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IS GOLD INVESTMENT AN EFFECTIVE HEDGE AGAINST INFLATION AND U.S. DOLLAR? EVIDENCE FROM TURKEY

Abstract. *Gold is regarded as "safe haven" for most investors due to its stable movement over the long run. This paper examines whether gold is an effective hedge instrument against the inflation and the currency risk of Turkish Lira against U.S. Dollar using the monthly data from February 1986 to June 2013. We in this study employ new generation Kapetanios (2005) unit root and Maki (2012) cointegration tests allowing unknown number of breaks that are determined endogenously. This method is regarded as superior to previous cointegration tests because it considers all economic crises over the long run and all developments that cause the radical changes in the economy. Our findings show that gold is indeed an effective investment tool to hedge against the risks of inflation and currency risks. We therefore conclude that it is always rational to include gold for a well-diversified portfolio.*

Keywords: *Gold, Inflation Risk, Currency Risk, Hedging, Portfolio, Cointegration.*

JEL Classification: G11, F31

1. Introduction

Gold, the representative of precious metals, has always been regarded as the "safe haven" for most investors. Apart from occasional downfalls, it has shown a stable rise over the long run. It has especially out-competed every national currency for decades. A research by World Gold Council compared changes in the purchasing power indexes (PPI) of gold and Sterling over 90 years period, namely, from 1900 to 1990. PPI of gold rose up to 150 from 130, with an average annual change of 0,16%, while that of Sterling fell to 2.4 from 100, with an average annual change of -4.06% (El-Diwany, 2004). Nominal gold price rose by almost

100% from the beginning of the financial crisis in July of 2007 (Central Bank of Republic of Turkey, 2013).

The basic rule of portfolio management suggests that portfolio with negative or low correlation assets could reduce risks and maintain a sound return rate. Because gold has usually shown upward moves during the bad times of economy, it is commonly regarded as a hedge tool to be included in portfolios. In other words, it seems to be the most reliable tool to cope with the volatility in stock market and currency. Gold is superior over the other assets as it is a precious metal with functions that a currency has; among all the functions, the purchasing power is the most important one (Wang et.al., 2010).

Despite the descriptive data and common ideas suggest that gold is a sound hedge tool, this hypothesis is still require advanced econometric analyses. This paper attempts to show whether gold an effective hedge instrument against the inflation and the currency risk of Turkish Lira against U.S. Dollar using the monthly data from February 1986 to June 2013. What makes this study distinct from the previous research is the utilization of Kapetanios stationarity test (2005) and Maki cointegration tests (2012) that allow unknown multiple number of breaks obtained endogenously. This method is regarded as superior to previous unit root and cointegration tests where either no break is assumed or number of breaks is specified a priori because it considers all economic crises over the long run and all developments that cause the radical changes in the economy.

2. Literature Review

Wang et.al. (2011) investigated whether gold can be used as a hedge instrument against inflation in the U.S. and Japan. They found that gold has significantly reacted against inflation in both countries. Beckman and Czudac (2013) examined the same effect for Japan, United States, England and Euro zone and found similar results. A similar study by Ghosh et.al. (2004) based on the U.S. data showed that gold is the most effective hedging tool both in short and long term.

Among those studies that consider structural breaks, Worthington and Pahlavani (2007) used the U.S. data and Shahbaz et.al. Pakistani data. Both studies found that gold is an effective hedge instrument against inflation.

Chua and Woorward (1986) examined six industrial countries and found gold as an effective hedge tool only in the U.S. Baur and Mcdermott (2010) tested the hyptothesis in the context of the stock markets and concluded that gold can be used as a hedge tool in the developed European countries whereas the hypothesis cannot be accepted for Australia, Canada, Japan and BRIC countries. Baur and Lucey (2010) did a similar work for the U.S., England and Germany to examine

the changing relationship and found that gold is reliable hedge instrument against the stock market volatility in the short run.

Aksoy and Topçu (2013) examined the hedging behavior of gold against inflation and stock market index using Turkish markets data and concluded that gold is a reliable instrument against both parameters. Likewise, Öztürk and Açıkalın (2008) proved that gold is cointegrated with both currency and inflation, and, thus, it is a reliable investment.

Reboredo (2013) investigated the tendency of gold to move together with currency for Canada, England, Japan, Norway, Swiss and the Euro zone. He found that it is useful to include gold and currency in a portfolio for an effective diversification. Joy's (2011) study, using the data of sixteen countries including both developed and emerging ones, found that gold is a reliable investment tool to cope with the currency risk. Another study that examined whether gold is a hedge tool against U.S. dollar currency is done by Capie et.al. (2005). They too verified that gold is reliable investment tool.

Ciner et.al. (2013) examined the hedging function of gold using time-varying tests for the U.S. and England and found that gold is a sound hedging tool against the currency.

Hoang (2012), contrary to the others, found no relationship between gold prices and inflation in his research based on French markets. Similarly, Lawrance's (2003) research on London markets showed no relationship between these two parameters. Dee et.al. (2013) studied the Chinese markets and found that gold is not statistically related with stock market and inflation in the short run, whereas it is significantly related with the two parameters in the long run.

Wang et.al. (2013) used non-linear cointegration test on the U.S. and Japanese markets and showed that there is no cointegration between the gold prices and inflation both in short and long run.

As can be noted, most studies proved that gold is an effective investment tool to avoid the risks in currency, stock market and inflation.

3. The Model

Kapetanios (2005) improved Zivot Andrew (1992) and Lumsdaine-Papell (2003) tests and developed a new technique that tests stationarity hypothesis with unknown number of breaks in lieu of conventional unit rool test. Because the appropriate number of breaks is endogenously obtained through this method, the constraint that requires a priori specification of number of breaks has been

eliminated. The only a priori information required is the maximum number of breaks. The mathematical model is expressed as follows:

$$y_t = \mu_0 + \mu_1 t + \alpha y_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta y_{t-i} + \sum_{i=1}^{m} \phi_i \mathrm{DU}_{i,t} + \sum_{i=1}^{m} \psi_i \mathrm{DT}_{i,t} + \epsilon_t$$

$$\mathrm{DU}_{i,t} = 1(t > T_{b,i}), \quad \mathrm{DT}_{i,t} = 1(t > T_{b,i})(t - T_{b,i})$$

Here the null hypothesis is for the existence of unit root while alternative hypothesis for the stationarity of the series.

$$\mathrm{H}_0: \alpha = 1$$

$$\mathrm{H}_A: \alpha: < 1$$

The process of this method is as follows: first, a single break is sought through the entire sample and t statistics for α = 1 hypothesis is obtained. Secondly, the structural break date is selected for the sum of least-squares of residuals model and, by adding the first break date previously estimated to the model, the second break date is sought through the remaining parts. Then, t statistics for α = 1 hypothesis are obtained and break date is found by summing the least-squares of residuals. This process is continued until obtaining m number of breaks. The optimal number of break is the one with the minimum t statistics.

$$\mathrm{SSR} = \sum_{t=k+2}^{T} \left(y_t - \hat{\mu}_0 - \hat{\mu}_1 t + \hat{\alpha} y_{t-1} + \sum_{i=1}^{k} \hat{\gamma}_i \Delta y_{t-i} + \hat{\phi}_1 \mathrm{DU}_{1,t} + \hat{\psi}_1 \mathrm{DT}_{1,t} \right)^2$$

Maki (2012) adopted the unknown number of breaks approach for cointegration tests. He criticized Gregory-Hansen (1996) test for allowing single break and for a priori specification. He also criticized Hatemi-J (2008) test for allowing maximum two breaks. Instead, he suggested a new model with unknown number of breaks determined endogenously. According to this model, the null hypothesis states that there is no cointegration between the variables while alternative hypothesis states that there are as many cointegrations with structural breaks as produced by the model. This method is considered less computationally intensive than methods that are widely used in literature (Maki, 2012). One of the following models is selected for this test:

$$y_t = \mu + \sum_{i}^{k} \mu_i D_{i,t} + \beta' \mathbf{x}_t + u_t, \qquad (1)$$

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \beta' \mathbf{x}_t + \sum_{i=1}^{k} \beta_i' \mathbf{x}_t D_{i,t} + u_t, \quad (2)$$

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \gamma t + \beta' \mathbf{x}_t + \sum_{i=1}^{k} \beta_i' \mathbf{x}_t D_{i,t} + u_t, \quad (3)$$

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \gamma t + \sum_{i=1}^{k} \gamma_i t D_{i,t} + \beta' \mathbf{x}_t + \sum_{i=1}^{k} \beta_i' \mathbf{x}_t D_{i,t} + u_t, \quad (4)$$

We in this study prefer model 4 that allows variation in trend and independent variables.

Maki cointegration test is conducted as follows: first, the selected model is estimated for each possible structural break. Through this process, unit root test statistics are obtained to be applied to residuals (Çağlı and Mandacı, 2013) Then the model with the minimum residual sum of squares is specified as the first break point. After the first structural break is employed in the model, the second, third, and the other breaks are utilized in the model upto the maximum number of breaks specified at the outset. Among such estimated models, the one with the least t statistic indicates the appropriate number of breaks. In other words, the appropriate number of breaks is the one that exist in the model with the minimum t statistic (Yılancı, 2013).

4. Data

We used monthly data for the period from February 1986 to June 2013, resulting in 329 observations. Gold prices, inflation and currency data were obtained from the electronic data delivery system of The Central Bank of Turkey. The consumer price index (CPI) was used to represent the inflation, as in the case in most previous studies. The series were converted to natural logarithms before entering the analysis. The descriptive statistics of these three variables are shown in Table 1. The distributions of the variables are left-skewed and Jarque-Bera values indicate that the series are not normally distributed.

Table 1

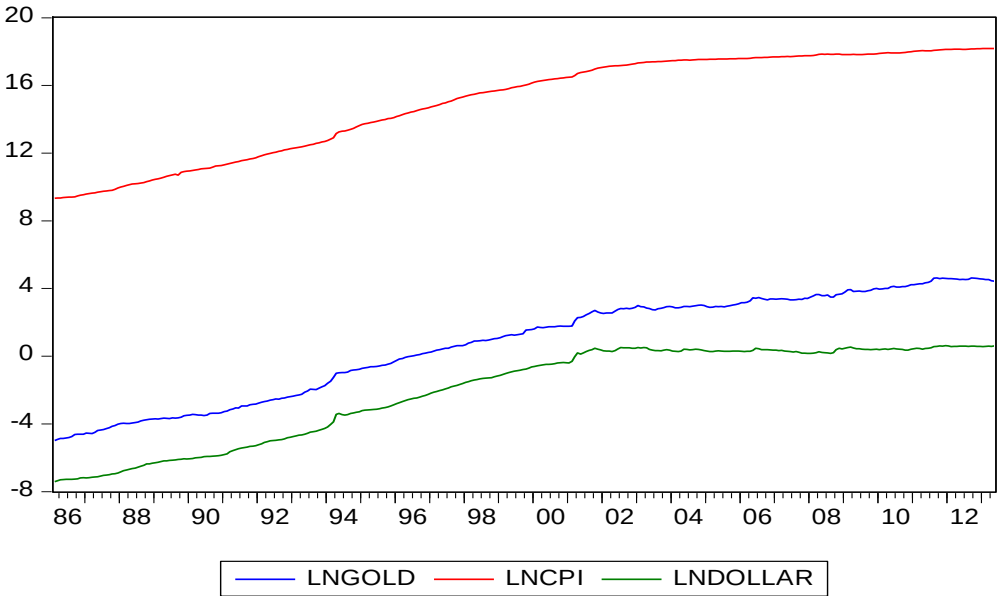
Descriptive Statistics

	LNGold	LNCPI	LNDollar
Mean	0.67	14.99	-2.06
Maximum	4.63	18.18	0.62
Minimum	-4.98	9.33	-7.41
Standart Deviation	3.02	2.95	2.78
Skewness	-0.41	-0.57	-0.63
Kurtosis	1.72	1.81	1.80
Jarque-Bera	31.61	36.96	41.12

Chart 1 illustrates that the variables have constantly moved together. These findings verify the previous studies that include no breaks or single break.

Figure 1

Line Chart of the Series



We in this paper first apply the conventional augmented Dickey-Fuller (ADF) (1979) and Phillips-Perron (PP) unit root tests and Engle Granger cointegration tests (1987) all of which allow no structural breaks. Then, we employ Lumsdaine Papell unit-root (2003) and Hatemi-J (2008) cointegration test with two structural breaks that are determined endogenously, followed by Kapetanios (2005)

unit-root test and Maki (2012) cointegration tests that allow more than two structural breaks that are determined endogenously. We thereby attempt to show that allowing more than two breaks in such a long period would lead to better measurement.

5. Empirical Results

Though some studies directly assume the linearity of the series that they use, it is widely accepted that testing the linearity of series prior to unit root and cointegration tests is a more accurate approach. We use linearity test of Harvey et.al. (2008) to see whether the series are linear. As seen from Table 2, all the series are linear and there would be no problem with using linear unit root and cointegration tests.

Table 2

Results of Linearity Test of Harvey

	W-Lam	W 10%	W 5%	W 1%
Gold	1.51*	7.69	7.74	7.86
CPI	20.48*	74.27	74.47	74.82
Dollar	43.89*	58.29	58.53	58.96

***Conventional Tests Allowing No Structural Breaks*.** In order to reveal the superiority of new generation tests allowing structural breaks we first conduct the conventional ADF and PP unit-root and Engle Granger cointegration tests. Table 3 and Table 4 show the respective results.

Table 3

Results of ADF and PP Unit Root Tests

	ADF		PP	
	Level	**1st Difference**	**Level**	**1st Difference**
Gold	0.18 (0.99)	-4.89 (0.00)***	-0.78 (0.96)	-13.38 (0.00)***
CPI	0.07 (0.99)	-3.28 (0.07)*	-1.48 (083)	-9.80 (0.00)***
Dollar	0.63 (0.99)	-10.83 (0.00)***	-1.92 (0.64)	-12.21 (0.00)***

Table 4

Results of Engle Granger Cointegration Tests

	Test Statistic	Probability
Gold-CPI	-8.81*	0.00
Gold-Dollar	99.17*	0.00

Note: Probability values represent Mackinnon (1996) cointegration Probability values.

As revealed by Table 3, the series are not stationary at the levels. Therefore, the first differences are considered for cointegration test. Engle Granger cointegration test results indicate that gold is significantly related with inflation and USD currency in the long run.

We now consider the new generation tests that allow two and unknown number of structural breaks.

***Tests Allowing Two and Unknown Structural Breaks*.** Table 5 reveals the results of Lumsdaine Papell and Table 6 Kapetanios unit root tests.

Table 5

Lumsdaine Papell Unit Root Test Results

Test Statistic	Level	1st Diff.
Gold-CPI	-4.86	-14.23***
Gold-Dollar	-4.23	-13.57***

Note: Critical values are -7.19, -6.75 and -6.48 at 1%, 5% and 10% significance levels, respectively as specified by Ben-David et.al. (2003)

Table 6

Kapetanios Unit Root Test Results

Breaks	Gold	Gold (1st diff.)	CPI	CPI (1st diff.)	Dollar	Dollar (1st diff.)
5	-8.07*	-13.68*	-8.94*	-14.89*	-9.61*	-11.87*
4	-7.32	-13.54*	-8.53*	-14.62*	-8.71*	-11.77*
3	-6.50	-13.34*	-7.91*	-14.22*	-7.95*	-11.63*
2	-5.86*	-13.13*	-7.18*	-13.22*	-7.23*	-11.48*
1	-3.61	-12.98*	-4.52	-5.35*	-4.57	-11.32*

Note: Critical values are -8.34 for five breaks, -7.73 for four breaks, -7.00 for three breaks, -6.11 for two breaks and -5.08 for one break at 5% significance as specified by Kapetanios (2005).

Both Lumsdaine Papell (2003) and Kapetanios (2005) unit root tests show that series have unit roots at the levels and become stationary when converted to the first differences. Kapetanios unit root test also indicates that the appropriate model is the one with single break because the least t values are obtained at that model.

Table 7

Hatemi-J Cointegration Test Results

	Test Statistic	Critical Value	First Break	Second Break
Gold-CPI	-14.71*	-6.50	September 1993	July 1997
Gold-Dollar	-16.87*	-6.50	February 1990	January 1997

Table 8

Maki Cointegration Test Results

	Test Statistic	Critical Value	Break Dates
Gold-CPI	-10.31***	-7.41	June 1990; June 1994; January 2000; February 2005; September 2008
Gold-Dollar	-9.86***	-7.41	December 1992; August 1999; January 2001; April 2006, October 2008

Note: Critical value for five breaks at 5% significance level is specified by Maki (2012).

Both Hatemi-J and Maki cointegration tests results indicate significant correlations between the variables in the long run, verifying the previous studies that gold is an effective hedge instrument against gold and inflation. Distinct from the others, Maki test finds five structural breaks appropriate for the study period. These breaks indicate problematic periods in the Turkish economy. Following the capital flow liberalization in 1989, there were several fluctuations mostly caused by political instability and Gulf War in 1991. In 1994, 2000 and 2001 significant crises occurred in Turkey due to political, economic and financial turmoils. Devastating Marmara earthquake in August 1999 also hit the economic conditions. In 2005 Federal Reserve Board of the U.S. decided to increase the interest rates and a dramatic currency fluctuation occurred in Turkey around May-June 2006 period. The final break is obviously is a result of 2008 mortgage crisis that affected all over the world.

The most significant contribution of Maki cointegration test here is that is has considered all crises in the long run. Though inclusion of all crises in the analysis did not change the conclusion that gold is an effective hedge tool, this process definitely provide more accurate measurement.

6.Conclusion

This paper has investigated whether gold is an effective hedge against inflation and currency risks using the monthly data in Turkey between February 1986 and June 2013. Following the conventional tests allowing no structural breaks, Lumsdaine Papell (2003) that allows two breaks and Kapetanios (2005) that allows unknown number of breaks test are performed. The unit root tests in all of the three approaches show that the series are stationary at the first differences.

Finally, the existence of meaningful cointegration between the three variables have been tested through Engle Granger allowing no structural break, Hatemi-J (2008) allowing two breaks and Maki (2012) allowing unknown number of breaks. All the three methods indicate significant cointegrations, implying the gold is an effective investment tool to cope with the inflation and currency risks. The new generation unit root and cointegration tests, namely Kapetanios (2005) and Maki (2012) respectively, strengthen the results in previous tests. This result also supports the findings Öztürk and Açıkalın (2008) and Aksoy and Topçu (2013) all of which applied Engle Granger tests on the data in Turkey. However, our tests provide more accurate measurement as they consider all the crises occurred during this period.

In brief, this study provides even stronger evidence from Turkey that gold should be included in the portfolios for an effective diversification.

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