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Analysis of the Effect of Macroeconomic Variables on Fluctuation of Future Gold Market in Iran

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ABSTRACT

The future value of gold coins has received much attention in the world for its risk-taking function. The introduction of this tool into the Iranian financial market was not initially welcomed, but over time it was welcomed by investors in the futures market. Therefore, the volatility of gold coin futures trading and its influencing factors is important. In this study, the effect of macroeconomic variables affecting the volatility of gold coin futures trading is with GARCH MIDAS Model investigated. Therefore, in this study, the effect of selected macroeconomic variables (inflation, exchange rate, oil price and liquidity) and changes of each of these variables have been investigated on future gold market in Iran during the period of 2009-2017. In order to estimate the model, the effect of each of the variables on the gold coin futures fluctuations is first investigated individually. Then, using the principal component analysis, the macro variables index was extracted and estimated in the model. The results indicate a significant effect of macro variables on the future fluctuation of gold coins. Rising inflation and rising oil prices lead to a long-term component of the currency and the exchange rate will reduce the volatility of gold coin futures.

1. Introduction

Gold has been used as a multipurpose metal and has been a tool for wealth preservation because it has protected it against various risks. With the increasing role of the gold market, statistical modeling and prediction of gold market fluctuations have attracted widespread attention (Batten et al. 2010). In times of war, revolution, and extreme inflation, a nation's currency

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cannot play its role as a store of value, as government's inevitably print unsecured money to finance the cost of war and exit the recession. Increasing the volume of circulating money and reducing production and diverting the country's resources from welfare to war production and equipment will cause inflation and reduce the value of money. At this time, people turn to gold to preserve the value of their property, which increases in value with inflation and benefits its holder against inflation. So gold is an important asset because of its high liquidity power in the worldwide. The price of gold around the world is determined by the dollar or national currency of the country and if gold is denominated in the national currency of a country, this calculation is determined through the exchange rate of the dollar and the national currency and the dollar and gold. Analysis of gold world Council shows that gold can be used to maintain purchasing power during the period of momentum. Although (Barro & Misra, 2016) noted that gold may not always be a risk management tool, they found that the average annual return on gold in a set of macroeconomic crises was 1.2%, whereas in normal periods it was not more than 1.5%. Between 1836 and 2011, the standard deviation of the annual return on the gold market was 13.7%, which was only 3% below the volatility of the US stock market. It is therefore important to know whether gold market fluctuations are independent of the macroeconomic situation and how macroeconomic factors affect the gold market (Fang et al. 2017).

Firstly, most research is based on the hypothesis that commodity futures are an asset type, and therefore researchers have used asset pricing models used in equity markets to price commodities (Shang et al., 2016). n recent decades, commodity futures have shown significant price volatility. At the beginning of 2002 commodity markets entered a strong upward trend and prices peaked in middle of 2008. In the second half of 2008, with the advent of the global financial crisis, commodity prices experienced a significant decline, although commodity prices have improved since March 2009, but they are still highly volatile. Price fluctuations tend to affect current and future production capacity as well as government and corporate investment decisions. As price volatility grows, producers and consumers may incur higher borrowing costs as well as greater fluctuations in their liquidity. The challenges associated with high volatility necessitate the identification of key determinants for producers, researchers, and policymakers. Manufacturers and consumers can make their investment decisions wiser by understanding the dynamics of volatility (Mi et al. 2017).

Gold coin future trades have acted as a hedge against speculators' risk and speculation and examined how factors in gold coin futures volatility have reduced the risk of trading and stabilizing the market. Many factors influence the future fluctuation of the gold coin, including short and long term factors, which include some macroeconomic variables. Therefore, the effect of these macro variables on the futures fluctuation of gold coin is investigated using the GARCH-MIDAS model.

In this paper, the effect of macroeconomic variables on the futures price fluctuation of gold coins is investigated, because of the inconsistent frequency of the variables, i.e., high and low frequency of the hybrid GARCH model. Previous studies have been mainly restricted to variables that have available daily data. To investigate the impact of some low-frequency macro variables, some studies such as (Batten et al. 2008) used higher frequency data to lower frequency, as a criterion for low-frequency observations. This method generally prevented the extraction of information from high-frequency data and eliminated a considerable amount of useful information (Ghysels et al. 2007). The GARCH-Midas approach is therefore used by Engle et al. because it can improve the problem of mismatch between daily data and macroeconomic variables. The GARCH-Midas approach has the advantages of separating short- and long-term components of volatility and employs a straightforward approach that encompasses time series. Engel et al 2013, found long-term component models in which data loss was reduced due to multi-stage estimation. In addition, given that the macroeconomics is slowly evolving, the Low frequency component modeling of fluctuation is more rational with the GARCH-Midas model and can be used for any series without the need for economic structure specifications. Therefore, high-frequency gold data are combined with macroeconomic variables that are only observed at low frequencies (Mi et al. 2017). Using this model and macroeconomic data as well as gold coin futures data on the Iranian commodity exchange, the subject is discussed.

In this article, after reviewing previous studies and researches, we have reviewed the macroeconomic data and the future price of gold, as well as the Midas GARCH model. In the preliminary results section, first the time series mania were tested and the normality test was performed on the time series wastes. In the next steps, the weight function was extracted and the optimal interruption of the model was selected. Then, with the entry of variables in the GARCH Midas model, the effect of macro variables on the future fluctuation of gold was investigated. Finally, a general conclusion of model estimation with research variables is presented.

2. Research literature

Lan et al. (2019), examined empirical analysis between macroeconomic variables and gold prices based on the relationship between a particular set of macroeconomic variables (stock index, crude oil and exchange rates) and gold prices. The study contains 18 years of annual data from 2001 to 2018. The regression equation and correlation matrix were used to investigate the relationship between gold price returns and a set of macroeconomic variables. The Breusch-Godfrey Test was also used to determine the accuracy and normality of time series data. The results show the positive effect of gold price return on crude oil prices and the KSE-100 index is negative and significant at 1% and 10%, respectively. Gold prices and exchange rates are significant but negatively correlated.

Fung et al. (2017), by predicting the futures of the gold futures market using macroeconomic variables in the United States, investigated the effect of macroeconomic variables on the futures gold fluctuation using the GARCH-Midas model in the United States. They found that macroeconomic variables have a significant effect on gold fluctuation. Unemployment and inflation variables have a positive effect on gold market volatility.

Aylin & Erdogdu (2017, examines the most important factors affecting gold prices in the United States by studying the dynamic factors affecting gold prices and determining macroeconomic variables that play an important role in this process. The data were analyzed by the Central Bank of America and with the help of Eviews econometrics software and using the GARCH model. The results indicate a negative relationship between gold prices and the US currency, as well as a negative relationship between gold and silver prices and oil prices.

Ranjusha et al. (2017) examined the relationship between gold price and exchange rate in India using exchange rate and gold price data from 1970 to 2015. Various econometric tools such as unit root test, Johansen coefficient test, VECM vector error correction model and Granger causality test have been used to determine the long-run relationship. The results show that there is a long-run relationship between the variables and that gold price movements can be kept constant by controlling the exchange rate fluctuation. It also states that there is no causal relationship between the exchange rate and the price of gold, and vice versa. This means that the time series data of one variable cannot be used for another prediction.

Mi et al. (2017) study the effect of macroeconomic factors on commodity stock exchange including agricultural commodities, metals and oil in two emerging markets of China and India, by studying the macro factors determining the future volatility of commodity markets in China and India. Macroeconomic factors include domestic and international macroeconomic variables that represent the economic environment, monetary policy and financial market information. In this study, Garch-Midas model is used to investigate the long-term component of volatility. The results indicate that domestic and international macroeconomic variables play an important role in determining commodity market price volatility.

Hashim et al. (2017), examined macroeconomic factors affecting gold prices in the world's largest gold-consuming countries (India, China, the United States, Turkey, and Saudi Arabia). SPSS software was used to assess the possible relationships between gold prices and inflation rates, real interest rates, exchange rates, crude oil prices and GDP as well as annual data for 20 years from 1996 to 2015. The results showed that there is a positive relationship between crude oil price and gold price and there is a negative relationship between inflation rate, GDP, real interest rate, exchange rate and gold price. Regression results showed that independent variables other than exchange rate had a significant effect on gold price.

Liu et al. (2015) used an asymmetric spline-GARCH model to study low-frequency volatility in the Chinese gold futures market and its determinant macro factors to investigate the macroeconomic determinants of low-frequency volatility in China's gold futures. Their study provided unique solutions. This is the first study focused on an emerging commodity market that includes a wide range of macroeconomic variables from the Chinese and US markets. The results show that gold futures fluctuations are mainly determined by macroeconomic fluctuations and investor behavior, which are the main determinants of consumer price index fluctuations in China and US dollar fluctuations. The study by Liu et al is the only study based on information from the Chinese gold market. However, given the important role emerging markets play in the world, it is important to examine the macroeconomic determinants of emerging commodity markets.

Hazila & Noorsaadah (2015) examined the relationship between selected macroeconomic factors and gold prices in Malaysia to determine the relationship between macroeconomic factors such as oil prices and exchange rates, GDP and inflation with gold prices. They analyzed the relationship between macroeconomic variables and gold prices using multiple linear regression and SPSS software. The results show a positive relationship between oil prices and gold prices, as well as a negative relationship between the exchange rate and gold prices, and the relationship between GDP and positive gold prices, but with lesser effect, and a positive inflation relationship with gold prices.

Nadeem et al. (2014) studied the effects of inflation, stock prices, world gold prices, dollar-based rupees, world oil prices and earnings on the domestic gold price. Given the frequent fluctuations in gold prices, monthly time series data for the period 2000 to 2012 were used in this study. The effect of macroeconomic variables on gold prices in Pakistan has been investigated using GMM method. GMM results showed that inflation, world gold prices, world oil prices and earnings had a significant positive impact, while stock prices and exchange rates had a positive impact on gold prices in Pakistan. The results of this study are useful for financial analysts, policy makers, and investors in analyzing the determinants of gold prices and policy and investment decisions.

Tufail & Batool (2013) have developed a new inflation equation to measure the effects of gold and stock prices on inflation in Pakistan, which aims to evaluate the characteristics of inflation of gold compared to other assets such as real estate, securities and foreign exchange reserves. Using time series econometric methods such as cointegration and vector error correction models (VECM) and applying 1960 to 2010 data, they found that gold is a determinant of inflation in Pakistan. In other words, it is also not a full-fledged inflation hedge. Real estate assets are more of a hedge against expected inflation, although the Stock Exchange has listed gold and real estate as a hedge against unforeseen inflation. Given the dual nature of the relationship between gold and inflation, the regulation and adjustment of the gold market in Pakistan have a particular importance to the government. Investment in the stock market should therefore be encouraged by the government, as asset price inflation is not yet a major issue in Pakistan.

Lee and Chang (2012) examined the impact of oil price fluctuations on gold market returns using monthly data from 1994 to 2011. They used a multivariate VAR model to examine the dynamics between oil price shocks and gold yields. Experimental tests use different criteria for oil prices to illustrate the nonlinear relationships in the dynamics between oil price shocks and gold yields. Oil price shocks appear to have a significant positive and negative effect on real yields of gold, whose effect is symmetric but nonlinear. The results indicate that oil price fluctuations can help predicting gold price movements, which will significantly help monetary authorities and policymakers in controlling commodity prices as well as in investors and managers in securities optimization.

Simakova (2011), by studying the relationship between oil and gold using monthly data from 1970 to 2010, found a long-run relationship between the analytical variables. This study provides an analysis and determination of the common features of driving factors between price levels as well as the underlying factors that determine the current price trend. This study uses the method of analyzing and integrating theoretical knowledge from existing literature, published articles and other publications, including quantitative analysis of variables such as Granger causality test, Johansen coefficient test, and VECM vector error correction model.

Button et al (2010) studied the macroeconomic determinants of monthly price volatility for the four precious metals (gold, silver, platinum, and palladium) by studying the macroeconomic determinants of the precious metal market. Macroeconomic determinants are variables related to the business cycle, monetary environment and financial market sentiment. The results for different commodities are different, especially gold fluctuations explained by monetary variables such as money volume and inflation.

According to previous studies using different economic models such as splin garch, midas garch as well as co-integration and vector error correction (VECM) models and in some studies using multiple linear regression method to The effect of macroeconomic variables on the gold market was investigated and the results show the significant effect of some macro variables such as inflation, exchange rate, oil prices, etc. on the price of gold. Most of the studies with different methods pointed to almost similar results regarding the positive effect of inflation and liquidity and oil prices on the price of gold, as well as the negative effect of the exchange rate. Our research using the GARCH-Midas method and examining the component, long-term volatility of macro variables, as well as the direct use of data with different frequencies to prevent data loss, achieved results that include the positive effects of inflation, liquidity and oil prices. On the future fluctuation of gold as well as the negative and significant effect of the exchange rate. Therefore, the findings of the present study in most cases were consistent with previous findings.

3. Data and research methodology

The data used in this paper are the daily time series of gold futures returns from April 2009 to March 2017 as dependent variables and the variables of inflation, exchange rate, oil price and liquidity as independent variables are reported as monthly variables. The CPI (Consumer Goods and Services Price Index) is used to calculate inflation. The unofficial exchange rate reported by the Bank of Iran and Brent oil prices were also used in the data collection. The liquid variables here include money and near money. Gold coin futures yields have been extracted from the gold futures prices and in the two-month maturities from Iranian commodity exchange site.

Monthly macro variables are also collected from the Bank of Iran website. This variable has been studied until March 2017 due to the gold coin futures stop since 1977 and lack of data.

3-1. GARCH-Midas model

In this paper, a new type of GARCH model based on Midas regression is used. Midas regression models were introduced by Giesels et al. (2006). The Midas model provides a framework for combining macroeconomic variables with financial time series at different frequencies. This new component of the GARCH models is called the Midas GARCH, where macroeconomic variables enter directly into the long run. This new type of GARCH model has attracted much attention in recent years by Giesels et al. (2004). Kutze (2007) used the Midas regression with high-frequency data on asset prices to predict inflation with low-frequency data. In addition, a number of articles used regression to predict seasonality with daily and monthly data. For example, Bai et al. (2009) and Tai (2007) used monthly data to improve seasonal forecasts.

Fluctuation is one of the most important financial concepts that discuss uncertainty or financial asset risk. Financial series have a specific feature called the swing cluster. Cluster fluctuation is a phenomenon in which a large fluctuation in prices tends to form clusters together and these clusters remain stable for a long time. In other words, there is a positive correlation of returns in different periods. This phenomenon violates the assumption of homoscedasticity. To address this problem, Engles (1982) introduced a model called Arch. In this model, the short-run variance appears to depend on the square of the previous errors. Four years later Bollevslev (1986) extended the Arch model to a common version called the GARCH. Unlike the Arch model, the GARCH model allows the variance of errors to depend not only on past values of errors but also on past values of variance. So it's called a short-term variance.

Engels, Geissels, and Sun argued that fluctuation has different components. They also added benefits to the model with these components. In an effort to find out the effect of macro variables on the stock market volatility, Engle and Rangel (2008) proposed an idea of dividing the volatility of returns into short and long term components, called Spline-GARCH. The long run component is reported for low frequency macro variables, while the short run component is the inverse of GARCH. Compared to the original GARCH model, this model allows for short-term variance changes over time. But there are some drawbacks to this model. First, it cannot directly import large variables into the model. So the estimation has to be done in several stages which results loss of information during the estimation process. Engle et al (2008) developed this model using a new method called Midas. Midas was introduced by Geissels et al (2005). In their paper, data with different frequencies are included in the same model. Particularly the square of daily returns has been used to predict low frequency fluctuations. The combination of the Spline GARCH and Midas model is called the GARCH Midas model. As with the Spline GARCH model, the fluctuation is still the product of short and long-term components. The short-term component means a return to the Spline GARCH model. However, the long run component now reflects information on actual variance or macroeconomic variables. Engle et al (2008) suggested some benefits of this model compared to Schwartz's (1989) conventional approach. First, both the long run and the short run come from regression. Second, macro variables can be directly modeled by one-step estimation (Asgharian & Huang, 2015).

Following is a description of the GARCH Midas model:

Based on GARCH Midas model, the returns are as follows:

$$r_{i,t} = \mu + \sqrt{\tau_t . g_{i,t}}\varepsilon_t \quad , \qquad \forall_i = 1,2,\dots,N_t \qquad (1)$$

And $r_{i,t}$ is the return on day i in month t. τ_t is the long-term swing component and $g_{i,t}$ is the short-term swing component.

Macroeconomic factors that are observed in the monthly frequency will, in addition, have long-term impact.

$$\varepsilon_t | \emptyset_{i-1,t} \sim N(0,1) \qquad (2)$$

So that $\emptyset_{i-1,t}$ provides information for day i-1 of period t.

Short-term variance follows the GARCH (1 and 1) process:

$$g_{i,t} = (1-\alpha-\beta) + \alpha\frac{(r_{i-1,t}-\mu)^2}{\tau_t} + \beta g_{i-1,t} \quad (3)$$

$$\alpha > 0 \quad , \beta > 0 \qquad و \ \alpha + \beta < 1$$

Unlike Schwartz's (1989) and other conventional methods that used past values as a criterion, the Midas GARCH method creates a long-term component with the weight function.

$$\tau_t = m + \theta_l \sum_{k=1}^{K} \varphi_k\,(\omega_1, \omega_2) X_{t-k}^{l} \quad (4)$$

A logarithmic form is used to avoid the negative effect of the long-term component of the fluctuation in the estimation process.

$$\tau_t = \exp\left(m + \theta_l \sum_{k=1}^{K} \varphi_k\,(\omega_1, \omega_2) X_{t-k}^{l}\right) \quad (5)$$

K is the optimal number of interrupts that the oscillation is estimated to use.

X_ (t-k) ^ l is the level of macroeconomic variables at k intervals.

The weight function β used in the equations is as follows:

$$\varphi_k(w) = \frac{\left(\frac{k}{K}\right)^{\omega_1-1}\left(1-\frac{k}{K}\right)^{\omega_2-1}}{\sum_{j=1}^{K}\left(\frac{j}{K}\right)^{\omega_1-1}\left(1-\frac{j}{K}\right)^{\omega_2-1}} \quad (6)$$

Geisels,Santaclara,and Valcano(2005) put forward some features of this scheme:

1. All weights are positive.
2. The sum of the weights equals one
3. Different values of ω_2 and $\omega_2$can give various forms of weighting, such as uniformly increasing, decreasing, or shaped between the two.
4. It only contains two parameters, so the model estimation is easy to do.

The weight scheme can also be used as the following weight scale:

$$\varphi_k(\omega) = \frac{\omega_k}{\sum_{j=1}^{K}\omega_j} \quad (7)$$

Existing literature shows that both methods have similar results. Therefore, the beta function is used in this study, because it's more flexible. The weights in Equation (7) show the effect of past information on stock volatility. Larger weight has stronger analytical power. The purpose of this estimation is to calculate the parameters $\Theta = \left\{\mu, \alpha, \beta, m, \theta, \omega_1, \omega_2\right\}$. In addition to the level of macro variables; we also want the second most effective factor in the swing. This is done by the following equation:

$$\tau_t = \exp\left(m + \theta_v \sum_{k=1}^{K} \varphi_k (\omega_1, \omega_2) X_{t-k}^{v}\right) \quad (8)$$

X_{t-k}^{v} is the fluctuation of macro variables at k intervals.

It should be noted that the surface weights and fluctuations of the variables are different. Fluctuation of macro variables estimates 12th autoregressive.

$$X_t = \sum_{j=1}^{12} \propto_j D_{jt} + \sum_{i=1}^{12} \beta_i X_{t-i} + \varepsilon_i \quad (9)$$

Then the residuals of the above equation are used as the oscillations of the macro variables. This criterion has also been used by Engels et al. (2008) (Asgharian & Huang, 2015).

3-2. Summary of statistics and normality test

Many economic and financial variables often violate the assumption of normality, which is due to the nature of the data as well as the existence of remote observations. The normality test, which is tested by the Jarque-bera method, is based on skewness (asymmetry) and elongation (wide tails). Remote observations can violate the assumption of normalcy. The presence of distant observations causes excessive elongation and therefore turns it into a wide tail distribution. This is a phenomenon that is commonly seen in stock market data. According to the table (1), the assumption of normality for the variables of inflation, exchange rate, oil price and liquidity, as well as the future price of gold is rejected. Therefore, not all research variables have a normal distribution.

Table 1. Normality Test

Variable	INF	EX	OIL	M2	GOLD
Mean	18.10	20730	79.58	663999	0.00
MEDIUM	15.55	24792.50	76.15	5285829	0.00
Max	40.4	37424	122.8	5299476	0.13
Mean	8.6	9741.3	28.3	1970485	0.09
Standard deviation	9.03	9676.99	26.76	4030308	0.01
skewness	0.99	0.088	-0.11	0.65	0.95
kurtosis	3.03	1.282	1.57	2.15	13.00
jarque bera	17.73	13.42	9.35	10.910	10147
Probability	0.00	0.00	0.00	0.00	0.00

3.3. Preliminary results

This section of the paper is devoted to model analysis and estimation. First, the decay time series are checked by Dickey Fuller test. The model is then estimated using the weight function estimation and determining the optimal interval. Initially, the macroeconomic variables are individually included in the estimation model. Large variables include inflation, exchange rates, oil prices, and liquidity, which enter both the level and the fluctuation of these variables. Finally, using the correlation matrix of the model variables, the main component of the macro variables index is extracted and then using this index, the GARCH Midas model is estimated.

3.4. Variance Test of Variables

In econometrics, the most important debate currently exists is to examine ways to ensure that the estimated regression is false. Non-false regression studies evaluate estimations in different ways. Mainly unstable variables or in other words, random time series of variables leads to false regression estimation. Therefore, before testing the research hypotheses, since the data is time series, the reliability of the model variables is investigated by generalized Dickey Fuller method.

According to Table (1), it can be seen that the null hypothesis that the existence of a unit root for the gold coin price variable is at the variable level and with the width of the source is rejected, which means Stationary of variable. Inflation, exchange rate, oil price, and liquidity variables in their first order difference with the intercept and process are stationary.

Table 2 . Time series analysis of macro variables

Name of variable	Probab ility	Critical value 10%	Critical value 5%	Critical value 1%	t-statistic
GOLD	0.000	-2.567341	-262527	-3.432842	-35.58382
INF	0.0004	-2.582041	-2.890037	-3.495677	-4504813
EX	0.000	-2.581596	-2889200	-3.493747	-6.956794
OIL	0.000	-2.581493	-2.888932	-3.493129	-7.559198
M2	0.000	-2614300	-2.951125	-3.639407	-5.801216

3.5. Weight function estimation

During estimation, several strategies are developed to simplify estimation and make the model more efficient:

We must first select the weights of ω_1 ω_2 in the beta function. There are three alternatives for ω_1 and ω_2:

1. Estimate ω_1 and $\omega_2$as free parameters within the model
2. Holding constant ω_1 and estimating ω_2 in the model
3. Holding constant $\omega_1$and ω_2

Figure (1) shows the plot of the weight function for two choices of ω_1(1,2,4) and two choices of ω_2(2,4,7) .This shows that as long as ω_1 is equal to 1, the weight function decreases uniformly. Given that ω_1 is equal to one, the increase in ω_2 gives more weight to recent observations. ω_1 which is Greater than one gives less weight to recent observations. According to engles et al. (2009), the weight ω_1 is considered to be twice as large as to reduce the weight uniformly during the break. Since there is no preference for choosing ω_2 , we allow estimating the model ω_2.

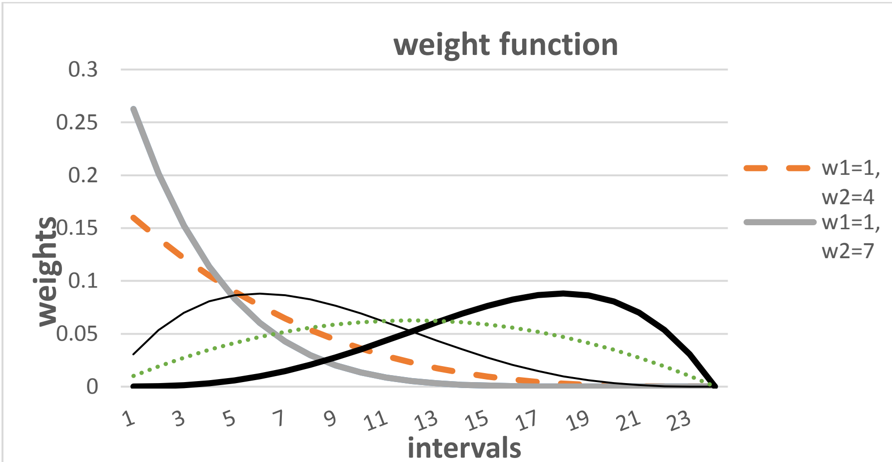

Figure 1. Weight function for different values of ω_1 and ω_2

3-6. Determine the optimal timeout

In order to determine the optimal interval in the Midas equation, the number of total interruptions is determined using the number of Midas years and by the time period t used to calculate τ_t in Equations (3) and (4). This time period can be one month, one season or half a year. Due to the short time period in this paper monthly periods are used and by optimizing the loglikelihood function values in Fig. (2) Using different interrupts, the optimal interrupt number is calculated in the Midas equation. Figure (2) shows that the optimal value of the logliklihood function increases with increasing number of interrupts and reaches its highest value in about 24 interrupts. Therefore, the optimal number of interruptions is considered in the Midas equation 24.

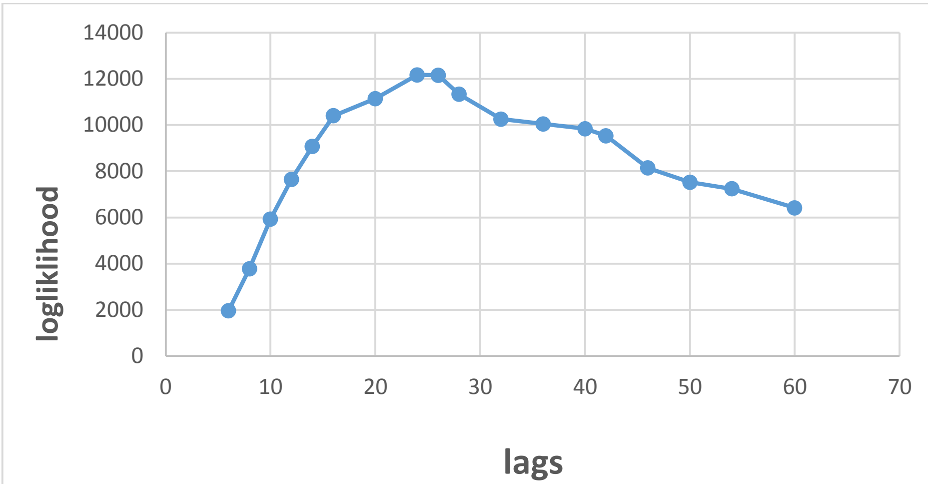

Figure 2. Determine the optimal model lag with logliklihood values

4. Estimation of research model with macro variables

The estimation of the research model is first performed by extracting the beta weight function and determining the number of optimal interrupts by maximizing the logliklihood function. Then by estimating the optimal interval and monthly data of macro variables and future gold coin daily data are estimated in the parameters model.

In this section, the level of macro variables is individually entered into the GARCH Midas model. According to Table (2) among the estimated parameters, the parameter θ_l indicates the relationship between the level of macro variables and the long-run future volatility of the gold coin. LLF is the value of the logliklihood function and the BIC is the busy information criterion. In this estimation, it is important to evaluate other parameters about how macro variables information affects the long-term future fluctuation of the gold coin. The results of model estimation with inflation variable indicate positive and significant μ values as well as α and β at 5% confidence level and the sum of the two parameters is always close to one and less than one. The parameter θ is positive and significant, indicating an increase in the inflation rate associated with an increase in the gold coin futures price fluctuation. The effect of inflation on the futures fluctuation of the gold coin is calculated by the parameters θ and ω. According to the estimated parameters $\theta = 0/0966$ and ω = 5 the weighting coefficient ϕ is calculated. So increase of 1 percent in inflation in this month will cause 0.77 percent increase in the futures price of the gold coin next month, and so will continue in the next intervals. By introducing the exchange rate variable into the model and estimating the parameter θ which is -2.75 and also the value of the parameter ω which is a weighted function of 4.9, it can be said that with the increase of the exchange rate this month, the coin futures fluctuation of gold will down 52.25% next month. The results of the estimation with the oil price variable also show the positive effect of this variable on the futures fluctuation of the gold coin. According to table (2), the parameter value θ is estimated to be 0.071 and ϕ 0.19. Thus, with a 1 percent increase in oil prices this month, the futures for the gold coin will increase by 1.4 percent next month and finally the liquidity variable will be examined. The value of parameter θ is calculated to be 6.62 and the weighted function is equal to 0.26 which indicates the type and amount of liquidity variable's impact on the futures fluctuation of the gold coin.

In this paper, in addition to the level of macro variables, the variations (fluctuation) of the variables are entered into the model and the estimated results are as described in Table (3). Inflation changes have a positive and significant effect on the gold futures fluctuation, with θ values of 0.099 and ω of 6.69. So 1 percent increase in inflation this month will cause 60.21 percent increase in the gold futures fluctuation in the next month. Also, changes in exchange rate due to negative value of parameter θ have negative effect on futures fluctuation of gold coin. Oil price changes also have a significant positive effect on the futures fluctuation of the gold coin, with an estimated θ of 0.096 and ω of 0.69. The effect of liquidity changes on the gold futures fluctuation is also positive and significant. One percent increase in liquidity this month will lead to a 3.34 percent increase in the gold futures fluctuation in the next month.

Table 3. Results of estimating the Midas GARCH model with the level of variables

parameters	inflation	Exchange rate	Oil price	Liquidity
M	4.8021	7.7136	7.4797	7.7296
A	0.3017	0.3017	0.3017	0.3017
B	0.5752	0.5752	0.5752	0.5752
θ_l	0.0966	-2.755	0.1000	6.6278
ω	6.6985	6.6985	6.6985	6.6985
M	-0.0089	0.0095	8.629	0.0099
LLF	3765.96	4461.5	13278.9	3783.85
BIC	-7485.13	-8876.2	-26511.1	-7520.91

Reference: research findings

Table 4. Estimation results of GARCH Midas model with macro variables changes

Parameters	Inflation	Exchange rate	Oil Price	Liquidity
M	7.5375	7.7218	7.3533	7.7296
A	0.3017	0.3017	0.3017	0.3017
B	0.5752	0.5752	0.5752	0.5752
θ_v	0.0999	-7.5073	0.0969	3.4104
ω	6.6985	6.6985	0.6985	6.6985
M	-2.0544	0.0098	-0.0051	0.01
LLF	5751.5	-3194.18	2717.06	1215.76
BIC	-11465.2	-6341.56	-5378.33	-238472

Reference: research findings

4-1. Correlation matrix

Given that the Midas GARCH model is computationally complex and the incorporation of several macroeconomic variables into one model has led to the identification of cross-border problems. So at one time a variable is used in the Midas equation. In order to combine the information contained in the various variables in the same equation, the basic components are also constructed based on these variables. Since macroeconomic variables have different scales, the correlation matrix is used to construct the underlying component.

Table (4) shows the correlation between monthly observations of macroeconomic variables. As expected, oil prices have a negative correlation with the exchange rate, and inflation and liquidity have a positive correlation. There is also a positive correlation between liquidity and exchange rate, and inflation and exchange rate have a positive correlation. The highest correlation was observed between exchange rate and liquidity and the lowest correlation was observed between exchange rate and inflation. Using this correlation matrix of variables and information provided, the underlying component is constructed and used to estimate the model as an index of macro variables.

Table 5. The correlation matrix of the model variables

	EX	INF	M2	OIL
EX	1.000000			
INF	0.209067	1.000000		
M2	0.942014	0.368027	1.000000	
OIL	- 0.696631	0.536372	0.651563	1.000000

Reference: research findings

4-2- Basic Components

According to Table (5), the number of extracted components is equal to the number of variables. In fact, four vectors were extracted for each of the four variables, and all of the data set dispersion was considered in this study. Drawing the graph selects the best component for estimation. Figure 3 shows that the first component is the most appropriate choice. According to Table (5), the eigenvalue of the first component is greater than one, and about 70% of the data set is represented by this component. Therefore all criteria show that the selection of the first component is sufficient for estimation. Regarding the computational coefficients in the first vector, it can be said that the most correlations with the first component are in the variables of liquidity, exchange rate, oil price and inflation respectively. The first vector, called pc1, can be used as an index of selected macro variables in model estimation. The linear combination of the first component and the main variables is as follows:

Table 6. Basic components

PC	Value	Difference	Proportion	Cumulative
1	2.762646	1.871297	0.6907	0.6907
2	0.891347	0.574180	0.2228	0.9135
3	0.317167	0.288327	0.0793	0.9928
4	0.028840	-	0.0072	1.0000

Pc1 =0.54 EX –0.34 INF + 0.55 M2 –0.52 OIL

PC	PC1	PC2	PC3	PC4
EX	0.545666	0.423762	0.088976	0.717467
INF	-0.340841	0.844655	-0.364076	-0.194511
M2	0.556945	0.272437	0.452929	-0.640660
OIL	-0.525251	0.181003	0.808943	0.192254

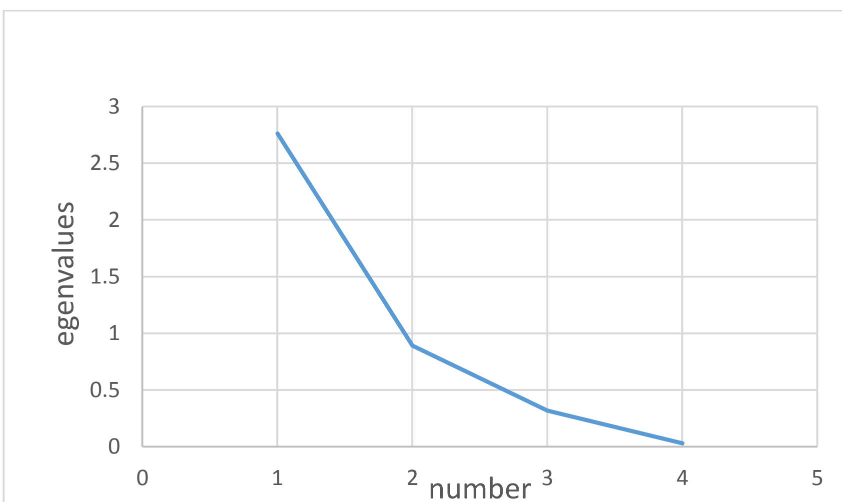

Figure 3. Eigenvalues of vectors

4-3-Estimation of the model with basic component of macroeconomic variables index

By estimating the model using the basic component of macroeconomic variables index, the effect of selected macroeconomic variables on the long run component of the volatility was investigated. The parameter θ indicates a positive and significant effect of variables on the future fluctuation of gold coins. The results show that the fluctuation of the macro variables in the estimation periods leads to an increase in the future fluctuation of the gold coin yield.

Table 7. Results of the model estimation with the basic component of macro variables index

Parameters	Coefficients	Statistic t	Probability
M	7.4931	0.1666	0.0476
A	0.0558	0.7122	0.0176
B	0.9441	6.4039	0.00
θ	0.1000	133.37	0.00
ω	6.363	7.3018	0.00
M	0.0017	689.26	0.00
LLF	5061.45		
BIC	-10076.1		

5. Conclusion

In this paper, the effect of selected macroeconomic variables (inflation, exchange rate, oil price and liquidity) on the volatility of futures price of gold coins in Iran was studied using monthly time series data from GARCH Midas model during 2009-2017. GARCH Midas model was used separately to allow direct input of data at different frequencies as well as to study the long and short term component of fluctuation. First, by examining the effect of each of the macro variables on the futures fluctuation of the gold coin, it is found out how is the affection of variables and how much is their affection. Inflation variables entered the model at the level and changes and the model results indicate a positive and significant effect of inflation on the long-term component of the future gold coin fluctuation. Long term component of the fluctuation always accompanies the total fluctuation and its effect on the total fluctuation is observed. Another macro variable that is included in the model is the exchange rate, which has a negative effect on the futures fluctuation of the gold coin. That is, as the exchange rate rises and changes, the long-term component of the gold coin's future volatility also decreases. Long run fluctuation of the exchange rate in the years 91 and 92 corresponds to the total fluctuation. This means that short-term volatility has had little effect on total volatility in these years. The oil price has a positive and significant effect on the gold futures fluctuation and the long-term component of the fluctuation in the year 94 corresponds to the total fluctuation. The liquidity variable also has a positive effect on fluctuation. In addition to estimating the model with single macro variables, the principal component analysis was used to investigate the effect of the total macro variables on the gold futures fluctuation. Using the correlation matrix between variables, the underlying component with the highest correlation between variables was selected and entered into the model as a criterion for the index of macro variables. The results of the model estimation with the underlying component indicate the positive effect of macro variables changes on the gold futures fluctuation. Therefore, the results of this study emphasize the reduction of future gold coin fluctuations by using macro variables. Given that the gold coin futures contract itself is a means of covering the risk of gold price changes, reducing the volatility of these transactions through macroeconomic variables can reduce the risk and uncertainty of gold coin futures.

Due to the positive effect of inflation on the future fluctuation of gold coins in Iran, it is recommended to policymakers and the government By controlling inflation through contractionary and expansionary policies, as well as controlling the exchange rate with supply and demand, and using the policies of the central bank and various financial instruments, try to reduce the fluctuation of the future price of gold coins. To be able to reduce the risk of investing in this financial asset. By controlling and directing these macroeconomic variables, they can stabilize the gold coin futures market and reduce trading risk.

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