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Examination of the Existence of Month of the Year, Day Effect of the Week, and Seasonal Anomalies in Gold Futures Contracts: The Case of Turkey

Yasemin Karataş Elçiçek[1]

Abstract: *This study aims to examine the existence of the month of the year effect, the day of the week effect, and seasonal anomalies in the return of gold futures contracts traded in the Borsa Istanbul Derivatives Market (BIST-VIOP) in the period of 02.09.2013 - 30.11.2022 through the Autoregressive Moving Average Models (ARMA)(2,2) and Generalized Autoregressive Conditional Heteroskedastic (GARCH)(1,1) model. According to the results, positive returns were found on other days except Thursday from the model examining the relationship between the gold futures contract and the day of the week effect, positive returns were found in January and March from the model results examining the relationship between the gold futures contract and the month of the year effect, and positive as well as statistically significant returns were found in other seasons except for summer from the model examining the relationship between the gold futures contract and seasonal anomalies.*

Keywords: Gold Futures Contract, Anomaly, Seasonal Effect, Month of the Year Effect, Day of the Week Effect

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1. Introduction

Gold is a precious metal that is always in demand without losing its popularity from past to present. The fact that gold is preferred both in jewelry making and as an investment tool has made it an important market tool. Having been generally preferred as a medium of exchange in the past, gold is now more prominent as a means of investment, savings, and intervention in the money market. Among the reasons why gold is so prominent in the money market are that gold always maintains its purchasing power regardless of financial conditions and is accepted as a valuable tool by all authorities and as a safe haven even when risk and uncertainty are high, and as revealed by empirical studies, gold has a negative correlation with almost all investment instruments (Rodoplu & Elitaş, 2018: 676).

Gold futures contracts are agreements traded in a market that impose an obligation to buy or sell gold of predetermined quantity, price, and purity at a specified time in the future. The price in these contracts indicates the forward price of the amount of gold that is contractual basis. Gold futures contracts provide the opportunity to protect against possible fluctuations in gold prices and to perform effective risk management for both investors, who have gold savings or plan to buy gold, and institutions operating in the gold industry. In addition, these contracts offer investors the advantage of gaining profit from changes in gold prices (Öz & Yolcu, 2010: 18). Therefore, the factors affecting the gold futures contracts, which provide such advantages, on the basis of return, and whether an anomaly is observed in the returns of the said

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[1] Asst. Prof., PhD., Siirt University, Social Services Vocational High School, Accounting and Tax Department, Accounting and Tax Applications Program, Siirt, Turkiye, yaseminkaratas@siirt.edu.tr

contracts, are followed with great interest by the market actors. In this context, the present study is aimed at investigating the existence of the month of the year and the day of the week effects and seasonal anomalies in gold futures contracts traded in the Borsa Istanbul Derivatives Market (BIST-VIOP) between 02.09.2013 - 30.11.2022. The present study differs from other studies in the literature in that it focuses on futures contracts since the literature review section reveals that while there are studies examining the anomaly relationship with both the spot and forward price of gold in the international literature, there is no Turkish study that focuses on the anomaly relationship with the gold futures contract. Therefore, the study is expected to make important contributions to the literature both in this sense and in terms of analysis through current data.

The second section of the study encompasses the theoretical framework of the anomalies included in the analysis and the reasons for their existence. The third section includes the literature review on studies examining the gold-anomaly relationship on both the spot and futures. The fourth section includes the data set, model determination, and methodology. The fifth section includes empirical findings. And finally, the last section includes an overall evaluation of the findings.

2. Theoretical Framework for Month of the Year, Day of the Week, and Seasonal Anomaly

The efficient market hypothesis is the basic paradigm that explains the formation process of securities prices in financial markets. According to this hypothesis, the information available and reaching the market is reflected in the prices quickly and accurately by rational investors. Profitable investment strategies cannot be determined by using historical information in efficient markets since it is not possible to predict the movements of market prices, which are formed as a result of independent buy-and-sell decisions of investors using current information. However, there are situations in the markets that differ from the assumptions of the efficient market hypothesis and are called anomalies (Konak & Kendirli, 2015: 138).

The literature on the explanation of the concept of anomaly contains a myriad of similar definitions. Based on a general definition in line with all these definitions, an anomaly is a situation of unusual behaviour and deviation from theory in general (Thaler, 1987; Jassal & Dhiman 2016; Khan et al., 2017). Anomalies suggest that the underlying principles of rational behaviour underlying the efficient markets hypothesis are not entirely correct and that we need to look as well at other models of human behavior, as have been studied in the other social sciences (Shiller, 1998: 2).

Anomalies in financial markets can occur in different ways, such as political, technical, calendar, and cross-sectional anomalies (Demireli, 2008: 225). Calendar anomalies are separated into four types: day/days, month/months, holiday/holidays, and other special days/weeks. In this study, it would be useful to briefly mention these types of anomalies, as the relationship between the types of seasonal (calendar) anomalies such as the month of the year, the day of the week, and seasonal anomaly and gold futures contract returns.

The day of the week effect relates to the examination of whether market actors can achieve lower/higher returns on certain day/days of the week compared to other days of the week. In the literature, the day or days of the week effect refers to the regular negative returns from stocks on the first trading day of the week (Monday). Previous studies on this type of anomaly revealed that the returns from stocks are generally lower on Mondays compared to the previous trading day, while the returns on Fridays are higher than on the previous trading day. In other words, such studies concluded that the average return is the lowest on the first trading day of the week and the highest on the last trading day of the week (Barak, 2006: 126; Gümüş & Durmuşkaya, 2015: 50; Özarı & Turan, 2016: 1604; Karcıoğlu & Özer, 2017: 457).

Although all the days of the week are examined in the studies of the literature on the day/days of the week effect, there is a common consensus that generally anomalies exist on Mondays and Fridays. However, recent studies have shown that anomalies also exist on Tuesdays and Thursdays (Krężołek, 2018: 81; Wang et al., 2019: 522). It is suggested that a great number of factors have an impact on the formation of the day/days of the week effect. If some of these factors are to be mentioned, first of all, it is necessary to focus on the day on which individual and institutional investors make the most buying-selling decision to well-understand the underlying reason for the relevant effect. This is because it is both time-consuming and costly for the investor to gather, analyze, and classify all the necessary information and then decide whether to invest or not. For individual investors, particularly assuming that such investors work in different fields, it is rather hard to take time out on a weekday and make an investment decision. On the other hand, though institutional investors follow the market closely during the week, they mostly prefer weekends to analyze the information they collect. In this case, the most suitable time for both types of investors is certainly the weekend. Therefore, an anomaly exists as both types of investor profiles make an evaluation at the weekend and perform the trade on the first trading day. In addition to this, the announcement of negative news about the company and the economy, either on the last trading day or at the weekend, may cause negative returns on the first trading day (Tunçel, 2008: 153; Atakan, 2008: 109).

The month of the year effect relates to the examination of whether market actors can achieve lower/higher returns in certain months/months of the year compared to the rest of the year. Previous studies on the month/months of the year effect in the finance literature revealed that the results obtained in January are generally higher than the returns obtained in the other months of the year. The month of the year effect is also called the January effect in the literature (Barak, 2006: 135; Erdoğan & Elmas, 2010: 283; Hoang et al., 2020: 2617). The reason for the January effect on the markets is that investors start to repurchase low-value stocks, which they sold out due to period-end closing procedures, at the end of the year to diversify their portfolios at the beginning of the year. For, as a result of this position, higher returns lead to the January effect on the markets (Özer, 2017: 71). In other words, investors dispose of the stocks they lost to reduce their tax rates at the end of December. In the first days of January, they invest in stocks that have decreased in value due to sales. Such behaviours ensure that investors both pay low taxes at the end of the year and build their portfolios with low-priced stocks at the beginning of the year. For this reason, investors have high returns as a result of the January effect (Atakan, 2008: 100).

Seasonal anomaly relates to the examination of whether market actors can achieve lower/higher returns in any season of the year compared to other seasons. The relationship between the season and the returns on financial assets is based on the effect of the sun's rays on the mood of the person. To be more precise, it is assumed that the sun's rays have a positive effect on people's moods and that people with a positive mood make their evaluations more optimistic (Lin, 2015:211).

Frequently mentioned in studies in the field of psychology, seasonal anomalies are called seasonal affective disorder (SADaffect) based on the relationship between daylight and depression. It is reported that individuals with seasonal affective disorder avoid taking risks and therefore the returns are relatively lower when the sun's rays are at their lowest level annually (Molin et al. 1996: 151; Kamstra et al. 2003: 324).

3. Literature Review

Ball et al. (1982) investigated the existence of the day of the week effect on gold prices based on the period between January 1975 and June 1979 and concluded that there were significant findings on the existence of the day of the week effect on gold prices. In another study carried out by Ma (1986) focusing on the existence of the day of the week effect on gold returns between January 1972-June 1985, the data set was divided into two periods (1972-1981 and 1981-1985) and the results were interpreted in terms of two different periods. Accordingly, while positive returns were obtained on weekends in the period between 1972 and 1981, negative returns were obtained on Mondays in the period between 1981 and 1985, showing that there was a weekend effect on the relevant periods of the gold market. Tully and Lucey (2006) tested the presence of the day of the week effect on the return and volatility of spot gold, spot silver, futures gold, and futures silver traded on COMEX during the period between 1982 and 2002. The results of the study revealed that the day of the week effect was present under spot gold (negative return on Monday), but no such effect was observed under futured gold along with similar results for silver. Kohli (2012) studied the existence of day-of-week anomalies on gold and silver in the 1980-2012 period using the regression analysis method. The results revealed that there were findings supporting the existence of an anomaly of the day of the week, however, this effect was weak in silver. Aksoy (2013) investigated the presence of the day of the week effect on the returns and volatility of the precious metals in question by using the gold and silver prices of the Istanbul Gold Exchange from August 2008 to December 2011. The results of the study revealed that both the return and volatility of gold had the day of the week effect while such an effect existed only in the volatility of silver. Górska and Krawiec (2014) examined whether the presence of a day of the week anomaly on the London price returns of 4 precious metals, gold, silver, palladium, and platinum, in the 2008-2013 period. Both regression and GARCH model were used as methods in the study. The results of the regression analysis revealed that only negative and statistically significant returns were obtained in silver on Friday, while there was no evidence of the presence of anomaly in the results of the GARCH model. Krężołek (2018) investigated the presence of the day of the week effect on the gold, silver, platinum, and palladium returns traded on the London Metal Exchange between January 2000 and December 2016. For this purpose, the relevant period was divided into two as the uptrend and the downtrend period, and the analysis was carried out in this way. The results revealed that the returns obtained on Friday in gold return volatility in all periods and the uptrend period were positive and quite different from other days of the week while the palladium returns were positive on Friday and negative on Monday-Tuesday-Thursday in all periods and during the uptrend. Wang et al. (2019) tested the presence of the day of the week effect on the returns and volatility of gold traded on the Shanghai Gold Exchange and the London Gold Exchange between January 2003 and March 2017. The results revealed that there was the day of the week (Monday) effect on the return and volatility of gold in the Shanghai Gold Exchange, while the day of the week (Thursday) effect was found only in the volatility of the gold traded in the London Gold Exchange. Temel and Güneş (2022) investigated the presence of a day of the week effect on precious metals (gold, silver, platinum, palladium), energy commodities (Brent oil, natural gas), and agricultural commodities (wheat, corn). The EGARCH method was used as a method in the study. The results of the study revealed that among the variables included in the analysis, only the day of the week effect was not found in platinum.

Coutts and Sheikh (2002) investigated the existence of weekend, pre-holiday, and January effects in the gold index of the Johannesburg Stock Exchange between January 1987 and May 1997 and concluded that there were no weekend, pre-holiday, and January effects in the index for the relevant period. Borowski and Łukasik (2017) investigated the existence of the day of the week effect, the weekend effect, and the month of the year effect for gold, silver, platinum, and copper traded on the London Metal Exchange in the January 1995-December 2015 period and for palladium in the January 1998-December 2015 period. They reported that the weekend effect was observed in copper and gold, and the month of the year effect was observed only in palladium. In addition, the findings contained the information that the day of the week effect was not found in any of the variables. Hoang et al. (2020) investigated the existence of calendar anomalies in both spot and forward gold prices traded on the Shanghai Gold Exchange during the period between 2002 and 2016. The results revealed that positive returns were obtained from spot gold prices on Monday and in January, while positive returns were obtained from forward gold prices only in January, therefore, there were some calendar anomalies in both spot and forward gold prices. Xiao and Maillebuau (2020) investigated whether the effect of the day of the week and the month of the year in the Shanghai Gold Exchange existed in the 2002-2016 period by using the UCM and ARCH method. The results of the model examining the effect of the day of the week revealed that positive returns were obtained on Mondays and negative returns on Tuesdays. However, the results of the model examining the effect of the month of the year revealed that the highest returns were achieved in January and February.

Baur (2013) tested the presence of the seasonal effect on gold prices in the period between 1980 and 2010 based on both return and volatility, concluding that positive and statistically significant results were obtained based on both returns and volatility in September and November; therefore, there was a seasonal effect on the relevant period. Kırlıoğlu and Tuna (2013) investigated the presence of the month of the year effect and seasonal anomalies in gold prices between January 1978 and June 2012 to conclude that there were both the month of the year effect and seasonal anomalies. Chhabra and Gupta (2022) examined whether fifteen calendar anomalies were observed on seven metal-based (aluminum, copper, gold, nickel, lead, zinc, silver) and two energy (crude oil, natural gas) futures contracts traded on the Indian Multi-Commodity Exchange –MCX during the period 2008-2018. According to the results, some calendar anomalies were observed in the aforementioned futures contracts, but these anomalies have disappeared recently.

In the literature, some studies scrutinize the existence of calendar anomalies in the gold market based on both spot price and futures price. The previous studies have shown that the international literature included studies aimed at testing the existence of calendar anomalies in spot and futures price, return, and volatility of gold, while Turkish literature included studies, which are in limited number, only for the spot price of gold. Turkish literature does not include any study that focuses on calendar anomalies in gold futures contract returns. However, when the studies in the literature are evaluated in general, it can be said that calendar anomalies are more common in spot markets, and less anomalies are encountered in futures markets when compared to spot markets. In addition, it is seen that the results obtained from the same type of markets (spot-spot, futures-futures), differ according to the country examined. For example, Wang et al. (2019) tested the existence of the day of the week effect on the returns and volatility of gold traded on the Shanghai Gold Exchange and the London Gold Exchange. In the results of the study, it was stated that there is a day of the week (Monday) effect on the return and volatility of gold in the Shanghai Gold Exchange, while the effect of the day of the week (Thursday) on the volatility of the gold in the London Gold Exchange only. Therefore, it is thought that examining the subject in terms of gold futures contracts traded in BIST-VIOP will make a significant contribution to the literature.

4. Data and Method

4.1. Data and Model Determination

This study aims to determine the existence of the day of the week effect, the month of the year effect, and seasonal anomalies on gold futures contract returns. For this purpose, the data set of the study includes 2317 daily data of gold futures contracts traded in BIST-VIOP between 02.09.2013 - 30.11.2022. The dependent variable of the study is the logarithmic returns of the closing prices of gold futures contracts. Logarithmic returns were calculated as $R_{v,t}=\ln(P_t/P_{t-1})$. The dummy variables used to determine anomalies take the value of one in the periods when an anomaly is expected to occur, and zero in other periods. In the established models, to avoid the trap of dummy variables, a dummy variable that takes the value of 0 or 1 in one less number (D-1) from the existing dummy variable was used. The dummy variable trap occurs when two or more dummy variables created by one-hot encoding are highly correlated (multi-collinear), which means that one variable can be predicted from the others, making it difficult to interpret predicted coefficient variables in regression models (Türkel, 2014: 1-57). Therefore, to avoid such a problem, 4 dummy variables were included when examining the day of the week effect (although there are five days in a week), 11 dummy variables were included (although there are 12 months in a year) when examining the month of the year effect, and 3 dummy variables were included when examining the seasonal anomaly (although there are four seasons). To put it more clearly, the models established in this study are as follows:

In the model including the examination of the day of the week effect, the returns are $a_0 + a_1$ on Friday, $a_0 + a_2$ on Monday, $a_0 + a_3$ on Tuesday, $a_0 + a_4$ on Wednesday, and a_0 on Thursday. So, the reference category is Thursday. The effects of other days are identified based on a comparison with Thursday.

In the model including the examination of the month of the year effect, the returns are $a_0 + a_1$ in December, $a_0 + a_2$ in January, $a_0 + a_3$ in February, $a_0 + a_4$ in March, $a_0 + a_5$ in April, $a_0 + a_6$ in May, $a_0 + a_7$ in June, $a_0 + a_8$ in July, $a_0 + a_9$ in August, $a_0 + a_{10}$ in September, $a_0 + a_{11}$ in October, and a_0 in November. So, the reference category is November. The effects of other months are identified based on a comparison with November.

In the model including the examination of the seasonal anomaly, the returns are $a_0 + a_1$ in Winter, $a_0 + a_2$ in Summer, $a_0 + a_3$ in Spring, and $a_0$in Autumn. So, the reference category is Autumn. The effects of other seasons are identified based on a comparison with Autumn.

The case where $D_1=D_2=D_3=D_4=0$ is used to express the reference category day. To put it verbally, if it is not Friday, Monday, Tuesday, or Wednesday, it's Thursday.

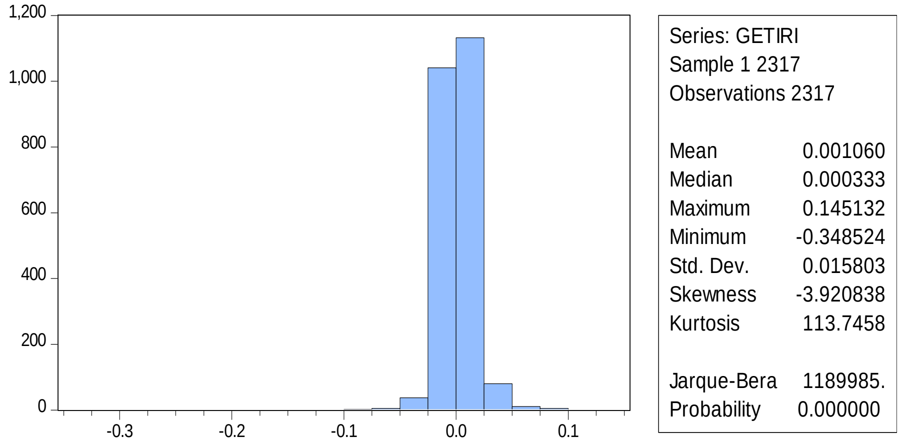
The case where $D_1=D_2=D_3=D_4=D_5=D_6=D_7=D_8=D_9=D_{10}=D_{11}=0$ is used to express the reference category month. In other words, if it is not January, February, March, April, May, June, July, August, September, October, or December, it is November.

The case where $D_1=D_2=D_3= 0$ is used to express the reference category season. In other words, if it is not Winter, Summer, or Spring, it is Autumn.

Data on closing prices were obtained from datastore.borsaistanbul.com and the Eviews 10 program was used for the analysis. The figures below show descriptive statistics of gold futures contract returns and daily return fluctuations.

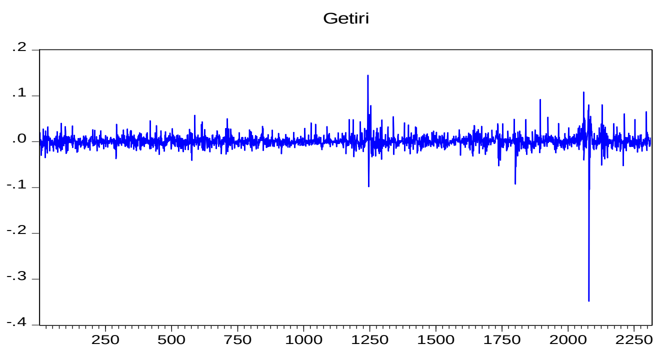
Figure 1 highlights that the minimum return is -0.348524, the maximum return is 0.145132, and the average return is very close to zero and positive 0.001060. However, the fact that the kurtosis coefficient is much larger than 3 and the skewness coefficient is negative indicates that the series has a fat tail (leptokurtic) and left-skewed distribution. Given the results of the Jarque-Bera test statistics, the null hypothesis, which assumes that the return series error terms are normally distributed, is rejected at the 0.01 significance level. In other words, the return series does not have a normal distribution. In addition, the fact that the mean and standard deviation values of the series in the figure are close to 0 gives a clue that the series may be stationary.

Figure 1. Gold Futures Contract Descriptive Statistics Information



The graph of daily return fluctuations in gold futures contract in Figure 2 highlights that volatility is quite high in certain periods.

Figure 2. Gold Futures Contract Daily Return Fluctuations



4.2. Methods

The ARMA model is formed by the combination of AR and MA models. The AR (Auto Regressive) model was introduced to the literature by Yule (1926). On the other hand, the AR model is formed through the calculation of the past values of the assumed time series as the dependent variable, and the observation of the future values of the series is explained by the past values of the series and the error term. The generalized formula for the AR(p) model is given as follows:

$$\mathrm{Y_t} = \delta + \alpha_1 \mathrm{Y_{t-1}} + \alpha_2 \mathrm{Y_{t-2}} + \cdots \alpha_\mathrm{p} \mathrm{Y_{t-p}} + \varepsilon_\mathrm{t} \quad (1)$$

where Yt denotes the time series, Y_{t-1} denotes the past data, ε_t denotes the error term, α denotes the unknown parameter, δ denotes the fixed parameter (cut-off parameter), and p denotes the delay count.

The MA (Moving Average) model was introduced to the literature by Slutsky (1937). This model is formed by determining the observation values at a certain period of the time series, the current error term, and the past values of the error term. In other words, past error terms affect current error terms. The generalized formula of the MA(q) model is given as follows:

$$\mathrm{Y_t} = \mu + \varepsilon_\mathrm{t} + \theta_1 \varepsilon_\mathrm{t-1} + \theta_2 \varepsilon_\mathrm{t-2} + \cdots + \theta_q \varepsilon_\mathrm{t-q} \quad (2)$$

where µ denotes the cut-off parameter and θ denotes the unknown parameter.

ARMA (Autoregressive Moving Average Models) model is formed by the combination of AR and MA features of the series, and by determining both the past values of the series and the past values of the error terms. The generalized formula of the ARMA(p,q) model is given as follows:

$$\mathrm{Y_t} = \delta + \alpha_1 \mathrm{Y_{t-1}} + \alpha_2 \mathrm{Y_{t-2}} + \cdots + \alpha_\mathrm{p} \mathrm{Y_{t-p}} + \varepsilon_\mathrm{t} + \theta_1 \varepsilon_\mathrm{t-1} + \theta_2 \varepsilon_\mathrm{t-2} + \cdots + \theta_q \varepsilon_\mathrm{t-q} \quad (3)$$

In the GARCH (Generalized Autoregressive Conditional Heteroskedastic) model introduced by Bollerslev (1986), the conditional variance (h_t) at time *t* depends on both the square of the past values of the error terms and the conditional variance in the past. In other words, the variance of the error terms is affected not only by their past values but also by the conditional variance values. The validity of the GARCH depends on the conditions that the ARCH (Autoregressive Conditional Heteroskedastic) and GARCH parameters in the estimated conditional variance equation are equal to or greater than zero ($\alpha_i \geq 0$; $\beta_j \geq 0$, i =1,2,3,4….q) and the constant coefficient on the right of the conditional variance equation is greater than zero ($\omega > 0$). In addition, to ensure the stationarity condition, all parameter sums must be less than one, except for the constant term on the right of the conditional variance equation. A GARCH(p,q) model, in which the squared error lag length is expressed as q and the lag length of the autoregressive part as p, could be written as follows:

$$h_t = \omega + \sum_{j=1}^{\rho} \beta_j \, h_{t-j} + \sum_{i=1}^{q} \alpha_i \, u_{t-i}^2 \quad (4)$$

In the GARCH-M (GARCH in Mean) model introduced by Engle et al. (1987), M stands for GARCH-in-mean. In this model, standard deviation or conditional variance is added to the mean equation as an explanatory variable. The GARCH-M (p,q) model is generally formulated as follows:

$$\gamma_t = \mu + c\sigma_t^2 + \varepsilon_t, \qquad \varepsilon_t = \sigma_t \mu_t \quad (5)$$

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \, \sigma_t^2 \quad (6)$$

Although μ and c are constants in the equation, the parameter c is also called the risk-premium parameter. A positive c indicates that the return is positively related to its volatility. The formulation also implies that there are serial correlations in the γ_t return series in equation 6. The serial correlations in question $\{\sigma_t^2\}$ have been demonstrated by those in the volatility process.

The EGARCH (Exponential GARCH) model of Nelson (1991) was extended to eliminate the inadequacy of the GARCH model in modelling the leverage effect. The main difference between the GARCH and EGARCH models is that the EGARCH model includes the possible leverage effect that may occur in the financial markets. The leverage effect in the financial return series was estimated with the EGARCH model as a result of Nelson's studies. Compared to the GARCH model, the EGARCH model has some advantages. The first of these advantages is that since the conditional variance is modelled in logarithmic linear form, the condition for ARCH and GARCH parameters ($\alpha_i$and β_i) to be greater than zero is eliminated. The second advantage is that in cases where the relationship between return and volatility is negative, the γ parameter is negative, allowing asymmetrical movements to be modelled. The EGARCH (p,q) model could be formulated as follows:

$$\log(\mathrm{h_t}) = \omega + \sum_{j=1}^{p} \beta_j \log(\mathrm{h}_{t-j}) + \sum_{i=1}^{q} \alpha_i \frac{|\mathrm{u}_{t-i}|}{\sqrt{h_{t-i}}} + \sum_{i=1}^{q} \gamma_i \frac{u_{t-i}}{\sqrt{h_{t-i}}} \tag{7}$$

The TGARCH (Threshold GARCH) model is another alternative model that assumes that the effects of negative shocks and positive shocks are not symmetrical. In the TGARCH model, where $u_{t-1}=0$ is assumed as the threshold, it is assumed that the effect of positive news (positive shocks $u_{t-i}>0$) on the conditional variance will be lower than the effect of negative news (negative shocks ut-i<0) on the conditional variance (Mapa, 2004: 3-5). This effect is included in the TGARCH model by adding the K_{t-i} dummy variable. The TGARCH (p,q) model is formulated as follows:

$$\begin{gathered} \mathrm{h_t} = \omega + \sum_{j=1}^{p} \beta_j \mathrm{h}_{t-j} + \sum_{i=1}^{q} \alpha_i u_{t-i}^2 + \sum_{i=1}^{q} \gamma_i K_{t-i} u_{t-i}^2 \\ K_{t-i} = \begin{cases} 1 & \text{where } \mathrm{u}_{t-i} < 0 \\ 2 & \text{where } \mathrm{u}_{t-i} \geq 0 \end{cases} \end{gathered} \tag{8}$$

In the case of $\gamma_i \neq 0$ in the above model, the effect of fresh news is expected to be different. In addition, the positive news effect will be as much as $\alpha_i + \gamma_i$ while the negative news effect will be as much as α_i. In cases where $\gamma_i > 0$, it is expected that the effect of negative news on volatility is greater than the effect of positive news, that is, there is a leverage effect from level *i*. On the other hand, where $\gamma_i = 0$, the effect of fresh news on volatility is not asymmetrical, and in such a case, the TGARCH model will be equal to the GARCH model (Hossain et al., 2005: 419-425). However, the only difference between TGARCH and EGARCH models is that the leverage effect is exponential in the EGARCH model and quadratic in the TGARCH model (Mapa, 2004:3-5).

5. Findings

Since the data set examined in the study is a time series, a stationarity analysis should be primarily performed. Frequently preferred Augmented Dickey-Fuller (ADF) and Phillips Perron (PP) tests were used while performing the stationarity analysis. In the ADF test, the error terms are considered to be statistically independent and homogeneous, while in the PP test, the error terms are considered to be weakly dependent and heterogeneous. In addition, compared with the ADF test, the PP test offers more accurate results from the series that does not have a normal distribution. In both tests, if the series contains a unit root, it is decided that the series is not stationary. The levels of significance used to determine statistical significance in the analysis results indicate the level of erroneous decision-making. The literature reveals that analyzes are made to make decisions at significance levels of 1%, 5%, and 10%. In both tests, if the test statistics are less than the critical values, the series is considered to be stationary while if the test statistics are higher than the critical values, it is rejected that the series is stationary (Dickey & Fuller, 1981). In the study, the results obtained from both ADF and PP tests were taken into account when deciding whether the data set was stationary or not. Since it was concluded that the series did not contain a unit root in both tests, it was decided that the series was stationary.

The correlogram graphs both give clues about the stationarity of the series and help determine the model. The correlogram graph of the gold futures contract return series is included in Appendices (Table A1) in terms of space saving. The correlogram graph of the series highlights that the partial autocorrelation (PACF) and autocorrelation (ACF) coefficients are within the range of $\pm 2/\sqrt{4896} = \pm\ 0.02858$. This indicates that the series has a stationary structure. However, it would be useful to employ formally used stationarity tests in the analysis of stationarity and to have information about the stationarity of the series in this way. In this context, Philips-Perron (PP) and Augmented Dickey-Fuller (ADF) tests, which are frequently preferred in the literature, were used while testing the stationarity of the data set, and the results are given in Table 1. The results in Table 1 suggest that the gold futures contract is stationary at the 1% significance level according to both ADF and PP test results.

Table 1. Stationarity Analysis Results Regarding Gold Futures Contract Return

Variable	Level	(ADF) Test	(PP) Test
Gold Futures Contract Return	Level	-30.03737***	-47.42978***

Note: *** indicates significance at 1% level.

Once it was decided that the data set was stationary, the ARCH-LM test was used to find out whether there was an ARCH effect on the data set to be able to apply ARCH models. Once the presence of the ARCH effect was found in the data set, the most appropriate ARMA model was determined.

The most suitable ARMA model was identified to examine the existence of the day/days of the week effect, the month/months of the year effect, and seasonal anomaly, and the Least Squares (LSM) method was used to do it. Since the Box-Jenkins methodology is based on the estimation of ARMA(p,q) models, the goal was to ensure that the models were suitable for parsimony (Akay & Nargeleçekenler, 2006:27). Therefore, the ARMA(3,3) model was mainly estimated. For, the correlogram graph of the return series gives clues that the model to be established should be ARMA(2,2). These clues result from the fact that both ACF and PACF values exhibit similar structures, that is, they both cease after the second delay. However, to make sure that the determined model is the most suitable ARMA model, it must meet some conditions. According to these conditions, the parameter in the model and the model F statistic should be statistically significant, the likelihood ratio (LR), the sum of squares error (SSE), and the coefficient of determination (R^2) should as high as possible, and the information criteria of Akaike (AIC) and Schwarz (SIC) should be as high as possible. Table 2 includes the estimated alternative ARMA model results for the gold futures contract return series.

The results in Table 2 highlight that the F-statistic in the Ar(1), AR(2), MA(1), MA(2), and ARMA(1,1) models are nonsignificant. On the other hand, parameters are nonsignificant in AR(3), MA(3), ARMA(3,1), ARMA(1,3), ARMA(3,2), ARMA(2,3), ARMA(3,3) models. Among the remaining models ARMA(2,1), ARMA(1,2), and ARMA(2,2), the last one ARMA (2,2) has the lowest Akaike (AIC) value and highest significance level of the likelihood ratio (LR), coefficient of determination (R^2), and F-statistics. Therefore, the most suitable ARMA model for the analysis was ARMA(2,2). The estimation results of the determined model are shown in Appendices, Tables A2, A3, and A4, respectively based on the day of the week effect, the month of the year effect, and seasonal anomaly.

Table 2. Estimated Alternative ARMA Model Results for the Gold Futures Contract Return Series

Model	Gold Futures Contract Return					
	AIC	SIC	SSE	OLB	R^2	F-ist
AR(1)	-5.455428	-5.447985	0.578182	6323.113	0.000373	0.649805
MA(1)	-5.455424	-5.447981	0.578185	6323.108	0.000368	0.652834
AR(2)	-5.454577	-5.444654	0.578175	6323.127	0.000385	0.827562
MA(2)	-5.454617	-5.444694	0.578152	6323.174	0.000425	0.805058
AR(3)	-5.461883	-5.449479	0.573465	6332.592	0.008529	0.000544
MA(3)	-5.462119	-5.449715	0.573329	6332.865	0.008763	0.000424
ARMA(1,1)	-5.454566	-5.444642	0.578182	6323.114	0.000374	0.833914
ARMA(1,2)	-5.457388	-5.444984	0.576051	6327.384	0.004058	0.051756
ARMA(2,1)	-5.457169	-5.444765	0.576178	6327.130	0.003839	0.063746
ARMA(2,2)	-5.457594	-5.442709	0.575433	6328.623	0.005127	0.036384
ARMA(3,1)	-5.461216	-5.446331	0.573352	6332.819	0.008725	0.001115
ARMA(1,3)	-5.461908	-5.447023	0.572954	6333.620	0.009411	0.000555
ARMA(3,2)	-5.462121	-5.444755	0.572337	6334.867	0.010479	0.000449
ARMA(2,3)	-5.461864	-5.444498	0.572485	6334.569	0.010223	0.000579
ARMA(3,3)	-5.461377	-5.441530	0.572268	6335.005	0.010598	0.000883

After the appropriate ARMA model was determined, the ARCH-LM test was applied to the model. If the ARCH effect occurs in the model after the ARCH-LM test, the analysis should be continued with ARCH and GARCH-type models that allow the heteroscedasticity structure. In this study, it would be useful to explain these models, as the Gold FC return is tried to be modeled with GARCH, GARCH-M, EGARCH, and TGARCH. To be able to interpret the predicted models, the variance of the residuals obtained from the models must be constant. In other words, to ensure that the model gives valid results, there should be no problem of heteroscedasticity in the model. Whether there was a problem of heteroscedasticity in the models was tested by the ARCH LM test, and the results are shown in Table 3. In all three models estimated according to the results in Table 3, the constant variance assumption is rejected at the 1% significance level. In other words, there is a problem of heteroscedasticity in all three models.

Table 3. ARCH LM Test Results for Month of the Year, Day of the Week, and Seasonal Anomaly Models

ARCH Test Results	Day of the Week	Month of the Year	Seasonal Anomaly
LM(1)	8.296746^{***}	8.856732^{***}	8.646327^{***}
LM(5)	42.50634^{***}	43.51669^{***}	43.10660^{***}
LM(10)	43.12651^{***}	44.14821^{***}	43.71902^{***}
LM(20)	62.28566^{***}	62.78474^{***}	63.00178^{***}

Note: *** indicates significance at 1% level.

The analysis continued with models that allow different variance structures. The models that are frequently used and considered sufficient in explaining the volatility of financial time series are ARCH(1) and GARCH(1,1) (Kendirli & Karadeniz, 2012: 99; Özer & Ece, 2016: 9; Karcıoğlu & Özer, 2017: 469; Kayral & Aksoy, 2022: 467). However, in this study, the most suitable model was tried to be determined among both the GARCH(1,1) model and the GARCH-M(1,1), EGARCH(1,1), and TGARCH(1,1) models. The results of the aforementioned models calculated for the gold futures contract return series are given in Table 4.

The results in Table 4 highlight that the ARCH effect has disappeared in all models. However, the leverage effect in the TGARCH(1,1) and EGARCH(1,1) models, and the GARCH parameter in the GARCH-M(1,1) model are statistically nonsignificant. Therefore, these three models could not be used. As a result of the GARCH(1,1) model, the α and β parameters are significant at the 1% significance level, and the condition of being $\alpha + \beta < 1$, which is required for the ARCH model, is met. Therefore, it can be claimed that the most appropriate model for the analysis is GARCH(1,1).

Table 4. GARCH(1,1), GARCH-M(1,1), TGARCH(1,1) and EGARCH(1,1) Model Results

	GARCH(1,1),	GARCH-M(1,1),	TGARCH(1,1)	EGARCH(1,1)
Mean Equation				
GARCH	-	-1.331290	-	-
Constant Term	0.001041***	0.001292***	0.000239	0.000215
AR(1)	0.059066**	0.059791	-1.085212***	-1.454121***
AR(2)	0.878996***	0.878242***	-0.986457***	-0.981383***
MA(1)	-0.080825**	-0.080641	1.084329***	1.455262***
MA(2)	-0.888191***	-0.886710***	0.990987***	0.979655***
Variance Equation				
Constant Term	3.66E-05	3.69E-05***	3.35E-05***	-0.940275***
α1	0.297117	0.298576***	0.212028***	0.271821***
β1	0.538470	0.535428***	0.655662***	0.271821***
γ	-	-	-0.028604	0.033713
T-Dıst. Dof	-	-	3.223802***	3.144013***
Log-likelihood	6864.654	6864.948	7106.589	7104.644
AIC	-5.923675	-5.923065	-6.130962	-6.129282
SIC	-5.903814	-5.900722	-6.106136	-6.104456
ARCH LM T *(R^2)	0.442130	0.367919	0.102472	1.038242
P	0.5061	0.5441	0.7489	0.3082

Once it was determined that the appropriate model for the analysis was ARMA (2,2) GARCH(1,1), the relevant model was used to investigate the existence of the month of the year effect, the day of the week effect, and seasonal anomalies on the gold futures contract returns.

The following tables show the results of the ARMA(2,2) GARCH(1,1) model created to measure the month of the year effect, the day of the week effect, and seasonal anomalies on the gold futures contract. According to the results in Table 5, the returns on Monday, Tuesday, Wednesday, and Friday are positive and significant at the 1%, 10%, 10%, and 5% significance levels, respectively. Since the category variable is Thursday, the coefficient (C) obtained for Thursday is negative but not statistically significant. In other words, according to the results obtained, the day of the week effect on the gold futures contract return occurred on Monday, Tuesday, Wednesday, and Friday. This shows that the average return of the gold futures contract changes on Monday, Tuesday, Wednesday, and Friday. Therefore, it can be suggested that market actors can gain above-average returns by taking advantage of certain days of the week. The result that above-average returns are obtained on Friday can be explained by the fact that the mood of market actors as well as their risk appetite increase on Friday, which behavioural finance attempts to explain. However, the result of above-average returns on Monday differs from the literature.

The results of the analysis examining the relationship between the gold futures contract return and the month of the year effect highlighted that positive and significant returns were obtained in January and March at the significance levels of 5% and 1%, respectively. This indicates that the month-of-year effect was observed on the gold futures contract return in the relevant period. This shows that investors who trade with gold futures contracts can gain above-average returns by taking advantage in January and March. It is suggested that the reason for the above-average earnings in January is the increase in the volume of money in the market with the arrival of information and news affecting the prices of financial instruments at the beginning of the year.

Table 5. Relationship between Gold Futures Contract Return and the Day of the Week Effect

Gold Futures Contract Return ARMA(2, 2) GARCH(1,1)				
Mean Equation				
Variables	**Coefficient**	**Standard Error**	**t-statistic**	**Likelihood**
Monday	0.002711	0.000645	4.204702	0.0000
Tuesday	0.001265	0.000699	1.808996	0.0705
Wednesday	0.001364	0.000723	1.887218	0.0591
Friday	0.001455	0.000699	2.082578	0.0373
C	-0.000325	0.000435	-0.746269	0.4555
AR(1)	0.061438	0.076653	0.801512	0.4228
AR(2)	0.878440	0.074838	11.73790	0.0000
MA(1)	-0.083205	0.081381	-1.022412	0.3066
MA(2)	-0.886789	0.080566	-11.00705	0.0000
Variance Equation				
c	3.67E-05	2.43E-06	15.13148	0.0000
α	0.301636	0.017097	17.64266	0.0000
β	0.533220	0.021450	24.85829	0.0000
ARCH LM T *(R^2)	0.354975			
P	0.5513			
Q (20)	36.627 [0.178]			
Q_s(20)	21.757 [0.354]			

Table 6. Relationship between Gold Futures Contract Return and the Month of the Year Effect

Gold Futures Contract Return ARMA(2, 2) GARCH(1,1)				
Mean Equation				
Variables	**Coefficient**	**Standard Error**	**t-statistic**	**Likelihood**
January	0.002540	0.000994	2.555925	0.0106
February	0.001337	0.000981	1.363042	0.1729
March	0.002327	0.000893	2.605127	0.0092
April	0.000809	0.000890	0.909547	0.3631
May	0.001406	0.001013	1.388326	0.1650
June	0.001175	0.000903	1.301073	0.1932
July	0.001300	0.001025	1.268684	0.2046
August	-0.000334	0.000930	-0.359377	0.7193
September	0.001260	0.001061	1.187713	0.2349
October	0.000915	0.000948	0.964734	0.3347
December	0.000745	0.001000	0.745509	0.4560
C	-0.000110	0.000659	-0.166684	0.8676
AR(1)	0.051146	0.074956	0.682348	0.4950
AR(2)	0.868581	0.073277	11.85332	0.0000
MA(1)	-0.078308	0.079376	-0.986545	0.3239
MA(2)	-0.882456	0.078877	-11.18776	0.0000
Variance Equation				
c	3.60E-05	2.48E-06	14.52615	0.0000
α	0.296468	0.018282	16.21646	0.0000
β	0.539206	0.022130	24.36494	0.0000
ARCH LM T *(R^2)	0.562439			
P	0.4533			
Q (20)	38.946 [0.127]			
Q_s(20)	21.374 [0.375]			

The results of the model, in which the relationship between the gold futures contract return and the seasonal anomalies in Table 7 are evaluated, highlight that positive and statistically significant returns are obtained in all seasons except summer. Therefore, it can be suggested that there is a seasonal anomaly in the gold futures contract return in the relevant period. This indicates that investors trading in gold futures contracts can earn above the average in seasons other than Summer (Autumn-Winter-Spring).

The literature reveals that the seasonal anomaly is based on the assumption that the sun's rays affect the mood of the individuals, affecting investment decisions. In other words, it is claimed that the sun's rays affect the mood of people positively and that people in a positive mood act more optimistically when making investment decisions. The results obtained from the study do not support this assumption since while anomaly is observed in the seasons other than summer in the results, no anomaly is found in this season. This is believed to arise from the fact that factors other than the sun's rays have a greater effect on the decisions of individuals in the relevant period.

Table 7. Relationship between Gold Futures Contract Return and Seasonal Anomaly

Gold Futures Contract Return ARMA(2, 2) GARCH(1,1)				
Mean Equation				
Variables	**Coefficient**	**Standard Error**	**t-statistic**	**Likelihood**
Spring	0.000942	0.000391	2.410068	0.0159
Summer	0.000121	0.000443	0.272427	0.7853
Winter	0.000994	0.000440	2.257115	0.0240
C	0.000519	0.000277	1.871935	0.0612
AR(1)	0.050693	0.073736	0.687493	0.4918
AR(2)	0.875243	0.072719	12.03595	0.0000
MA(1)	-0.075890	0.077936	-0.973754	0.3302
MA(2)	-0.888405	0.077734	-11.42877	0.0000
Variance Equation				
c	3.55E-05	2.39E-06	14.88278	0.0000
α	0.291701	0.017134	17.02509	0.0000
β	0.547385	0.021126	25.91038	0.0000
ARCH LM T *(R^2)	0.483838			
P	0.4867			
Q (20)	39.603 [0.104]			
Q_s(20)	21.827 [0.350]			

6. Conclusion and Discussion

Changes in technology also affect financial markets and investment instruments. This situation increases financial liberalization and enables investments to circulate freely in the markets via the internet. However, the issue is complicated for especially individual investors. Therefore, most of the individual investors still make their investments in foreign currency and gold (Cingöz & Kendirli, 2019: 552).

Just like in the prices of other financial instruments, gold prices tend to fluctuate over time. Gold futures contracts are among the tools that can be used by investors who have preferred or will prefer gold to make use of their savings, and by institutions operating in the gold industry, to protect themselves against such price fluctuations. These contracts allow market actors to perform effective risk management along with protection against price fluctuations and to gain profit from price fluctuations.

In this context, the the month of the year effect, day of the week effect, and seasonal anomalies on the return of gold futures contracts traded in BIST-VIOP for the period 02.09.2013 - 30.11.2022 were investigated through the ARMA(2,2) GARCH(1,1) model. The results obtained from the model including the examination of the relationship between the gold futures contract return and the day of the week effect revealed the days of the week effect on this contract return. For, positive and statistically significant returns were obtained on other days except for Thursday. In other words, market actors who made transactions with gold futures contracts in the relevant period achieved above-average returns on all days except Thursday. While these results overlap with the results of the studies by (Ma (1986), Wang et al. (2019), and Chhabra and Gupta (2022) that identified the existence of the day of the week effect, there exists differentiation in terms of returns (positive-negative) obtained on the day and the day when the effect occurs. In other words, the days with the effect observed in similar studies are usually Mondays and Fridays, while the effect was observed on all weekdays except Thursdays. However, the relevant studies also found that negative returns were obtained on Monday and positive returns were obtained on Friday, while positive returns were obtained on all days with an effect in this study. The source of difference may stem from the difference in countries and markets as well as in periods, since the perspective and demand of investors in different countries for gold futures contracts may vary.

As regards the month of the year effect, a month of the year effect on the gold futures contract return was observed. In other words, the contract returns provided positive and statistically significant returns in January and March. Particularly in the case of above-average returns in January, the January effect, which is frequently encountered in the literature, is shown to be valid for the contract in question. In this context, while the results overlap with the results of some studies (Hoang et al., 2020) that found the existence of the month of the year effect, they differ in terms of the month. In other words, while positive returns were obtained in gold futures contract returns only in January in the relevant study, the present study found positive returns in both January and March.

Finally, as regards seasonal anomalies, positive and statistically significant returns were provided in other seasons except for summer, which indicates the presence of seasonal anomalies in the return of the futures contract for the relevant period. Thus, it can be suggested that market actors trading with gold futures contracts in the relevant period achieved above-average returns except for the summer season. While these findings on seasonal anomalies show some similarities with the studies that identified the existence of seasonal anomalies in gold futures contracts (Baur, 2013), and in terms of the season in which the seasonal effect was observed, they also differ in some aspects. In other words, both studies found anomalies in autumn while the source of difference was that the present study found anomalies not only in autumn but also in spring and winter.

The presence of day of the week, month of the year, and seasonal anomalies in the gold futures contract yield shows that price formations that deviate from the assumptions of the efficient market hypothesis are observed in this type of contract. This indicates that the effectiveness is not achieved. Accordingly, it is possible to make predictions about the future by monitoring the past price movements in the gold futures contract. In addition, the differences in returns according to days, months, and seasons cause investors to earn above the average in these days/months/seasons. Considering the results, it can be suggested that market actors can increase their earnings by increasing their weight in their portfolios in the days/months/seasons where positive returns are obtained from the gold futures contract. In other words, in the gold market, investors can take advantage of this abnormal phenomenon to develop investment strategies and reduce investment risk.

A general evaluation of the findings denotes that gold is still viewed as a safe haven by market actors in Turkey for the relevant period and as an investment tool that they want to include in their portfolios, which in return increases the demand for gold and prices more than normal and leads to anomalies. It is anticipated that the findings of the present study will make significant contributions to investors who want to include gold in their investments, to institutions operating in the gold industry, and to the literature.

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Appendix

Table A1. Level-Value Correlogram of the Gold VIS Return Time Series

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
| |	| |	1	0.019	0.019	0.8642	0.353
| |	| |	2	0.004	0.004	0.8999	0.638
*| |	*| |	3	-0.090	-0.090	19.726	0.000
| |	| |	4	-0.009	-0.006	19.925	0.001
| |	| |	5	-0.026	-0.025	21.497	0.001
| |	| |	6	-0.016	-0.023	22.063	0.001
| |	| |	7	-0.048	-0.049	27.485	0.000
| |	| |	8	0.005	0.002	27.533	0.001
| |	| |	9	-0.021	-0.025	28.578	0.001
| |	| |	10	0.012	0.003	28.920	0.001
| |	| |	11	0.044	0.043	33.492	0.000
| |	| |	12	0.041	0.033	37.336	0.000
| |	| |	13	0.003	0.001	37.356	0.000
| |	| |	14	0.027	0.032	39.013	0.000
| |	| |	15	-0.022	-0.016	40.161	0.000
| |	| |	16	0.022	0.025	41.329	0.000
| |	| |	17	-0.039	-0.030	44.830	0.000
| |	| |	18	-0.021	-0.018	45.865	0.000
| |	| |	19	0.023	0.033	47.147	0.000
| |	| |	20	-0.052	-0.058	53.416	0.000

Table A2. Results of the Day of the Week Effect Regression Model

Estimation Results of the ARMA(2,2) Model for the Day of the Week Effect				
Parameters	Coefficient	Standard Error	t-statistic	Likelihood
Monday	0.002339	0.001167	2.004041	0.0452
Tuesday	0.000590	0.001203	0.490127	0.6241
Wednesday	-0.000192	0.001275	-0.150620	0.8803
Friday	0.001547	0.001220	1.268414	0.2048
C	0.000201	0.000881	0.228240	0.8195
AR(1)	-0.484016	0.092938	-5.207936	0.0000
AR(2)	-0.787336	0.069008	-11.40932	0.0000
MA(1)	0.518560	0.088716	5.845160	0.0000
MA(2)	0.821829	0.068447	12.00686	0.0000
SIGMASQ	0.000247	1.69E-06	146.5434	0.0000
R-squared	0.008571	Mean dependent var	0.001060	
Adjusted R-squared	0.004704	S.D. dependent var	0.015803	
S.E. of regression	0.015766	Akaike info criterion	-5.457609	
Sum squared resid	0.573440	Schwarz criterion	-5.432801	
Log likelihood	6332.640	Hannan-Quinn criter.	-5.448568	
F-statistic	2.216095	Durbin-Watson stat	2.028873	
Prob(F-statistic)	0.018608			

Table A3. Results of the Month of the Year Effect Regression Model

Estimation Results of the ARMA(2,2) Model for the Month of the Year Effect				
Parameters	Coefficient	Standard Error	t-statistic	Likelihood
January	0.001285	0.001694	0.758601	0.4482
February	-0.000741	0.001942	-0.381549	0.7028
March	0.000395	0.001526	0.258802	0.7958
April	-0.000999	0.002246	-0.444918	0.6564
May	0.000618	0.001730	0.357232	0.7210
June	-0.001687	0.001906	-0.885023	0.3762
July	0.000559	0.001935	0.288881	0.7727
August	0.000417	0.001404	0.296987	0.7665
September	-0.001268	0.001719	-0.737711	0.4608
October	-0.002008	0.001813	-1.107964	0.2680
December	-0.000700	0.001484	-0.471807	0.6371
C	0.001425	0.000999	1.426941	0.1537
AR(1)	-0.473539	0.099408	-4.763597	0.0000
AR(2)	-0.774679	0.070143	-11.04422	0.0000
MA(1)	0.510182	0.094793	5.382086	0.0000
MA(2)	0.810282	0.070052	11.56682	0.0000
SIGMASQ	0.000247	1.84E-06	134.6733	0.0000

R-squared	0.008845	Mean dependent var	0.001060
Adjusted R-squared	0.001950	S.D. dependent var	0.015803
S.E. of regression	0.015788	Akaike info criterion	-5.451844
Sum squared resid	0.573282	Schwarz criterion	-5.409670
Log likelihood	6332.961	Hannan-Quinn criter.	-5.436474
F-statistic	1.282879	Durbin-Watson stat	2.032214
Prob(F-statistic)	0.198660		

Table A4. Results of the Seasonal Anomaly Regression Model

Estimation Results of the ARMA(2,2) Model for the Seasonal Anomaly				
Parameters	Coefficient	Standard Error	t-statistic	Likelihood
Spring	0.001082	0.001091	0.991571	0.3215
Summer	0.000825	0.001042	0.791667	0.4286
Winter	0.001031	0.001057	0.975469	0.3294
C	0.000346	0.000722	0.478761	0.6322
AR(1)	-0.476621	0.095927	-4.968585	0.0000
AR(2)	-0.776745	0.069651	-11.15187	0.0000
MA(1)	0.512907	0.091675	5.594835	0.0000
MA(2)	0.811939	0.069455	11.69006	0.0000
SIGMASQ	0.000248	1.64E-06	151.5150	0.0000

R-squared	0.005875	Mean dependent var	0.001060
Adjusted R-squared	0.002429	S.D. dependent var	0.015803
S.E. of regression	0.015784	Akaike info criterion	-5.455757
Sum squared resid	0.575000	Schwarz criterion	-5.433430
Log likelihood	6329.495	Hannan-Quinn criter.	-5.447620
F-statistic	1.705022	Durbin-Watson stat	2.033307
Prob(F-statistic)	0.092291		

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