Chapter 2

A RESEARCH ON LONG MEMORY OF VOLATILITY AND RETURN IN THE GOLD MARKET IN TURKEY

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1. INTRODUCTION

Gold, which has a different place among precious metals, has maintained its importance not only as a jewel but also as a means of exchange, as a safe investment instrument. Especially due to the political turmoil, economic crises and uncertainties in financial markets, it has been a financial instrument for investors who prefer safe investment. Despite its low return, it protects investors against currency fluctuations. In cases where the reserve money gains value, the price of gold in US dollars decreases. Where the dollar depreciates against other currencies, the price of gold in US dollars is generally increasing. Since the factors causing fluctuation in gold prices are very different from traditional investment instruments, their prices do not move in the same way as other investment instruments. For this reason, the addition of stocks and bonds to the portfolio of investment instruments reduces the volatility of the portfolio. In addition, investors are directed to gold for the purpose of undermining the effects of inflation. Even in times of financial instability, economies of the countries remain stable when measured in terms of goods and services that the value of gold can buy. The inability to directly control the value of gold is one of the factors that make it a reliable investment instrument that cannot be determined by any central bank or state (Sarı, 2014; Cihangir & Uğurlu, 2017).

Gold was the basis of the monetary system in the 1870-1930 period, while in the 1944-1973 Bretton-Woods System it became a reserved instrument with a full convertibility. Since the beginning of the 1970s, when the convertibility of the dollar based on gold was terminated, it continued to be used as a part of the central banks' reserves and as a means of individual savings. In the 1980s and 1990s, it became a preferred investment instrument for investors again due to the

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diminishing preferability of financial markets as an investment instrument and the impact of uncertainty in financial markets in the 2000s. Gold has maintained its reliability with its reversal of return on other investment instruments and easy cash conversion (Yurdakul & Sefa, 2015).

Especially during the global economic crisis, gold prices reached high levels. As an investment instrument, it is a strategic financial instrument for financial funds, an input for the industry, and its ability to be ornaments for individuals thus is effective on decisions and strategies of each unit (Cihangir & Uğurlu, 2017). In the literature, many studies have been carried out on gold prices. Some of these studies are summarized below:

Cihangir and Uğurlu (2017) estimated volatility in price and asymmetric volatility using and appliying GARCH, APARCH, TARCH and EGARCH models for 2010-2016 period og İstanbul Gold Market in Turkey using the daily data. The findings showed that the APARCH model was more suitable for the prices and the leverage effect was negative; the volatility of the prices were effected by positive shocks compared to negative shocks.

According to Şencan's (2017) demonstrative study, daily BIST gold index closing prices were used and it was shown that the best modelling method for index return volatility is GARCH (1,1) model.

Natchimuthu et al. (2017), using the PGARCH model in their study, showed the existence of leverage effect on gold price volatility for six major Indian cities.

Senaviratna and Cooray (2017) used ARMA models for daily gold prices in Sri Lanka between 02.01.2007-06.01.2017 and examined the relation between inflation rate, exchange rate and money supply based on VAR models. Causality in terms of Granger was not found between the variables. In addition, EGARCH, PGARCH, C-ARCH, GJR-GARCH models were used to estimate the volatility. The results showed that the AR (1) -PGARCH (2,1) model is a suitable model for daily gold prices in Sri-Lanka.

Najaf *et al.* (2016) showed that Karachi Gold and Petroleum Exchange were more attractive for investors in the period 1996-2013 for Pakistan.

Nair *et al*. (2015) used the Cointegration Test and the Granger Causality test to understand how the relations between the US dollar and gold prices were affected in 2008 in India to understand the effects of the world economic crisis.

Karabacak, Meçik and Genç (2014) showed that GARCH (1.1) was the best model of volatility for the volatility of gold returns and volatility of the stock exchange.

Gencer and Musoğlu (2014) modeled the Istanbul Gold Exchange volatility dynamics using different GARCH models. Using the daily gold spot prices for the period of 2006-2013, they showed that the predictive results were significant for the EGARCH and CGARCH models.

Lee *et al*. (2012) used the Threshold Error Correction Model to examine asymmetric cointegration and causality relationships between crude oil and gold prices in Western Texas. The findings show the existence of asymmetric long-term relationship between two variables.

Toraman *et al*. (2011) tried to determine the factors affecting the gold prices in the USA. Using the monthly data for the period 1992-2010, they examined the relationship between exchange rate, inflation rate and interest rates with the CCC-MGARCH model. The findings showed a negative significant relationship between gold and exchange rate.

Muradoğlu, Akkaya and Chafra (2006) in their study offered a weak form of evidence of the effectiveness of the gold market for Turkey. For the period of 1992-1996, they examined the market efficiency by unit root and autocorrelation tests using 24-carat gold prices daily.

The studies in the literature generally examine the relationship between the factors affecting gold prices or the different macroeconomic variables. In this study, Monthly Weighted Average Gold Price (US $ / ons) of Istanbul Gold Exchange Market for 2005-2018 period in Turkey are used. The volatility in gold prices has been estimated by GARCH type models, the long memory characteristics on the return and the volatility of gold prices have been investigated with ARFIMA-FIGARCH type models.

2. Gold Market in Turkey

One of the methods of determining the richness of countries in terms of mineral resources is to evaluate the share of a country's mineral resources in terms of the share of reserves in the world's mineral resources. If the share of a country within the world's mineral reserves is higher than the world land area or one of the world population ratios, the country is considered rich. According to this, for our country which constitute 0.5% of the world land area and 1.0% of the world population, mines having more than 0.5% share in world reserves are accepted as precious metals. The gold reserve for our country has a share of approximately 2.0% in the world reserves. In this sense, Turkey is seen as a country rich in gold mines. Between the years of 2001-2015, total production amounted to 228.8 tons. However, as gold production could not meet Turkey's consumption, the gold imports fort he last 20 years amounted up to an average of 156 tons / year, thus our country is one of the world's major gold importers (MTA Report, 2016).

In times of economic instability, the price of gold, which is more preferred, increases significantly in such periods. Gold prices reached high levels after the oil crises. This rise, which has continued for a while, has left its place to decline, and since 1995, it has been rapidly declining. This is because the central banks have sought ways to sell tons of gold in their warehouses. Central banks received at least 4 to 5% interest in foreign currency in their portfolios, while the interest rate of gold rose by 1-2%. For this reason, in the 1990s, central banks started to sell gold. In the market, the abundance of gold ultimately reduces gold prices. However, after 2002, prices started to rise again (Gökdemir & Ergün, 2007). The period between 1944-1973 is called the Bretton Woods System during which dollar was bound to gold and the other currencies were bound to dollar that aims to protect the fixed exchange rate against short-term fluctuations. According to this system, named after the town of Bretton Woods in Hampshire, USA in 1944; The Golden Exchange System, a currency system in which the currency of the country can be changed freely with the currency of another country connected to the gold standard through a fixed exchange rate, has been implemented.

The US dollar is considered as the only national currency capable of issuing gold bonds. According to the agreement signed with the participation of the group (Belgium, Canada, France, Germany, Italy, Japan, the Netherlands, Sweden, the UK and the USA) on 31.08.1975, the gold was excluded from the reserve obligation in the monetary system and the official gold price was removed, economic validity has been eliminated and it is based on the transition to a floating exchange rate system between the currencies of different countries (Öz & Fidan, 2013; Özkan & Kolay, 2016; Gökdemir & Ergün, 2007).

In Turkey, not only as a physical instrument but also as an investment instrument gold has made significant progress. Structural changes within the scope of the decisions taken in the transition to a free market economy policy, had important consequences in terms of the development of the gold industry in Turkey. In 1983 and 1984, gold imports were released on the condition that they complied with the rules, and with the same decision, the Central Bank was authorized to determine the value of gold and exchange rates in exchange for the Turkish lira. In 1984, the gold market in denomination of Turkish lira was established under the CBRT and in 1989, gold market was opened for foreign exchange. According to decision no. 32 for protection of the value of Turkish currency law capital movements and according to the amendments made in 1993, the price of gold was determined freely in line with the world prices, and its imports and exports were released and gold banking was put on the legal ground on 21.03.1993 (Özkan & Kolay, 2016; Gökdemir & Ergün, 2007). According to the Regulation on Establishment and Working Principles of Precious Metals Stock Exchanges, the rules and principles of İstanbul Stock Exchange have been determined by the Istanbul Gold Exchange Regulation published in the Official Gazette dated 13.02.1994 and numbered 21848. Istanbul Gold Exchange was officially launched on 26.07.1995. Thus, gold was allowed to be traded in a market (Öz & Fidan, 2013). As of today, the final situation asserts that the gold transactions were replaced by Precious Metals and Precious Stones Market Department established under Borsa İstanbul A.Ş. instead of İstanbul Gold Exchange market.

3. ANALYSIS AND EMPIRICAL EVIDENCE

3.1. Methodology

The uncertainty characteristics of financial markets are related to the short and long term price conditions of these markets. This feature is undesirable for investors, but it is inevitable when financial markets are selected as an investment instrument. Financial market forecast is one of the instruments and methods used to reduce the uncertainty in question. Classical models like Ordinary Least Squares are not suitable models for conditionally varying variances in the financial time series. For this purpose, it was introduced by ARCH (Autoregressive Conditional Variable Models - Autoregressive Conditional Heteroscedasticity) model by Engle (1982), in which the error variance of the period of interest is defined as a function of the term error terms. Bollerslev (1986) proposed GARCH (Generalized ARCH-Generalized Autoregressive Conditional Heteroscedasticity) models, a generalized form of ARCH models. GARCH models are symmetric models where conditional variance depends on the conditional variances of previous periods and squared error terms. These models are widely used in the financial literature because they have the ability to capture volatility clusters. Let P_t show the price index series of a financial time series and Rt get a price return or price change in terms of percentage. It is obtained by $R_t=\log(P_t/P_{t-1})*100$. The GARCH model for R_t return series can be expressed as follows:

$$R_t = \mu + \varepsilon_t \sigma_t \quad (1)$$

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i \varepsilon_{t-i}^2 + \sum_{i=1}^{p} \beta_i \sigma_{t-i}^2 \quad (2)$$

Here; $p \geq 0$, $q > 0$, $\alpha_0 > 0$, $\alpha_i \geq 0$, i=1,2,…,q ve $\beta_i \geq 0$, i=1,2,…p. Parameter conditions are valid for conditional variance. To be sure of the variance's finite and expected value

$\sum_{i=1}^{p} \alpha_i + \sum_{i=1}^{q} \beta_i < 1$ is assumed.

Exponential GARCH -EGARCH model proposed by Nelson (1991) is a model that takes into account the distortions encountered in financial time series. Model is expressed as

$$ln\sigma_t^2 = \alpha_0 + \delta_1 \left|\frac{\varepsilon_{t-1}}{\sigma_{t-i}}\right| + \gamma_1 \left(\frac{\varepsilon_{t-1}}{\sigma_{t-i}}\right) + \beta_1 \ln(\sigma_{t-i}^2) \quad (3)$$

It also takes into account the asymmetry in the volumetric structure by the size and sign of the delayed error terms. The logarithm of conditional variance is used in EGARCH model. Thus, it is ensured that the conditional variance is not negative and also the restrictions in the GARCH model are not required. coefficient in the model enables examination of asymetrical effects. If , then there is aymetrical effect available. Different GARCH models such as APARCH, TARCH, GJR-GARCH have been developed to model conditional variance. In addition, Granger and Joyeux (1980), Hosking (1981) have developed ARFIMA (Autoregressive Fractional Integrated Moving Avarage-Autoregressive Fractional Integrated Moving Average) model to test the long memory of the yields/returns. The model in question is evaluating the series' conditional average's fractional integration process I().ARFIMA (p, ξ, d) model suggested by Granger and Joyeux (1980) and Hosking (1981) is expressed as below:

$$\psi(L)(1-L)^{\xi}(y_t - \mu) = \theta(L)\varepsilon_t, \quad (4)$$

$$\varepsilon_t = z_t\sigma_t, \quad z_t \sim N(0,1), \quad (5)$$

$$(1-L)^{\xi} = \sum_{k=0}^{\infty} \frac{\Gamma(k-\xi)L^k}{\Gamma(-\xi)\Gamma(k+1)}, \quad (6)$$

Γ ( ) here is a gama function. $(1\text{-L})^{\xi}$ can be written as an indicative section binomial expansion finite MA process as below:

$$(1-L)^{\xi} = 1 - \xi L + \frac{\xi(\xi-1)}{2!}L^2 - \frac{\xi(\xi-1)(\xi-2)}{3!}L^3 + \ldots \quad (7)$$

Here ε_t σ^2 are varied i.i.d. (independent and identically distributed). L denotes for deferment operator. (1-*L*) ξ is fractional difference operator. ξ shows fractional integration degree and it is not an integer. ξ's integer value expresses the traditional ARMA model. If

$0 < \xi < 0.5$, the process exhibits positive dependency in between far distanced observations (anti-persistence),

if $-0.5 < \xi < 0$, the process exhibits negative dependency in between far distanced observations (anti-persistence).

When $\xi = 0$, the process is stable and when $\xi = 1$, the process can be said to follow a unit root process.

$$\psi(L) = 1 - \psi_1 L - \psi_2 L^2 - \cdots \psi_p L^p \ , \tag{8}$$

and

$$\theta(L) = 1 + \theta_1 L - \theta_2 L^2 - \cdots \theta_q L^q \ , \tag{9}$$

are autoregressive AR and moving average MA polynomials (Granger & Joyeux, 1980; Hosking, 1981).

While the autocorrelation function of the standard ARMA processes decreases exponentially, in contrast to these processes Hosking (1981) showed that the autocorrelation function for fractionally integrated processes is gradually decreased hyperbolically. In other words, the approximation of the autocorrelation function to zero is slower than in the ARIMA processes. The idea that the impact of shocks on volatility is not constant but infinite is claimed by Baillie *et al.* (1996), Granger (1980) and Hosking (1981) for the first time on the average of the idea of fractional integration has led to the application of volatility. IGARCH (Integrated GARCH models) assume that the volatility has infinite memory, ie the volatility shocks never disappear, continue in the long run (Türkyılmaz, 2002). IGARCH models cannot be used to model long memory in the process of volatility.

Baillie (1996) and Baillie, *et al.* (1996) proposed the Fractional Integrated Generalized Autoregressive Conditional Variable Variance Model (FIGARCH) for this purpose. Fractional Integrated Generalized Autoregressive Conditional Variable Variance Model FIGARCH (p,d,q) model is denoted as;

$$\phi(L)(1-L)^d \varepsilon_t^2 = \alpha_0 + [1-\beta(L)]v_t \ , \tag{10}$$

Fractional difference operator is defined as

$$(1-L)^d = \frac{(n-d-1)!}{n!(-d-1)!} L^n \ , \ n=1,2,\ldots\ldots\infty \ . \tag{11}$$

Such an approach is more flexible than the GARCH model, which makes it possible to explain the observed temporary dependencies of financial market volatility (Davidson, 2004). ε_t^2 is defined as GARCH process's squared errors. For the stability of the process $\phi(L)$ ve $[1-\beta(L)]$'s all roots are assumed to be out of the unit circle. If d=0, FIGARCH (p,d,q) process is degraded to a GARCH (p,q) process. If d=1, FIGARCH process is an integrated GARCH (IGARCH) process. Shocks in this process have an endless impact on future volatility. As mentioned above an ARFIMA structure is imposed on FIGARCH(p,d,q) model ε_t^2. Baillie et al. (1996) showed that the effect of a shock on the conditional variance of FIGARCH (p, d, q) processes was decreasing at hyperbolic rate when 0 <d <1 in their studies.

3.2. Data

Monthly Istanbul Gold Stock Exchange Weighted Average Gold Prices covering the period of 08.2005-02.2018 are used in the study2. Weighted average prices are preferred as a data set because of the better market movements. Figure 1 shows the weighted average gold prices for the period in question.

Figure 1: Weighted Average Gold Prices

In Figure 1; we can say that there has been a general increase in the graph until August 2011 except for the declines between 2008-2009. During the global economic crisis period of 2008 - 2012; the lowest gold price was seen in October 2008. The previous low level was realized in August 2007. The most important point to be aware of here is the 2008 economic crisis, triggered by the mortgage crisis in the US in 2007. The global crisis, which began in August 2007 with the mortgage problem in the US, was felt in 2008 as the most severe. In unsafe environments such as the economic crisis, gold comes to the fore due to its reliability. Gold, which has no interest income, has been the instrument with which investors earn money when the crisis is at its highest. After the global crisis of 2008, gold prices continued to see great leaps. Gold prices, which entered the downward trend after 2011, saw the historical peak of gold in August 2011. In June 2013, gold began to show sharp declines. At this stage, where investors were almost shocked, there were uninterrupted declines in prices. At the same time, while the waves of the Arab Spring continued, political and military crises continued in the Middle East. This situation led to an increase in gold prices. The Arab Spring, which began in 2010, is a popular movement in the Arab world. This movement, whose effects are still continuing, is thought to balance the gold prices that the Federal Reserve (FED) has lowered. Gold prices in 2017 showed an upward trend (Bayhan, 2018).

[2] It is the weighted average price of one ounce of gold in the Istanbul Gold Exchange, which is the Istanbul Stock Exchange's Precious Metals and Precious Stones market.

In the study, the gold prices, which are important in determining the characteristics of the gold prices series, were obtained by taking the first logarithmic differences with $Rt = \ln (Gold_t / Gold_{t-1})$. Figure 2 shows a graph of the Gold Price Return Series (Rt).

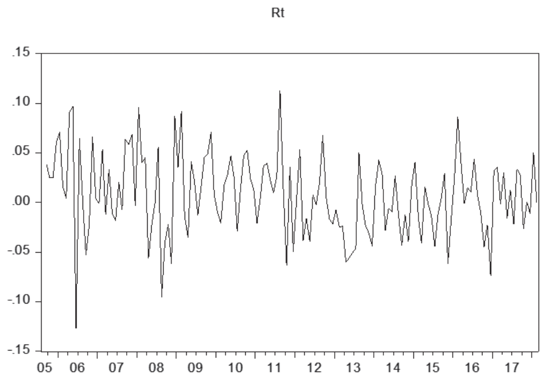

Figure 2: Weighted Average Gold Prices Return Series

When Figure 2 is examined, it is possible to see the volatility clusters in prices.

3.3. Empirical Findings

The first step in modeling the return and volatility of gold prices is the analysis of the stability of the series of returns. For this purpose, ADF (Augmented Dickey Fuller), PP (Phillips Perron) and KPSS (Kwiatkowski Phillips Schmidt and Shin) tests were used and the test results are summarized in Table 1.

Table 1: Unit Root Tests Results For Gold Prices

VARIABLE	UNIT ROOT TESTS		
	ADF	PP	KPSS
Gold	-1.988914 (-2.880853) [0.2915]	-2.058223 (-2.880722) [0.2620]	0.822673 (0.463000)
R_t	-10.65084* (-2.880853) [0.0000]	-10.63823* (-2.880853) [0.0000]	0.398579* (0.463000)

In the table, the value in (.) shows the test's critical value, the value in [.] shows p-probability value. For ADF and PP tests H0: Series Is Not Stable, for KPSS test H0: Series Is Stable. * shows that the test statistics is significantly meaningful based on 5% of meaning level.

When the unit root results in Table 1 are examined, it is seen that Gold series (Gold prices) is not static and Rt return series is average stationary. The estimated model results for the mean and conditional variance of the stationary Rt series are given in Table2-4, respectively.

Table 2: ARMA (1,1) – GARCH (1,1) Model Estimation Results For Rt Return Series			
p=1, q=1	**ARMA(1,1)-GARCH(1,1)**		
ω_0	1.053300** (0.10254) [0.0000]	**Q(5)**	4.18876 [0.2417898]
α_0	-0.903256** (0.0045135) [0.0000]	**Q(10)**	8.78773 [0.3605181]
α_1	1.041522** (0.0009693) [0.0000]	**Q(20)**	18.3065 [0.4356381]
ω	2.809978 (2.0259) [0.1676]	**Q(50)**	42.0188 [0.7153194]
β_0	0.062379 (0.055793) [0.2654]	**$Q^2(5)$**	5.35493 [0.1475776]
β_1	0.743309** (0.12777) [0.0000]	**$Q^2(10)$**	6.71599 [0.5675622]
Log(L)	-413.548	**$Q^2(20)$**	12.6692 [0.8108369]
AIC	5.593970	**$Q^2(50)$**	48.5116 [0.4522085]
SIC	5.714396	**ARCH(5)**	0.84434 [0.5205]
Skewness	0.19821	**ARCH(10)**	0.38879 [0.9496]
Extreme Kurtosis	4.27290	**J-B**	1.4477 [0.4840]

** 5% shows statistical significance in terms of meaning level, ( ) shows standard errors, [ ] shows estimation values.

In Table 2, the statistically significant parameter at the 5% meaning level in the predicted model indicates the permanence of shocks occurring in the market. shows the short-term effect of shocks on volatility, in other words the ARCH effect. In this model, the effect of the shocks is assumed to be symmetrical.

Table 3: EGARCH Model Estimation Results For Rt Return Series			
EGARCH(1,1)			
ω_0	2.777122* (0.15951) [0.0000]	**Q(5)**	2.51558 [0.4724820]
β_0	0.297413 (0.75841) [0.6955]	**Q(10)**	7.00919 [0.5356417]
β_1	0.623526* (0.11222) [0.0000]	**Q(20)**	16.8461 [0.5337080]
(Egarch) θ_1	0.101179 (0.094853) [0.2879]	**Q(50)**	37.0749 [0.8735906]
(Egarch) θ_2	0.224184 (0.17420) [0.2002]	**$Q^2(5)$**	3.72759 [0.2924219]
v	2.056798* (0.31544) [0.0000]	**$Q^2(10)$**	8.53786 [0.3827667]
Log(L)	-417.228	**$Q^2(20)$**	17.4385 [0.4931783]
AIC	5.683044	**$Q^2(50)$**	50.8204 [0.3631011]
SIC	5.863682	**ARCH(5)**	0.77085 [0.5723]
Skewness	-0.04494	**ARCH(10)**	1.0395 [0.4144]
Extreme Kurtosis	3.20470		
J-B	283.85		

*, ** %5 ve %10 shows statistical significance in terms of meaning level, ( ) shows standard errors, [ ] shows estimation values.

According to the results of EGARCH (1,1) model for the volatility of the R_t return series given in Table 3, (Egarch) parameter and (Egarch) parameter were not found statistically significant at the 5% significance level. (Egarch)parameter shows the symmetrical effect of the model or the effect of size. (Egarch)parameter shown in Table 3 is the leverage effect (leverage effect) parameter which is interpreted as the effect of positive and negative shocks on conditional variance. In the case of (Egarch) <0, the effect of the shocks on the volatility for the Rt yield series is short-term and asymmetric. In other words, the effect of negative shocks on the return volatility of Rt is higher than the effect of positive shocks and the effect of shocks is interpreted as being disappeared in the short term.

Table 4. ARFIMA (1,ξ,1)-FIGARCH(1,d,1) Model Estimation Results For Rt Return Series			
ARFIMA (1, ξ ,1)-FIGARCH(1,d,1)			
μ	0.408959 (0.65482) [0.5333]	**Q(5)**	1.61839 [0.6552267]
Ψ_1	-0.901412* (0.019452) [0.0000]	**Q(10)**	8.10617 [0.4231682]
θ	0.836648* (0.048426) [0.0000]	**Q(20)**	13.8280 [0.7402352]
ξ	0.124905** (0.069703) [0.0753]	**Q(50)**	33.0770 [0.9502849]
ω	0.422876* (0.21169) [0.0461]	**$Q^2(5)$**	4.90101 [0.1791912]
β_0	0.526348* (0.095382) [0.0000]	**$Q^2(10)$**	6.70441 [0.5688343]
β_1	0.386409* (0.16203) [0.0184]	**$Q^2(20)$**	12.9883 [0.7922672]
d	0.301846* (0.14562) [0.0400]	**$Q^2(50)$**	40.3356 [0.7761302]
v	1.893486* (0.30044) [0.0000]	**ARCH(5)**	0.90949 [0.4769]
Log(L)	-413.135	**ARCH(10)**	0.58465 [0.8241]
AIC	1.537687		
SIC	1.599288		
Skewness	-0.49056		
Extreme Kurtosis	4.0434		
J-B	540.98		

*, ** %5 ve %10 shows statistical significance in terms of meaning level, ( ) shows standard errors, [ ] shows estimation values.

According to Table 4, the long memory parameter ξ of the ARFIMA model for the R_t gold price return series was statistically significant at the 10% significance level. The parameterξ is obtained as 0.124905. The long memory parameter d of FIGARCH model volatility was found to be statistically significant at the 5% significance level as 0.301846 for the R_t yield series. ARCH-LM test with 5 and 10 delay shows that the model is suitable for removing the effects of ARCH in the errors. In addition, the tail statistics of the model are statistically significant and are indicative of the statistical characteristics of statistical errors.

4. CONCLUSION AND SUMMARY

Volatility, a measure of uncertainty in financial markets, has a significant place in the finance literature. It is imperative that policy structure, investors, analysts, and other market participants determine the crisis management policies, determine financial stability in markets and determine the structure of volatility in order to obtain information about the future situation of the markets. Increased interest in predictability of volatility has raised the necessity of conditionally changing variance models for high-frequency financial time series. For this purpose, the ARCH model proposed by Engle (1982) and the GARCH model derivative models proposed by Bollerslev (1986) are widely used in financial time series volatility analyzes. These models, which expressed volatility as a function of past period returns, are insufficient to assess the long memory characteristic, which is defined as the long-term dependency in the financial time series or the tendency to return to the slow average. The first studies evaluating the degree of long memory or fractional integration were conducted by Granger and Joyeux (1980) and Hosking (1981). Studying long memory features plays an important role in determining investment strategies and in portfolio management. Nevertheless, long memory has been a controversial topic in finance. The long memory in returns and volatility has evolved independently as a phenomenon that seems different. In fact, market shocks have a simultaneous effect on conditional mean/average and conditional variance. Empirical studies in recent years have focused on the relationship between conditional mean and conditional variance.

In this study; Turkey's gold market is modeled in terms of price index returns and volatility and long memory feature that is seen at the same time are analyzed based on binary fractional integration dynamics. For this purpose, monthly Istanbul Gold Exchange Weighted Average Gold Prices covering the period of 08.2005-02.2018 were used and return series were obtained with $R_t = \ln(Gold_t / Gold_{t-1})*100$ transformation. Return series are very important in determining the characteristics of financial time series. Firstly, ARMA (1,1) -GARCH (1,1) model was determined as a suitable model for the short memory of the mean and conditional variance (volatility) of the R_t return series. The GARCH model assumes that the effect of the shocks on the conditional variance of the return series is symmetric. The EGARCH (1.1) model parameters estimated to evaluate the asymmetric effect of the shocks were not found statistically significant. ARFIMA(1,ξ,1)-FIGARCH(1,d,1) model was estimated and ξ and d parameters were found to be statistically significant. Accordingly, the average and volatility of the R_t gold price return series has a long memory.

In other words, it is possible to say that the impact of shocks on permanent gold prices is permanent and it takes a long time for the series to return to the average. The effect of the shocks is symmetrical. Positive (good news) and negative (bad news) shocks have similar effects on prices and they are permanent. It is important to determine the relationship between the expected return and volatility, which is an important variable in making the best investment for investors. In recent years, in order to increase the effectiveness of market participants in policy selection and investment decisions, determining the characteristics of financial markets and determining the structure of the market by taking the volatility into consideration also plays an important role.

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