EFFECT OF GOLD PRICE VOLATILITY ON STOCK RETURNS: EXAMPLE OF TURKEY

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─Abstract ─

This study analyzes the effect of fluctuations in gold prices on ISE 100 index using daily prices and the index data from 01.01.2009 to 31.12.2012. The raw data has been converted into earnings yields and analyzed. The study first determines whether or not the use of a GARCH model would be appropriate using a heteroskedasticity test. The test results show that there was an ARCH effect in both variables, and that GARCH modeling could be used. The results obtained from MGARCH modeling show that gold and stock exchange yields have been affected both by their own shocks and by shocks of each other.

Key Words: *Gold Prices, Stock Returns, GARCH modeling*
JEL Classification: G1, G2

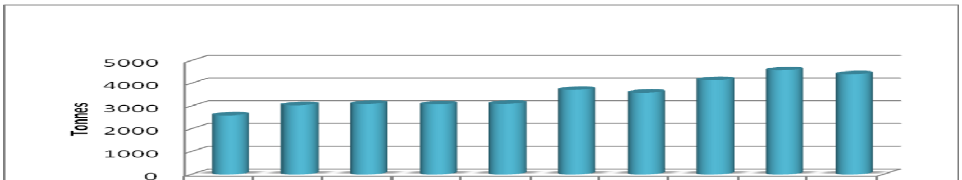
INTRODUCTION

Gold is a precious mineral that is extracted in limited quantities. It is not found easily in nature and therefore has a limited supply. A significant portion of Turkish people have used gold as an investment for centuries. Gold is sometimes seen as an ornament,, sometimes as a helping hand in hard times, sometimes as a symbol of wealth. Its most attractive features are its de facto value all around the world, its ability to yield returns on investments, to protect investors from risks arising from counterparties and its liquidity.[1]

Despite recent stagnation, the demand for gold has increased due to increased risk factors in markets caused by the crises occurring in the world economy, instability in the financial markets, concerns about terrorism and political tensions between countries. The graph below illustrates the change in the world's total gold demand between 2003 and 2012.

As the graph shows world gold demand is on the rise. However, at this point it is necessary to point out that while gold appeals to investors as a safe harbor, investment is not its only area of use. Although the jewelry sector gets the lion's share, gold is in demand, particularly in the electronics sector, dentistry, souvenir coins and medallion printing.

Figure 1: Historical Data for Gold Demand



2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
2594	3044	3098	3077	3104	3720	3593	4147	4582	4405

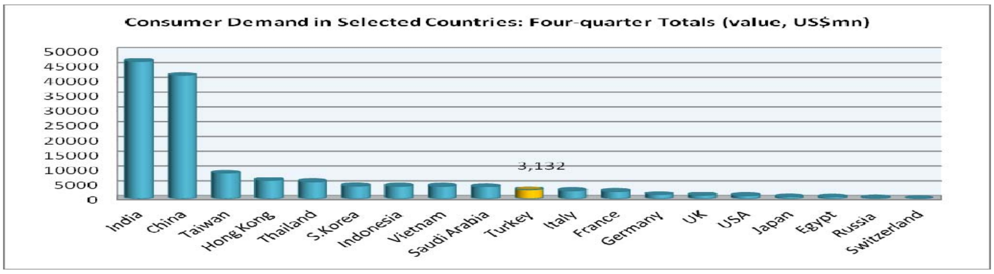
Source: World Gold Council

The next graph displays gold demand in certain countries in 2012.

[1] Korkmaz,T.; Ceylan,A. (2010) "Sermaye Piyasası ve Menkul Değer Analizi",Ekin Yayınevi,Bursa,s:95

The gold trade that was being conducted illegally before 1980 in Turkey gained an official identity upon deregulation in 1980, and its trade volume has steadily increased. This rising demand led to the need a separate market for gold transactions, and the Istanbul Gold Exchange was established in 1995 to serve to buyers and sellers of gold. However, unlike traditional jewelry transactions,

Figure 2: Consumer Demand in Selected Countries: Four-Quarter Totals (value, US$mn)



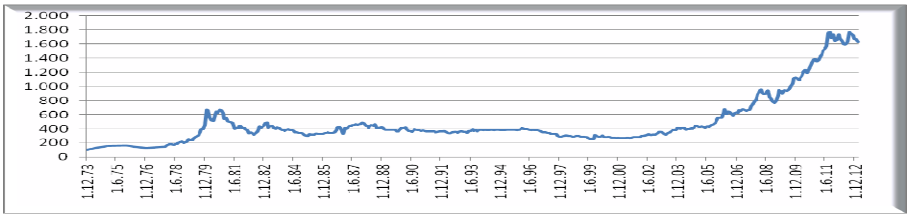
Source: World Gold Council

ornaments and jewelry are not the subject of this exchange. Only standard bullion with the minimal craftsmanship provided by the market's officially recognized refineries is traded.[2] With the establishment of this exchange Turkey's gold sector gained an organized structure, competitive pricing has been facilitated, the illegal gold trade has been prevented, and integrating domestic gold prices with international gold prices has lowered costs in the gold sector. Thanks to this development, international competitive power of the Turkish jewelry sector, which is one of the few sectors in the Turkish economy that is considered a global player, has increased as well. Meanwhile, trading has been subjected to certain standards and legal inspections. From the perspective of investors, the traceability and reliability of transactions have increased and the investor has been protected.[3] With this market, databases of official transactions have been developed, and researchers can obtain a larger range of accurate and accessible information.

The graph below displays the direction of the change in gold prices according to data from the Central Bank of Turkish Republic.

[2] http://www.uzmantv.com/altin-almakla-altin-borsasinda-islem-yapmak-arasinda-ne-fark-var
[3] http://www.iab.gov.tr/docs/iab.pdf

Figure 3: 1Ons Gold London Sales Price (U.S. $/Ounce)



Source:TCMB

Since the demand for which rises in times of economic instability, the price of gold has been rising significantly due to instability. Gold prices, which increased from $59 to $160 during the world wide “Oil Embargo” in 1973, reached its historical peak with the “Second Oil Shock” in 1979, as the graph shows. With the Iranian revolution following this serious increase, crude oil barrel prices jumped to $100,(in current prices) and this led to a further increase in gold prices. Gold that was traded at 614.61$/ounce (850$ in current prices) began to lose value when central banks started to cash in their gold reserves, and this continued until the September 11 attacks. Since 9/11, however, economic recession in the US, terrorist attacks and political tensions have driven investors back to gold.[4]

This study analyzes the relationship between changes in gold prices and ISE returns. There is more than one factor that affect stock and gold prices, which are alternatives to one another from the investor’s point of view, and show price movements are expressed as opposites in the literature. Particularly because gold is not a local investment instrument and it is a worldwide de facto commodity, changes in its price are explained, not by the local factors, but by macro factors. The literature on this subject (Koutsoyiannis (1983), Ghosh et al. (2002), Vural (2003), Tully and Lucey (2007), Topcu (2010), Toraman et al. (2011)) reveals that, because gold prices are in dollars, they are directly affected by all kinds of policy changes, political and economic developments in the United States of America, as well as changes in oil prices. Likewise, there are also many factors that affect stock returns including macroeconomic variables such as: government

[4] Gökdemir L.; S. Ergün(2007) “Altın Fiyatlarındaki İstikrarsızlığın Altın Ticareti Üzerindeki Etkisi: Türkiye Örneği”, E-Journal of Yaşar University, 27-40, No.5, Vol.1

debts, interest and inflation rates, export and import figures, foreign exchange rates, money supply, gold prices, arrangements concerning capital markets, oil prices and growth rates (Fama., (1981), Gong and Mariano (1997) Cheung et al., (1998), Zugul and Sahin 2009; Bali and Cinel, 2011; Yılmaz et al.; (2007), Kaya et al.,(2013).

Previous Studies

Despite the many studies of gold prices couple studies that are considered helpful, we present below a grouping of gold price-index relationships and the factors that affect gold prices to provide subject matter integrity.

Using a probit economic model and 1997-2011 data in their study of the relationship between gold prices and stocks Mulyadi and Anwar (2012) compared stocks and gold investments. They concluded that gold investment was more advantageous than stock investment. However, in a study conducted in India by Bhunia and Das (2012) the causal relation between gold prices and stock exchange returns was analyzed using the Granger Causality test. Their results show that selected variables affect each other, and gold prices move in tandem with stock prices during and after a global financial crisis. Besides, the study also states that Indians started to see gold, not only as jewelry, but also as an important investment instrument. Gwilym et al. (2011) tried to explain the relation between gold prices and gold stock index levels, and whether or not this relation has any explanatory power regarding future gold investment yields. Their model was able to account for the stock prices of gold manufacturing companies.

Another study of gold prices by Bali and Cinel (2011) measures the effect of gold prices on the ISE. By using panel data analysis the study attempts to determine whether gold prices had any effect on the ISE 100 Index, its direction and magnitude and to determine this constant effect models and random effect models were used.The analyses performed make it evident that gold prices do not have a direct effect on ISE 100 Index but it is a factor ranking among the parameters explaining the changes in the ISE 100 Index. However, in a study by Mishra et al. (2010), the relation between gold price volatility and stock market returns was analyzed using the Granger Causality test for the period between January 1991 and December 2009. The study found a causal relationship between gold prices and stock market returns, and it determined that both variables contained important information for forecasting each other. In a 2001 study Graham Smith used data from between January 1991 and October 2001 to analyze the relation between the price of gold and stock prices for the United States. His study found a minor negative relation between the price of gold and stock prices. Another study by Smith (2002) attempted to determine the short and long term relations between gold prices and stock market prices. The study used three different gold prices from the London exchange (at 10:30, at 15:00 and closing time) and 18 different stock market indexes. The study found that in the short term there was a negative relation between gold prices and the stock market, but that there was no significant relation in the long term. Another study by Kaliyamoorthy and Parithi (2012) analyzed the relation between gold prices and stock market for the period from June 2009 to June 2010 using the Chi Square test. The study found no relation between stock prices and gold rates. It claimed that the increase in the stock market index was not caused by an increase in the gold price.

Considering studies of the factors that affect gold prices, Toraman et al. (2011) attempted to determine these factors using the MGARCH model. In their study they used monthly data from between January 1992 and March 2010 and a series of oil prices, the USD exchange rate, the US inflation rate, US real interest rates, which are thought to affect gold prices. Their model shows that the highest correlation between gold prices was with the USD dollar exchange rate, and it was negative. The second highest correlation value with oil prices was positive.

Another study of the variables affecting gold prices by Duyar (2010) analyzed the effect of world gold supply on price formation. The study analyzed the world gold supply, gold prices, gold manufacturing costs and manufacturing–price movements of firms.

Poyraz and Didin's study (2008) analyzed the extent of the effect on gold prices of foreign exchange rates, foreign currency reserves and oil prices using a multi factor model, and found a negative relation between gold prices and oil prices and a positive relation between gold prices and central bank foreign currency reserves. Another study conducted by Aksoy and Topcu (2013) analyzed short term and long term relations between gold prices and stocks, government debt securities, the consumer price index (CPI) and the producer price index (PPI). The analysis found a negative relation between gold returns and stock returns, and a positive relation between gold returns and PPI based inflation. Another study by Omag (2012) analyzed the relation between gold prices in Turkey and selected financial variables for January 2002- December 2011, and attempted to determine how gold prices were affected by these variables. It found that gold prices in terms of national currency were affected positively by the Turkish lira/American dollar exchange rate and the ISE 100 index. Another study by Dirk G. Baur (2009) analyzed daily, weekly, monthly and quarterly gold prices using the GARCH model for the period between 19 November 1979 and 18 November 2009 and found that in times of high uncertainty in the markets or in macroeconomic crisis environments gold prices rose due to gold's capacity to serve as a safe harbor.

Data Set and Methodology

This study uses daily gold prices and ISE return data from January 2009 to December 2012. It is an attempt to analyze the interactions of price fluctuations between these two investment instruments. Some studies of this subject show that the least squares method and the Granger causality method can be utilized to analyze the relations between two investment instruments. However, to determine price volatility and the dynamic relations between the two variables the GARCH (Generalized Autoregressive Conditional Heteroskedasticity) model, a nonlinear method, provides more effective results. Therefore, we will attempt to analyze the effect of volatility in gold prices on ISE 100 index returns by employing the M-GARCH (Multivariate- Generalized Autoregressive Conditional Heteroskedasticity) based on Baba-Engle-Kraft-Krone (BEKK) modeling.

GARCH Models

After the success of the autoregressive conditional heteroscedasticity (ARCH) model and the generalized ARCH (GARCH) model in describing the time-varying variances of economic data in the univariate case, many researchers have extended these models to multivariate dimension. Engle and Kroner (1995) proposed a class of MGARCH model called the BEKK (named after Baba, Engle, Kraft, and Kroner) model. The motivation is to ensure the condition of a positive-definite conditional-variance matrix in the process of optimization. Engle and Kroner provided some theoretical analysis of the BEKK model and related it to the vech-representation form.

Applications of the multivariate GARCH (MGARCH) models to financial data have been numerous. For example, Bollerslev (1990) studied the changing variance structure of the exchange rate regime in the European Monetary System assuming the correlations to be time invariant. Kroner and Claessens (1991) applied the models to calculate the optimal debt portfolio in multiple currencies. Lien and Luo (1994) evaluated the multiperiod hedge ratios of currency futures in a MGARCH framework. Karolyi (1995) examined the international transmission of stock returns and volatility using different versions of MGARCH models. Baillie and Myers (1991) estimated the optimal hedge ratios of commodity futures and argued that these ratios are nonstationary. Gourieroux (1997, Chapter 6) presented a survey of several versions of MGARCH models. See also Bollerslev, Chou and Kroner (1992) and Bera and Higgins (1993) for surveys on the methodology and applications of GARCH and MGARCH models.

Engle and Kroner (1995) propose a parametrization that imposes positive definiteness restrictions. Consider the following model;

$$\mathbf{H}_t = \mathbf{CC}' + \sum_{k=1}^{K}\sum_{i=1}^{q}\mathbf{A}_{ik}\epsilon_{t-i}\epsilon'_{t-i}\mathbf{A}'_{ik} + \sum_{k=1}^{K}\sum_{i=1}^{p}\mathbf{B}_{ik}\mathbf{H}_{t-i}\mathbf{B}'_{ik} \qquad (1)$$

where C, Aik and Bik are (N × N).

• The intercept matrix is decomposed into CC′, where C is a lower triangular matrix.

• Without any further assumption CC′ is positive semi definite.

• This representation is general, it includes all positive definite diagonal representations and nearly all positive definite vech representations.

For exposition simplicity we will assume that K = 1:

$$\mathrm{H}_t = \mathrm{CC}' + \sum_{i=1}^{q}\mathrm{A}_i\epsilon_{t-i}\epsilon'_{t-i}\mathrm{A}'_i + \sum_{i=1}^{p}\mathrm{B}_i\mathrm{H}_{t-i}\mathrm{B}'_i$$

Consider the simple GARCH(1,1) model:

$$\mathbf{H}_t = \mathbf{CC}' + \mathbf{A}_1\epsilon_{t-1}\epsilon'_{t-1}\mathbf{A}'_1 + \mathbf{B}_1\mathbf{H}_{t-1}\mathbf{B}'_1 \qquad (2)$$

Proposition 1. (Engle and Kroner (1995)) Suppose that the diagonal elements in C are restricted to be positive and that a_{11} and b_{11} are also restricted to be positive. Then if K = 1 there exists no other C, A_1, B_1 in the model (2) that will give an equivalent representation.

MGARCH(1,1)-BEKK, $N = 2$:

$$\mathbf{H}_t = \mathbf{CC}' + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} \varepsilon_{1t-1}^2 & \varepsilon_{1t-1}\varepsilon_{2t-1} \\ \varepsilon_{2t-1}\varepsilon_{1t-1} & \varepsilon_{2t-1}^2 \end{bmatrix} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}' + \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix} \begin{bmatrix} h_{11t-1} & h_{12t-1} \\ h_{21t-1} & h_{22t-1} \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{bmatrix}'$$

Proposition 2. (Engle and Kroner (1995)) (Sufficient condition). If H_0, H_{-1}, . . . ,$H_{-p}+1$ are all positive definite, then the BEKK parametrization (with K = 1) yields a positive definite H_t for all possible values of ε_t if C is a full rank matrix or if any B_i i = 1, . . . , p is a full rank matrix.

Consider MGARCH(1,1)-BEKK, N = 2 with

$A_1 = \text{diag}(a_{11}, a_{22})$ $B_1 = \text{diag}(b_{11}, b_{22})$ the model reduces to:

$$\mathbf{H}_t = \mathbf{CC}' + \begin{bmatrix} a_{11} & 0 \\ 0 & a_{22} \end{bmatrix} \begin{bmatrix} \varepsilon_{1t-1}^2 & \varepsilon_{1t-1}\varepsilon_{2t-1} \\ \varepsilon_{2t-1}\varepsilon_{1t-1} & \varepsilon_{2t-1}^2 \end{bmatrix} \begin{bmatrix} a_{11} & 0 \\ 0 & a_{22} \end{bmatrix}' + \begin{bmatrix} b_{11} & 0 \\ 0 & b_{22} \end{bmatrix} \begin{bmatrix} h_{11t-1} & h_{12t-1} \\ h_{21t-1} & h_{22t-1} \end{bmatrix} \begin{bmatrix} b_{11} & 0 \\ 0 & b_{22} \end{bmatrix}'$$

$$h_{11,t} = c_{11}^2 + a_{11}^2\epsilon_{1t-1}^2 + b_{11}^2 h_{11t-1}$$
$$h_{12,t} = c_{21}c_{11} + a_{11}a_{22}\epsilon_{1t-1}\epsilon_{2t-1} + b_{11}b_{22}h_{12t-1}$$
$$h_{22,t} = c_{21}c_{11} + c_{22}^2 + a_{22}^2\epsilon_{1t-1}^2 + b_{22}^2 h_{11t-1}$$

Application of MGARCH Model to the Gold price and ISE 100 Index Volatility

We can show MGARCH(1,1)-BEKK, N = 2 parametrization used in the study as follows;

$$\begin{bmatrix} h_{11t} & h_{21t} \\ h_{21t} & h_{22t} \end{bmatrix} = \begin{bmatrix} a_{11}^* & 0 \\ a_{21}^* & a_{22}^* \end{bmatrix} \begin{bmatrix} a_{11}^* & a_{21}^* \\ 0 & a_{22}^* \end{bmatrix}$$
$$+ \begin{bmatrix} b_{11}^* & 0 \\ 0 & b_{22}^* \end{bmatrix} \begin{bmatrix} h_{11,t-1} & h_{21,t-1} \\ h_{21,t-1} & h_{22,t-1} \end{bmatrix} \begin{bmatrix} b_{11}^* & 0 \\ 0 & b_{22}^* \end{bmatrix}$$
$$+ \begin{bmatrix} c_{11}^* & 0 \\ 0 & c_{22}^* \end{bmatrix} \begin{bmatrix} \varepsilon_{1,t-1}^2 & \varepsilon_{1,t-1}\varepsilon_{2,t-1} \\ \varepsilon_{2,t-1}\varepsilon_{1,t-1} & \varepsilon_{2,t-1}^2 \end{bmatrix} \begin{bmatrix} c_{11}^* & 0 \\ 0 & c_{22}^* \end{bmatrix}$$

So the diagonal MGARCH model is:

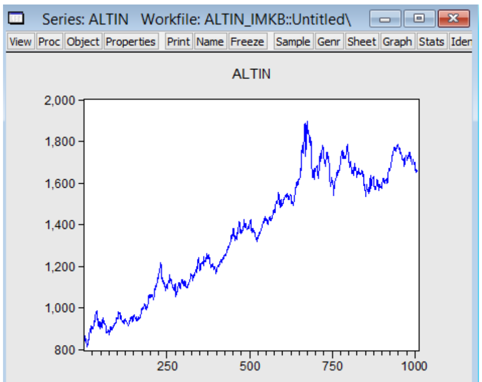
$$h_{11t} = a_{11}^{*2} + b_{11}^{*2} h_{11,t-1} + c_{11}^{*2} \varepsilon_{1,t-1}^2$$

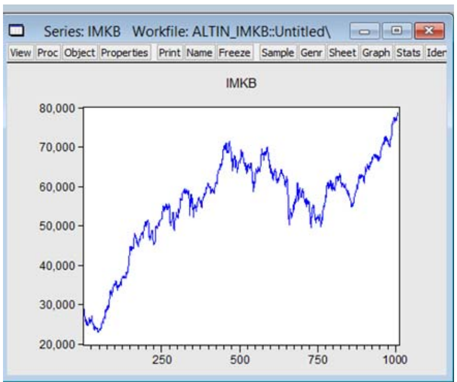
$$h_{21t} = a_{11}^* a_{21}^* + b_{11}^* b_{22}^* h_{21,t-1} + c_{11}^* c_{22}^* \varepsilon_{1,t-1} \varepsilon_{2,t-1}$$

$$h_{22t} = (a_{21}^{*2} + a_{22}^{*2}) + b_{22}^{*2} h_{22,t-1} + c_{22}^{*2} \varepsilon_{2,t-1}^2$$

h_{11t} is gold price variance model, h_{21t} is ISE 100 variance and h_{22t} is covariance model.

When we look at the graphics, we can see gold price and ISE 100 series are not stationary.





Gold Price Data ISE 100 Indeks Data

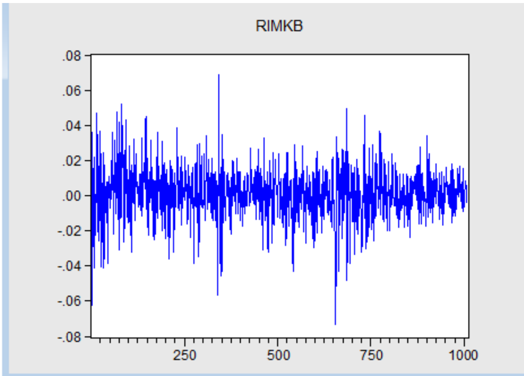
We can show some descriptive statistics about series as follows;

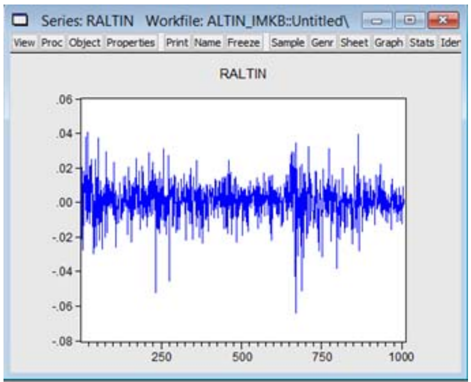
Group: UNTITLED Workfile: ALTIN_IMKB::Untitled\

	RIMKB	RALTIN
Mean	0.001056	0.000650
Median	0.001598	0.001156
Maximum	0.068952	0.040875
Minimum	-0.073401	-0.063901
Std. Dev.	0.015327	0.010748
Skewness	-0.264689	-0.468263
Kurtosis	4.887541	6.244584
Jarque-Bera	161.2482	478.5099
Probability	0.000000	0.000000
Sum	1.063332	0.654164
Sum Sq. Dev.	0.236330	0.116205
Observations	1007	1007

Desciptive Statistics of ISE100 and Gold Return

In the study prices are converted to return series. Graphics of return series are as follows;





ISE 100 Returns

Gold Return

Compliance of GARCH modeling is tested by investigating of presence of ARCH effects in residuals of the series. We used Heteroskedasticity test to investigate ARCH effects in residuals.

Heteroskedasticity Test: ARCH ISE 100 Return Series

F-statistic	34.09982	Prob. F(1,1004)	0.0000
Obs*R-squared	33.04539	Prob. Chi-Square(1)	0.0000

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 04/10/13 Time: 17:55

Sample (adjusted): 2 1007

Included observations: 1006 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.000191	1.61E-05	11.89489	0.0000
RESID^2(-1)	0.180862	0.030972	5.839505	0.0000

R-squared	0.032848	Mean dependent var	0.000234
Adjusted R-squared	0.031885	S.D. dependent var	0.000462
S.E. of regression	0.000455	Akaike info criterion	-12.55166
Sum squared resid	0.000208	Schwarz criterion	-12.54189
Log likelihood	6315.486	Hannan-Quinn criter.	-12.54795
F-statistic	34.09982	Durbin-Watson stat	2.057815
Prob(F-statistic)	0.000000		

Heteroskedasticity Test: ARCH Gold Return Series

F-statistic	22.11416	Prob. F(1,1004)	0.0000
Obs*R-squared	21.68067	Prob. Chi-Square(1)	0.0000

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 04/10/13 Time: 17:59

Sample (adjusted): 2 1007

Included observations: 1006 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.85E-05	9.01E-06	10.93569	0.0000
RESID^2(-1)	0.146813	0.031220	4.702569	0.0000

R-squared	0.021551	Mean dependent var	0.000115
Adjusted R-squared	0.020577	S.D. dependent var	0.000265
S.E. of regression	0.000262	Akaike info criterion	-13.65605
Sum squared resid	6.88E-05	Schwarz criterion	-13.64628
Log likelihood	6870.994	Hannan-Quinn criter.	-13.65234
F-statistic	22.11416	Durbin-Watson stat	1.997417

Prob(F-statistic)	0.000003

As seen in Heteroskedasticity Test results, ISE 100 return and Gold return series reflect ARCH effects. So we concluded that GARCH model is suitable for our study.

Result of the MGARCH model is presented as follows.

Estimation Command:

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ARCH(DERIV=AA) @DIAGBEKK C(INDEF) ARCH(1,DIAG) GARCH(1,DIAG)

Estimated Equations:

=====================

RALTIN = C(1)

RIMKB = C(2)

Substituted Coefficients:

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RALTIN = 0.000624907626417

RIMKB = 0.00143136704808

Variance-Covariance Representation:

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GARCH = M + A1*RESID(-1)*RESID(-1)'*A1 + B1*GARCH(-1)*B1

Variance and Covariance Equations:

=====================

GARCH1 = M(1,1) + A1(1,1)^2*RESID1(-1)^2 + B1(1,1)^2*GARCH1(-1)

GARCH2 = M(2,2) + A1(2,2)^2*RESID2(-1)^2 + B1(2,2)^2*GARCH2(-1)

COV1_2 = M(1,2) + A1(1,1)*A1(2,2)*RESID1(-1)*RESID2(-1) + B1(1,1)*B1(2,2)*COV1_2(-1)

Substituted Coefficients:

=====================

GARCH1 = 2.02528042073e-06+0.0347599201076*RESID1(-1)^2+0.945655264683*GARCH1(-1)

GARCH2 = 8.82955222273e-06+0.0860227858744*RESID2(-1)^2+0.874653103174*GARCH2(-1)

COV1_2 = 7.01947597745e-07 + 0.0546822198198*RESID1(-1)*RESID2(-1) + 0.909461550473*COV1_2(-1)

System: UNTITLED

Estimation Method: ARCH Maximum Likelihood (Marquardt)

Covariance specification: BEKK

Date: 04/10/13 Time: 18:42

Sample: 1 1007

Included observations: 1007

Total system (balanced) observations 2014

Presample covariance: backcast (parameter =0.7)

Convergence achieved after 11 iterations

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.000625	0.000303	2.062004	0.0392
C(2)	0.001431	0.000446	3.212094	0.0013
Variance Equation Coefficients				
C(3)	2.03E-06	7.08E-07	2.860545	0.0042
C(4)	7.02E-07	4.00E-07	1.755694	0.0791
C(5)	8.83E-06	2.52E-06	3.500068	0.0005
C(6)	0.186440	0.014555	12.80964	0.0000
C(7)	0.293296	0.020677	14.18494	0.0000
C(8)	0.972448	0.004709	206.5023	0.0000
C(9)	0.935229	0.009230	101.3271	0.0000

Log likelihood	6028.963	Schwarz criterion	-11.91231
Avg. log likelihood	2.993527	Hannan-Quinn criter.	-11.93954
Akaike info criterion	-11.95623		

Equation: R GOLD = C(1)

R-squared	-0.000005	Mean dependent var	0.000650
Adjusted R-squared	-0.000005	S.D. dependent var	0.010748
S.E. of regression	0.010748	Sum squared resid	0.116206
Durbin-Watson stat	1.935602		

Equation: R ISE = C(2)

R-squared	-0.000601	Mean dependent var	0.001056
Adjusted R-squared	-0.000601	S.D. dependent var	0.015327
S.E. of regression	0.015332	Sum squared resid	0.236472
Durbin-Watson stat	1.963983		

Covariance specification: BEKK

GARCH = M + A1*RESID(-1)*RESID(-1)'*A1 + B1*GARCH(-1)*B1

M is an indefinite matrix

A1 is diagonal matrix

B1 is diagonal matrix

Tranformed Variance Coefficients

	Coefficient	Std. Error	z-Statistic	Prob.

M(1,1)	2.03E-06	7.08E-07	2.860545	0.0042
M(1,2)	7.02E-07	4.00E-07	1.755694	0.0791
M(2,2)	8.83E-06	2.52E-06	3.500068	0.0005
A1(1,1)	0.186440	0.014555	12.80964	0.0000
A1(2,2)	0.293296	0.020677	14.18494	0.0000
B1(1,1)	0.972448	0.004709	206.5023	0.0000
B1(2,2)	0.935229	0.009230	101.3271	0.0000

The results obtained from MGARCH modeling show that gold and stock exchange yields have been affected both by their own shocks and by shocks of each other.

Results

As you know, gold and equity investment are the most preferred types of investing tools. Researches have shown that these investment tools, compared to other investment tools provide a greater return.

There is more than one factor that affect stock and gold prices, which are alternatives to one another from the investor's point of view. Particularly because gold is not a local investment instrument and it is a worldwide de facto commodity, changes in its price are explained, not by the local factors, but by macro factors. Likewise, there are also many factors that affect stock returns including macroeconomic variables such as: government debts, interest and inflation rates, export and import figures, foreign exchange rates, money supply, gold prices, arrangements concerning capital markets, oil prices and growth rates.

This study analyzes the relationship between changes in gold and ISE returns. It is an attempt to analyze the interactions of price fluctuations between these two investment instruments. To determine price volatility and the dynamic relations between the two variables the GARCH (Generalized Autoregressive Conditional Heteroskedasticity) model provides more effective results. Therefore, we will attempt to analyze the effect of volatility in gold returns on ISE 100 index returns by employing the M-GARCH (Multivariate- Generalized Autoregressive Conditional Heteroskedasticity) based on Baba-Engle-Kraft-Krone (BEKK) modeling.

The first step of the analysis is to investigating an ARCH effect in the in residuals of the series. For realizing this aim we employed Heteroskedasticity test. The test results show that there is an ARCH effect in residuals. So we concluded that using GARCH models in our study is appropriate.

According to the results of the MGARCH models, gold and stock exchange yields have been affected both by their own shocks and by shocks of each other. For this reason, investors when investing in these instruments it is important that knowing prices and therefore returns of them are affected by each other.

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