application of GARCH model for crude oil and unleaded fuel will provide better results. They made use of VaR approach to define the risk in both short-term and long-term trading position. This investigation was carried out on a number of important markets indexes (such as Japan, England, Germany and the United States). The results show that the models that are more flexible do not produce essentially better performance in forecasting the value of VaR, most likely due to the complexity of such models. (Jorion, 2000)

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studied the forecast of futures prices of gold and stocks in the exchange market. In this investigation, the data related to the gold and other economic variables of the period 1984-2003 was collected. They used a variety of independent variables as well as different Autoregressive Conditional Heteroskedasticity methods including GARCH, TGARCH and EGARCH as well as the leverage effect method; finally, the asymmetric GARCH method was selected as the preferred one. Moreover, the results related to weight of investment in the Tehran Stock Exchange (TSE) suggests that the investment in this market is not suitable due to high risk and low efficiency (Scholes, 2000).

Sundararajan (2007) have investigated the Mont Carlo Stimulation and Random Walking methods to forecast VaR. In this study, we introduce Mont Carlo Stimulation method based on random walking approach in evaluation of VaR. Then, we make use of this method to forecast VaR of TSE index and five sample stocks of this market and compare the results by two methods of historical stimulation and variance-covariance (Kupiec, 1999). The results of the study show that the Mont Carlo Stimulation method is reliable particularly at high levels of confidence and has higher qualification in forecasting the VaR if the assets under study. Stambaugh (1996) carried out an investigation on the evaluation of the predictability of gold prices as well as the comparison of linear and non-linear methods. The results showed that the difference between the prediction of nonlinear methods and linear methods of ARMA. Sundararajan (2013) investigated the swinging effects of futures market of gold coin on its cash market in Iran. They first analyzed statistically the performance of futures contract market and then, tested the research hypotheses, using daily data in the period 2006-2013 and econometric techniques of GARCH models (Dowd and Blake, 2006).

The results of estimating the econometric models and statistical analyzes suggest that the introduction of trading tolls in the future contracts of the gold coins have caused larger fluctuations in the gold cash market in Iran.

1.2 Research Purposes

The main purpose of this study is to investigate and compare the risk of investment in the precious metals (gold) and stocks in Iran.

1.3 Research Questions

- 1) Does the increased risk of investment in the gold reduce the risk of investment in the stocks?
- 2) Does the increased return on investment in the gold reduce the return on investment in the stocks?

1.4 Research hypotheses

- 1) There is a significant relationship between the investment risk in the gold and in the stocks.
- 2) A significant relationship exists between the gold rate of return and that of stocks.

2. Materials and methods

2.1 Methodology

This investigation is considered a descriptive-fundamental study in terms of analysis level and it is an applied research in the application of the results. It examines the effects of investigating and comparing the investment risk in the gold and the stocks, using VaR measure. This study was performed on the period 2010-2013. The data collected concerning the coin price in the mentioned period is gathered and the VaR model is used to measure the risk.

2.2 The Statistical Population

The statistical population of this study consists of the BaharAzadi gold coin and the stocks (Stock Market). The data so collected in this research include the daily numerical value of the stock market as well as the prices of BaharAzadi coin gained from IRI Central Bank and TSE website, using NovinRahavard software for the period 2010-2013.

2.3 Procedures and Design

In this investigation, the sample is firstly selected among the statistical population, considering the predetermined conditions in terms of time and locative aspect (2010-2013) and the Rahavard software and the econometric methods of GARCH time series with t distribution is used to collect data for calculating the risk. Since it requires analyzing the data, Excel spreadsheet software is used and the EvIEWS and Stata software is applied to do statistical test. The data analysis is conducted by the econometric method. Therefore, we continue to explain the following procedures.

2.4 An Introduction to the Research Statistical Tests

In the present investigation, the inferential statistics will be applied to achieve the research results. In this type of statistics, a small group the population is selected and the related hypotheses of the researcher about them are examined. Then, to generalize the results from the sample to the population, a series of statistical tests are done. Afterwards, we suggest to the statistical tests used in this investigation.

2.4.1 T-test

The t-test is used to examine the significance of the calculated coefficients, correlation coefficients and regression models. The t-distribution is very similar to z-distribution. However, some differences are found between these two distributions. As an example, Z quantity distribution is normal, while t quantity distribution is affected by the number of the subjects. The t-distribution is applied for small samples; the greater the quantity of the samples, the distribution form is closer to the normal curve. When the sample size reaches 30, it will be equal to normal distribution. According to t-test, if the calculated significance level is less than 5% (significance level equal to 5%). In this case, the calculated values are statistically 95% significant.

Correlation: it is a measure for determining the level of correlation between the two variables; the examination of this issue that whether a changed variable will expose another variable to change or not? The statistical index, which shows the correlation between the variables, is called correlation coefficient that may be determined using the regression, because the correlation coefficient mark is identical to the mark of regression line slope. It means that if the regression line slope is positive, the correlation coefficient will be positive to, and if the regression line slope is negative, the correlation coefficient will be negative as well. Furthermore, if the regression line slope is zero, the correlation coefficient will became zero too.

2.4.2 Unit Root Tests and Durability

Application of traditional and common econometric methods in estimating the model coefficients by using time series data is based on the assumption that the model variables are durable. Identification of the existing random process in a time series is simply possible through the unit root (generalized) tests. To explain the “root unit” more simply, consider firstly the non-random mode. Assume that Y_t has an equation as follows (Soori, 2013).

$$Y_t = \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \dots + \phi_p Y_{t-p} + \mu \quad (1)$$

This is a differential equation, the response of which is as follows:

$$Y_t = c_1 \lambda_1^t + \dots + c_p \lambda_p^t + \frac{\mu}{1 - (\phi_1 + \phi_2 + \dots + \phi_p)} \quad (2)$$

λ s are called “characteristic roots” which is calculated by the following characteristic equation:

$$\lambda^p - \phi_1 \lambda^{p-1} - \phi_2 \lambda^{p-2} - \dots - \phi_{p-1} \lambda - \phi_p = 0 \quad (3)$$

Now, for simplicity, consider the first-order differential equation:

$$Y_t = \phi Y_{t-1} + \mu \quad (4)$$

The characteristic equation and its root consist of:

$$\lambda - \phi = 0 \quad \Rightarrow \quad \lambda = \phi \quad (5)$$

And, the response of equation is:

$$Y_t = c_1 \lambda^t + \frac{\mu}{1 - \phi} = c_1 \phi^t + \frac{\mu}{1 - \phi} \quad (6)$$

Therefore, the characteristic root is equal to ϕ . However, the characteristic root shall be opposite to ($\lambda \neq 1$), because otherwise the $\frac{\mu}{1 - \phi}$ phrase cannot be defined. But if the characteristic root is equal to 1, the response of differential equation is as follows:

$$Y_t = c_2 + \mu t, \quad \lambda = \phi = 1 \quad (7)$$

If we assume that $1 \geq \phi$, as $1 > \phi$ and $\phi = 1$ have been defied. We examine the tests including:

- 1) Generalized Augmented Dickey Fuller (ADF) test
- 2) Phillips–Perron (PP) test

The related statistic for Generalized ADF test is as follows:

$$\Delta y_t = \alpha + \beta t + \delta y_{t-1} + \sum_{i=1}^p \theta_i \Delta y_{t-i} + \varepsilon_t \quad (8)$$

Jackson et al. (1998) show that if the test statistic for the test is $=1$, when the $u(s)$ in similar forms are not distributed independently of each other, this statistic will have a different extreme distribution.

Jackson et al. (1998) suggested a non-parametric method to control serial correlation in order to test the unit root. The PP method does the generalized ADF test with an adjusted t-ratio in a way that the serial correlation does not affect asymptotic distribution of t-statistic. Thus, the PP statistic is introduced as follows:

$$\hat{t} = t_\alpha \left(\frac{\gamma_0}{\hat{f}_0} \right)^{1/2} - \frac{T(f_0 - \gamma_0)(se(\hat{\alpha}))}{2\hat{f}_0^{1/2}s} \quad (9)$$

Where $\hat{\alpha}$ is the estimated coefficient of AR(1), t_α is the same ratio of t for α , $Se(\alpha)$ is the standard error and the s is the regression standard error. Moreover, γ_0 is an estimation of the adaptability of errors variance. The term \hat{f}_0 is an estimation of the spectral density of the error values in zero frequency. In most of the cases, the theory of being durable and nondurable as well as serial unit root (serial auto-regression) are tested. Adoption of the unit root test (ADF) for the theory of being durable depends on the fact that the null hypothesis based on being a serial unit root is rejected. Most of the unit root tests have a low testing power against durability and accordingly, the null hypothesis is usually conformed. In most cases, this conventional approach rejects the durability of the series by mistake. The most important argument in using the test for durability null hypothesis is that it is believed that controlling the size of this statistic is very difficult when this process is durable; namely, the size of the statistic is calculated larger than the real size.

3. Discussion and results

The variables under study include the general index of Tehran Stock Exchange and BaharAzadi Coin as a measure of the gold for the period 2010-2013. Firstly, these two variables are graphically described.

The price chart of the (gold) coin is shown as follows:

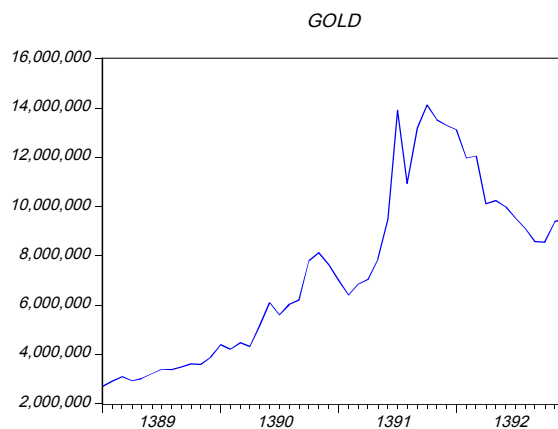


Figure 1. (gold) coin price diagram

As seen in the figure, the price of the coin and the gold started to increase remarkably from the March 2010 and continued until 2012 when it reached to 14,000,000 Rials as the highest rate up to now. Many factors caused such an increase including inflation, economic sanctions, government policies, the people starting to buy the gold and the coin for investing and selling in the future and gain profit, increased bubbles in the coin price and the raised world prices of the gold and the oil. However, the prices began to decrease to 8,500,000 Rials. Among the reasons of such reduction, we may suggest to increased rate of banking interests and the great boom of the stock exchange. Then, the price of the gold and the coin enjoyed a relative stability. The diagram of TSE general index is depicted in the following graph.

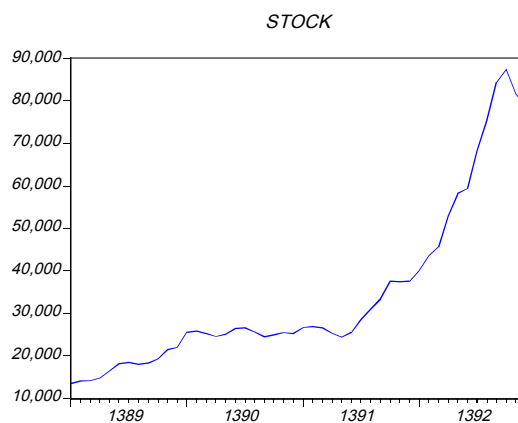


Figure 2. TSE general index diagram

The general index of the stock exchange began to increase relatively from March 2010 like the price of the gold and the coin and continued to increase up to the February 2011. However, it increased considerably from March 2012 when the investments in the stock exchange raised and the price of the gold and the coin decreased and the people returned to this market; this increase continued until March 2013.

The main goal of this study is to compare the risk level of investment in these two markets in order to identify which market has the lower risk for investment.

To estimate more accurately, it is necessary to take logarithm from the variables and their efficiency is calculated according to the following formula:

$$\text{Return } Y_t = \ln(Y_t) - \ln(Y_{t-1}) * 100 \quad (10)$$

Thus, we make use hereinafter of the variables' efficiency in accordance with the following diagram:

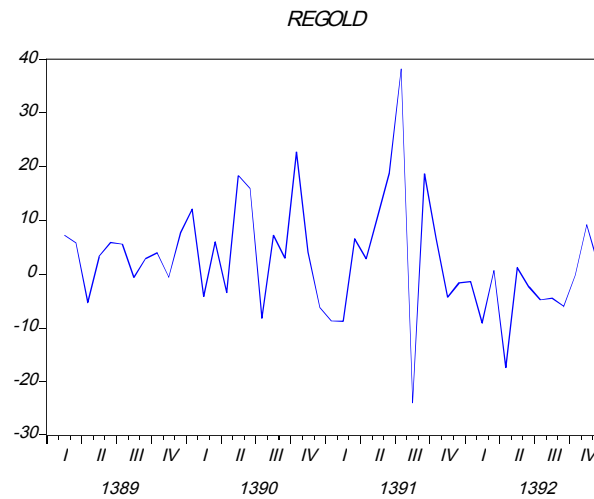


Figure 3. The rate of changes in the coin price based on the efficiency measure

As shown in the diagram, the level of changes in the market price of the coin is very high. Since the coin price has been increased until 2012, the market has suffered obviously a high volatility before 2012. After 2012, the changes level was very big, as the coin price decreased and drastically changed; this issue would probably increase the risk in this market.

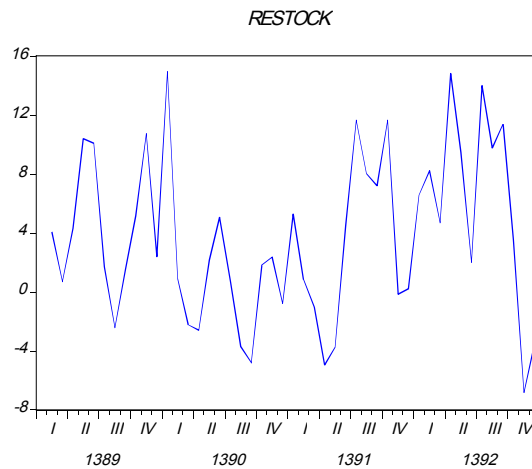


Figure 4. The level of changes in general index of the stock exchange, based on the efficiency measure

The level of volatility in this market is not relevant to the ascending trend of the general index in the period under study and it suffered a high volatility as shown in the diagram.

In this section, we apply regression and estimate the two variables together in order to understand how the increased return on investment in the gold affects the return on investment in the stocks. The result is suggested in the following table.

Table 1. Estimation of the stocks return on the gold returns

Dependent Variable	Independent Variable	Coefficient	Standard Error
Stocks Returns	Gold Returns	-0.031	0.079
Stocks Returns	Intercept	3.83	0.85

As it can be seen in the table in estimating the two variables, the gold returns and the stocks returns are inversely related; an increase of 1% in the gold returns will bring an increase of 0.03% in the stocks return. Furthermore, the stocks return with an intercept of 3.83 is higher than the gold returns. Indeed, the above table can be modelled as follows:

$$(1) \text{ Restockt} = 3.83 + (-0.03) * \text{Regoldt} + \epsilon t$$

(11)

Where the Restock is the stock returns, Regold is the gold returns and ϵ_t is the error term or the impact of other variables.

Before any estimation, the durability of time series should be firstly examined. The durability in time series means the stability of the average and variance within a period. in case the time series is not durable, the estimation has been inaccurate and the reliability of the model reduces remarkably. To examine the durability of the variables, two valid and known tests of generalized ADF and PP are used. The null hypothesis in these two tests shows the existence of a unit root; in case the null hypothesis is confirmed, the related time series has no unit and durable root. First, we investigate the durability of the returns on the gold price.

Table 2. Unit Root Test (ADF) for the gold price returns

Probability	t-statistic	
Dickey Fuller statistic	-6.96	0.000
Critical Values	At the level of 1% -3.607	
	At the level of 5% -2.941	
	At the level of 10% -2.605	
Intercept		0.107

Table 2 indicates that the level of Dickey-Fuller statistics for the gold price returns is at the critical situation and its probability is smaller than 0.01 (acceptable area 0.99). As a result, our time series (gold price returns) is durable (reliable). Another significant issue in this table is that the intercept significance probability in the model is larger than 0.01.

This, it is not significant in the model[†]; the gold price returns model has not an intercept. To ensure the above estimation, we will apply PP test as well.

Table 3. Unit root test (PP) for the gold price returns

	rho statistic	Probability
PP statistic	-51.11	0.000
Critical values	At the level of 1% -18.62	
	At the level of 5% -13.17	
	At the level of 10% -10.62	
Intercept		0.107

The results of this test are consistent with that of Dickey Fuller; durable and lacking intercept. Now, we begin to examine the durability of the stock exchange returns.

Table 4. The unit root test (ADF) for the returns on the stock exchange index

	rho statistic	Probability
ADF statistic	-4.18	0.000
Critical values	At the level of 1% -3.607	
	At the level of 5% -2.941	
	At the level of 10% -2.605	
Intercept		0.030

The results of ADF test of the stock exchange returns show that this series will move to critical area at the level of 1% and consecutively, it is durable. The other point is the significance of intercept in this model. To ensure about the above estimation, we use the PP test as well.

Table 5. Unit root test (PP) for the stock exchange returns

	rho statistic	Probability
PP statistic	-26.46	0.005
Critical values	At the level of 1% -18.62	
	At the level of 5% -13.17	
	At the level of 10% -100	
Intercept		0.030

The results of this test underline the accuracy of the ADF test. After examining the durability, it is the time for modeling the GARCH for both variables and then calculating the risk.

To conduct this study, we were going to use APGARCH model, but when we entered this command in the software, no results were achieved and the software could not calculate it. This test was examined with different a software, which brought no other result. That is because some time series cannot be estimated by APGARCH model due to low volatility over the time (the time series being ascending or descending) and instead, the GARCH model should be applied.

The GARCH (1,1) model are tested for both variables that yields the following results:

Table 6. Estimation of GARCH (1,1) model for the gold price returns

Variable	Coefficient	Standard Error	Z statistic	Probability
ARCH with an interval	0.438	0.208	2.10	0.035
GARCH with an interval	-0.121	0.642	-0.19	0.85
Intercept of GARCH model	74.01	61.35	1.21	0.228

The general model of GARCH (p,q) is as follows: (Bollerslev,1986)

$$\sigma_t^2 = \alpha_0 + \alpha_1 \epsilon_{t-1}^2 + \dots + \alpha_q \epsilon_{t-q}^2 + \beta_1 \sigma_{t-1}^2 + \dots + \beta_p \sigma_{t-p}^2 \quad (12)$$

Considering the table 6, it is written as below:

$$\sigma_t^2 = 74.01 + 0.438 \epsilon_{t-1}^2 + (-0.121) \sigma_{t-1}^2 \quad (13)$$

The estimated amount of the model's variance, which is different for every period, is calculated by the software. On the other hand, we calculate the average value of the time series (variable) that is a fixed number.

Using the VaR model as below, we begin to model and calculate the investment risk level in the gold market.

$$(4) \text{ VaRYt} = (\sigma_t * z) - \text{Mean} \quad (14)$$

Where σ_t is the square root of the variance calculated for the related time series;

Z is the numerical value of the probability for which the confidence level of 99% is considered in this study; consecutively, the z value is equal to 1.96; Mean indicates the average of the related time series. The investment risk level for the gold market is modeled as follows:

$$(5) \text{ VaRregoldt} = (\sigma_t * 1.96) - 2.667689 \quad (15)$$

Now, we shall repeat the above procedures for the stock exchange index. The results of the GARCH model estimation is as follows:

Table 7. Estimation of GARCH (1,1) model for the returns on the stock exchange index

Variable	Coefficient	Standard Error	Z statistic	Probability
ARCH with an interval	-0.12	0.251	-0.48	0.643
GARCH with an interval	0.261	2.232	0.12	0.907
Intercept of GARCH model	26.89	70.12	0.38	0.701
The variable's intercept	3.659	0.782	4.67	0.000

The GARCH model for this time series is as follows:

$$(6) \sigma_t^2 = 3.659 + 26.89 + (-0.12) \varepsilon_{t-1}^2 + 0.261 \quad (16)$$

The variance value is also calculated by the software and is placed in the risk formula.

$$(7) \text{VaR}_{\text{restockt}} = (\sigma_t * 1.96) - 3.7506 \quad (17)$$

The investment risk level is also determined in this variable.

4. Conclusion

In this study, the returns of variables have been used for estimating the models more accurately that shows the volatility level of the variables in a better way. Then, the durability of the series was examined and the GARCH was modeled. We used GARCH (1,1) and the significance of the GARCH model variables was not considered, because the purpose was not to estimate the VaR model. Therefore, we calculated the variance of time series and estimated the VaR after modeling the GARCH. The results showed that the level of volatility and investment risk in the gold market is higher than that in the stocks market; that is because the gold market variance is very higher than that of the stocks market. On the other hand, the share of the stocks product in the optimal portfolio of the investor is greater than that of the gold product.

4.1 Suggestions of the applied research findings

The users of this study can make use of the model applied in this investigation for further examination of and estimation of different financial markets and comparison of the risks in both markets. In fact, the significance of modeling and estimation and the way to work with this model is particular to the students of financial and accounting majors. However, brokers and activists in the field of financial markets can take advantage of the results of this study and the similar ones. This issue will cause to improve the financial markets and will boom the business. Therefore, indeed, this investigation can be used by the students of financial majors and the activists in such markets.

4.1.2 Suggestions for further studies

The interested people as well as the students and activists of the financial markets are suggested to compare the risk of other markets in order to find an appropriate pattern for investment. There are many financial markets for comparing and examining their performance, including the gold price, coin price, commodity exchange, futures exchange, oil market, gas market, energy exchange, currency market, etc. A comparison between these markets can take a great importance in terms of both modelling and the results. Furthermore, it is suggested that such investigations will be carried out by different economic and financial models in order to compare the models and identify the best and most efficient one.

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