

# Impact of global financial crisis on the gold market: An empirical investigation

Farah ELIAS ELHANNANI, Mohamed DAOUDI, Mohamed BENBOUZIANE

**Abstract**— The global financial crisis of 2008 had strong effects on the world wide economy and finance. Indeed, American, European and Asian markets indices crashed down immediately 8 to 10% in a very short period. Investors lost their confidence on stocks and currencies and they started to buy alternative investments. This new behavioral fact led to an increase in prices of such investments. The precious metal gold has been used as money for many centuries till the breakdown of the “Bretton Woods” agreement. In addition to its use as jewelry and electrical components, gold is now used as an asset investment and a hedging strategy against inflation, this leads us to consider the gold market as a financial market. In fact, gold is one of the alternative investments and a safe haven that responded to the crisis.

The main objective of this paper is to focus on the gold market and try to analyze the trend of gold price before and after the crisis. We start with an overview on the causes and effects of the global financial crisis, then we provide a review on the gold market and the main causes of its price’s fluctuations. We, then, examine empirically the trend of gold price during 2000-2012 and show econometrically how it was affected by the financial crisis, and what are the main consequences of these alternative investment on the whole financial markets.

**Index Terms**— Financial crisis - gold market - volatility- hedging - investment.

## I. INTRODUCTION

In the late of 2007, the global economy has faced the strongest crisis since the great recession of the 1930s. In the aftermath of the global financial crisis, the housing prices declined sharply; the most developed and emerging financial markets crashed down immediately; unemployment reached historical rates in most industrial countries; oil prices fell sharply from 140\$ to 50\$ and other commodities markets have also been affected by this turmoil where the precious metal gold was one of these commodities.

The price of gold has been an interest for many portfolio investors due to the special characteristics that has acquired, since the end of the Gold Standard and Bretton Woods agreement, as a financial asset ( portfolio diversifier, a hedge against inflation and a safe haven). The gold price has risen dramatically since 2001 from its low level of 250 \$ per ounce , then it reached a peak in 2011 with a level of 1700 per ounce . During the last global financial crisis of 2007-2008, the fact

was that most of the investors in financial markets lost their confidence on different assets and currencies seeking to alter their portfolios by less risky assets. Indeed, gold was one of the alternative investments in that case, thus, the demand for gold increased sharply and consequently its price rose.

Gold as a financial asset is characterized also by a high volatility. The focus of our study is following the gold price trend and showing its reaction to the global financial crisis. The paper is organized as follow: section one presents an overview on the causes and effects of the global financial crisis. Section two provides a review on the gold market and some literature review of the main causes of its price’s fluctuations. Section three develop our empirical investigation using the generalized ARCH (GARCH(1,1)) model.

## II. 2008 GLOBAL FINANCIAL CRISIS (CAUSES AND EFFECTS)

The global economy has faced the most severe turmoil during 2007-2008 since the great recession of the 1930s. Indeed, the financial origins of the 2008 global crisis have had a spillover to the global economy and not only the world financial system.

### 2.1 The origins and causes

The causes of the crisis have been as complex as the crisis itself:

#### The quick development in the American sub-prime market:

Subprime loans are high risk credit given to individuals who fail to meet rigorous standards and could not really afford their loans because of inadequate income or poor credit histories.<sup>1</sup>

Two government corporations have been created by the federal U.S. government in order to push the home ownership. FANNIE MAE and FREDDIE MAC were the famous institutions sustained by the American state and they were specialized in subprime loans. The fact was that this kind of loans has been securitized and traded in the financial markets, then spread around the world because of the interdependence of financial markets, this has exacerbated the risk of loans and the borrowers’ inability to repay their credits.

#### Low interest rates on securities in most developed countries

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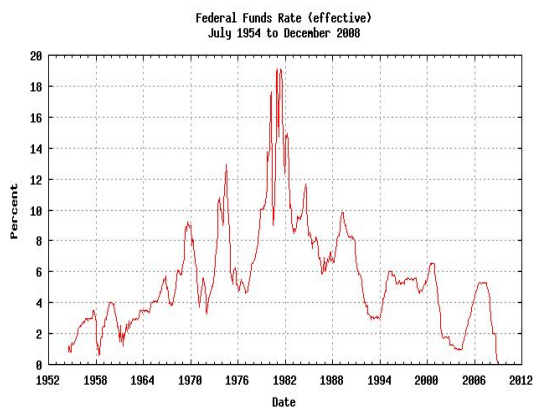
Farah ELIAS ELHANNANI, University of Tlemcen

Mohamed DAOUDI, University of Tlemcen

Mohamed BENBOUZIANE, University of Tlemcen

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**Innovations in the financial markets:**

One of the major causes of the global financial crisis is the new innovations in the financial instruments where the securitization was the most important instrument that could transmute the home credit risks from banks to the financial markets and exacerbate the crisis.

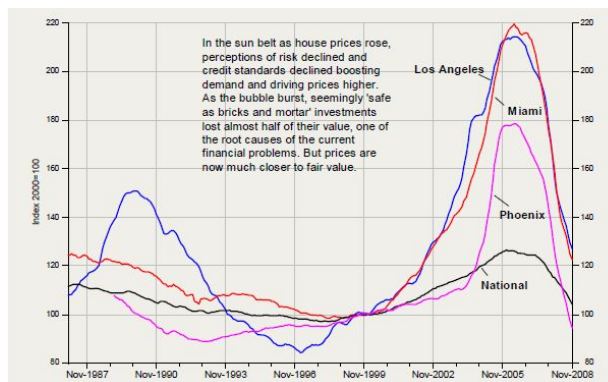
**Fast changes in the global economy:**

The globalization and interdependence in financial markets, Asian financial crisis of 1998, the so-called “DOT COM” crisis of 2001(the sharp decrease in NASDAQ index) and the large increase in world oil prices, all these elements have exacerbated the global financial crisis.

**1.2 effects and consequences**

The 2008 global financial crisis affected the global economy in all sides starting with the housing market, financial institutions and capital and financial markets to the real economy and commodity markets.

- Bursting of the housing bubble: housing prices fell down sharply starting with the U.S. markets:



- Bankruptcy of the famous bank Lehman Brothers due to the large losses sustained on the U.S. subprime mortgage market<sup>2</sup>: \$2.8 billion in the second quarter of 2008. This was followed by a failure of several strong banks and financial institutions: AIG insurance institution, Merrill Lynch...
- The fall of the financial institutions mentioned above causes a meltdown in the American and global

financial markets: decrease in the DOWJONS future contracts with 550 points, Asian and European markets crashed down immediately with 8% and 10% respectively. Such financial trouble was due to the lack of confidence on the financial markets.

- Decline in manufacturing and trade: several factories and dealerships closed because of the financial difficulties. The automotive industry was the first sector affected, with the demise of General Motors. Industrial production was down by 12 percent in Europe, 11 percent in the United States, and 43 percent in Taiwan. Tightening credit and consumer fear ultimately created a downward spiral that significantly diminished global trade. Germany saw its exports drop by 20 percent. China’s exports fell by more than 25 percent and U.S. exports fell by almost 24 percent in 2008.<sup>3</sup> Furthermore, unemployment reached historical rates in the U.S.A. and Europe (10% and 15% respectively).
- The recent crisis had also a remarkable impact on the most important commodities namely oil and gold. After the boom in oil market between 2003-2007 where the oil price reached 140\$ per barrel, it fell sharply during the financial crisis in less than two months from 148\$ to 50\$. Gold has also been affected by the crisis, after the loss of confidence on financial markets, investors turned their portfolio demand to the gold market which led to a large increase in the price of gold.

The latter idea is the focus of our paper in the following sections, we analyze the gold market showing its trend movements before, during and after the global financial crisis.

**III. AN OVERVIEW OF GOLD MARKET**

Although its important role in economic life and its large evolution among centuries, gold is still a precious metal. Today there are 165000 metric tonnes of stocks in existence above ground and if every single ounce were placed next to each other ,the resulting cube of pure gold would only measure 20 metres in any direction(WORLD GOLD CONCIL) .

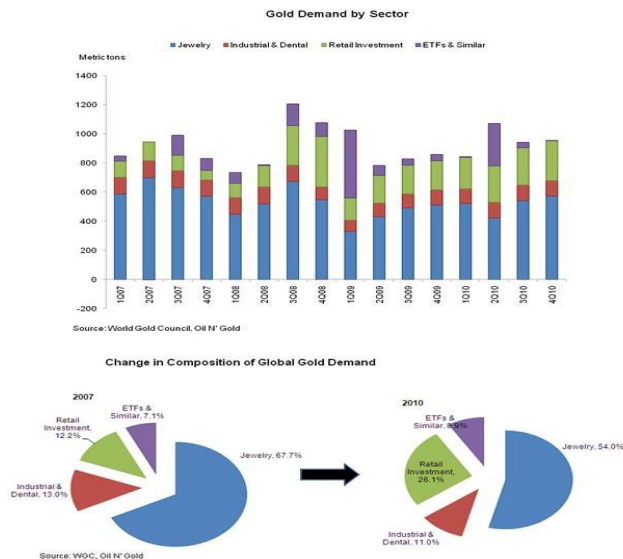
The demand for gold can be divided into two parts: the first is the « use demand » : jewelry , metals , coins electrical components...,the second is the « asset demand » (Levin et al.(2002)). In addition to the money characteristics which possesses gold, it is also used as an asset investment , an inflation hedge and is considered as a high liquid metal.

The price of gold has known small changes over the period :1833 to 1973 (before the breakdown of Breeton Woods agreement) ,from 20,65 \$ per ounce in 1833 to 42 \$ per ounce in 1971.After 1973 , gold has fluctuated , it was about 384 \$ per ounce in 1982 and 283 \$ per ounce in 1999.(Levin et al 2002).

The gold price has risen dramatically since 2001 from its low level of 250 \$ per ounce , then it reached a peak in 2011 with a level of 1700 per ounce .

<sup>2</sup>Mckibbin W.J. and Stoeckel A., « The global financial crisis :causes and consequences », international economics papers, September 2009, P9.

<sup>3</sup> [http://www.pearsonhighered.com/assets/hip/us/hip\\_us\\_pearsonhighered/samplechapter/0205779085.pdf](http://www.pearsonhighered.com/assets/hip/us/hip_us_pearsonhighered/samplechapter/0205779085.pdf)



Source : international business time <http://www.ibtimes.com>

The figure above shows clearly the increase of the investment demand for gold after 2007. If we link this with the financial events, we notice that the investment demand for gold has been a response to the decline in financial markets and global financial crisis.

### 3.1 Gold characteristics

It is obvious that the increase in the price of gold during the last decade was due to the special characteristics that acquired this commodity after the breakdown of gold standard and Breeten Woods agreement.

#### Gold as a portfolio diversifier<sup>4</sup> :

Many previous studies have argued the portfolio's role of gold as a good diversifier, its return has low correlation with other assets' returns in the portfolio. In fact, portfolios containing a moderate weighting of gold perform better than portfolios consisting only of financial assets.

#### Gold as a hedge against inflation:

Theoretically gold demand increases when expected inflation rises ; investors start buying gold to hedge against the expected decline in value of money. This fact leads investors to gain from buying and selling gold.

#### Gold as a safe haven<sup>5</sup> :

The gold price trend during the recent financial crisis confirmed the findings of several researches that gold is really a safe haven asset. The price of gold registered a large increase while most financial assets and indices declined sharply responded to the crisis.

### 3.2 Literature review

<sup>4</sup> A diversifier is defined as an asset with returns that are positively (but not perfectly) correlated with returns on another asset or portfolio on average. (Pullen, Benson and Faff 2010)

<sup>5</sup> A strong (weak) safe haven is defined as an asset with returns that are negatively correlated (uncorrelated) with returns on another asset or portfolio in certain periods of market stress or turmoil (e.g. a financial crisis). (Pullen et al. 2010)

Since the breakdown of the gold standard and the vital role of gold in economic life and financial investment, many researchers tried to estimate the factors that affect the price of gold then to forecast its price using different methods for analyzing the gold market movements, the investment role of gold and its reactions to global financial changes.

Baker and V.Tassel (1985) argued that the price of gold depends on a set of economic variables and it will go up in the long run in real terms .Lawrence (2003) showed no significant relationship between gold and other macroeconomic and financial indicators which makes gold as a good portfolio diversifier.

In a study using cointegration regression techniques , Levin et al (2002) argued that gold is an effective hedge of inflation. In other paper , Levin and Wright (2006) examined the short run and long run fluctuations of gold price, the authors found that the short changes are caused by : political and financial turmoil , exchange rates , real interest rate ,while the long run variables would be : US and world inflation , world income , US/World exchange rate , the gold lease rate , alternative investment opportunities , credit risk and time specific uncertainty.

Tully and Lucey (2006) investigated macroeconomic influence on gold using the asymmetric power GARCH model, authors confirmed that the US dollar is the main macroeconomic variable which influences gold .

S.K.Mishkra , Das and P.K.Mishkra (2010) examined the gold price volatility and the causality between domestic gold price and stock market return in India .Johansen's cointegration test and Granger causality were used ,hence, a long run equilibrium relationship was found. Thus ,each variable contains some significant information so that one can be used to predict the other.

In their paper, Dunis and Nathani (2007) provided a set of non linear methods ( HONN- MLP- Nearest Neighbors) to forecast the prices of gold and silver using the linear ARMA model for comparison .The researchers concluded that it was possible to forecast successfully the daily price of those two metals and they confirmed the nonlinearity of commodity markets.

In 2011, Sopipan , Sttaayathan and Premanode forecasted the volatility of gold prices using Markov Regim Switching GARCH models, they found that MRS-GARCH got the most cumulative return.

Table 1 summarizes some empirical studies concerning the price of gold.

## IV. DATA AND METHODOLOGY

Our aim in this study is to model the trend of gold price over the period 2000-2012 and pursue its reaction during the global financial crisis of 2008. Because of the high volatility of this time series we will apply GARCH model.

### 4.1 An overview of the model

Homoscedasticity , one of the least squares (OLS) assumptions which means that the expected value of all error terms when squared is the same at any given point. In some cross sectional and financial time series, this assumption is violated and the problem of heterocedasticity is present . Instead of concerning this phenomenon as a problem to be corrected, Robert Engle (1982) suggested a model in which this problem is a variance to be modeled.

The model suggested by Engle is: ARCH (Autoregressive conditional heteroscedasticity) model, is used to model and forecast variance of the error terms.

An ARCH model is defined as follow (Engle 1982) :

$$Y_t/\Psi_{t-1} \sim N(x_t \beta, ht)$$

$$ht = h(\epsilon_{t-1}, \epsilon_{t-2}, \dots, \epsilon_{t-p}, \alpha)$$

$$\epsilon_t = Y_t - x_t \beta$$

Where :

$\Psi_{t-1}$  : a set of information available at (t-1)

$\beta$  : a vector of unknown parameters

$ht$  : the conditional variance of the error term

$\epsilon_t$  : error term

$\alpha$  : an unknown parameters

$P$  : the order of the ARCH process.

In order to simplify, the model can be defined :

$$\sigma^2 = \alpha_0 + \sum \alpha_i \epsilon^2_{t-i} \quad i=1, \dots, p$$

Where :  $ht = \sigma^2$ .

In 1986, Bollerslev developed a generalized ARCH (GARCH) model which can be defined in the equation below:

$$\sigma^2 = \alpha_0 + \sum \alpha_i \epsilon^2_{t-i} + \sum \beta_j \sigma^2_{t-j} \quad i=1, \dots, p \quad j=1, \dots, q$$

This equation means that the conditional variance depends not only on the squared lagged error terms but also on the variance itself.

The orders p and q can be identified by applying Box and Jenkins techniques to the AC and PAC.

ARCH and GARCH models are right if :

$$\forall i, j : \alpha_0 > 0, \beta_j \geq 0, \alpha_i \geq 0$$

#### 4.2 Methodology

In order to achieve the objective of our paper, we will follow the steps below:

1\_ Testing the stationarity of the gold series using Augmented Dickey Fuller and Philip Perron tests, and providing some descriptive statistics concerning the series.

2\_ Testing the heteroscedasticity from the ARCH\_LM test by estimating the regression of the residuals :

$$\epsilon^2_t = \alpha_0 + \alpha_1 \epsilon^2_{t-1}$$

In the context of the null hypothesis of homoscedasticity, LM statistic follows a Chi Squared distribution  $X^2(p)$  :

If:  $LM > X^2$  : we reject the nul hypothesis  $H_0$ , and the series has an ARCH effect

If:  $LM < X^2$  : we accept the nul hypothesis and the ARCH effect doesn't occur in the series (the variance of the residual terms is constant)

3\_ Parameters estimation of GARCH (1,1) model : we estimate the parameters of the mean and the variance regressions :

$$R_t = \mu + \epsilon_t$$

$$\sigma^2 = \alpha_0 + \alpha_1 \epsilon^2_{t-1} + \beta_1 \sigma^2_{t-1}$$

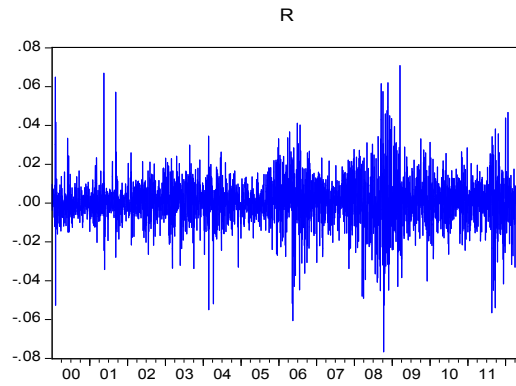
4\_ Modeling the volatility of the gold price series by plotting the standard deviation of the error terms.

#### 4.3 Data

In our study we are going to use the gold price (gp) daily data except the weekends, the data cover 3236 observations from 4st January 2000 to 31st May 2012, these data are brought from the web site of [www.kitco.com](http://www.kitco.com).

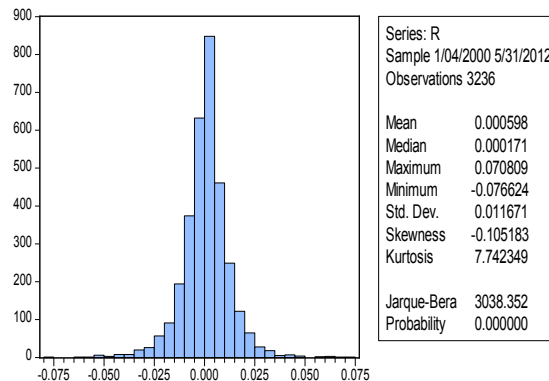
We use the series of gold returns ( r ) from the equation:

$$r_t = (gp_t - gp_{t-1}) / gp_{t-1}$$



Source: authors' calculations using Eviews program.

From the histogram and descriptive statistics of the gold return series, we observe that the mean and the median are positive with 0.00591% and 0.01% respectively which indicates the increasing trend of the gold price during the period of the study. The negative skewness (-0.105183%) and a kurtosis superior to 3 (7.74) indicates that the return series is asymmetric and highly leptokurtic to the normal. The Jack Bera test and its probability equals to 0 reject the hypothesis of the normal distribution which confirms that the return series is not normally distributed.



Augmented Dickey Fuller and Philip Perron tests reject the hypothesis of the existence of unit root in the series, that means the gold return series is stationary. The table below presents the t-statistics and probabilities of the ADF and PP

test at the level and with intercept, the values are approximately the same for both tests which confirms the stationarity of the gold returns series.(table2)  
The ARCH-LM test shows clearly the existence of an ARCH effect in the residuals then the model GARCH(1,1) is adequate to model the volatility of the gold market. Results for ARCH-LM test are presented in table3.

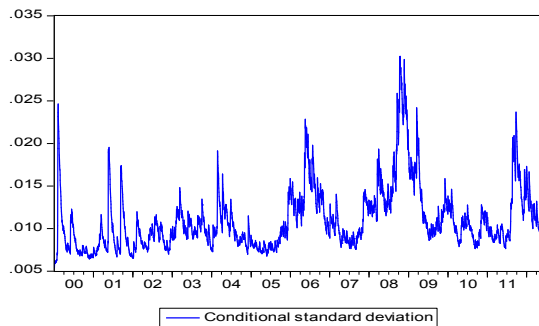
#### 4.4 Results

Our GARCH (1,1) estimation over the period ( 04/01/2000 to 29/05/2012) using Eviews computational package gives us the following mean and conditional variance equations:

$$r_t = 0.000560 + \epsilon_t$$

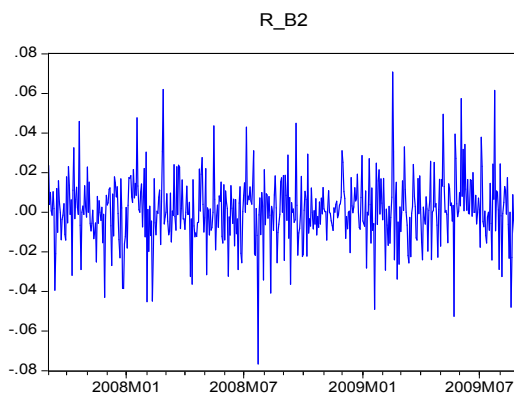
$$\sigma_{\epsilon_t}^2 = 2.5E - 06 + 0.066886\sigma_{\epsilon_{t-1}}^2 + 0.915495\sigma_{\epsilon_{t-1}}^2$$

The results summary (table4) exhibits high significance of the existence of GARCH effects, z-statistics are significant (16.887 for  $\alpha_1$  and 200.43 for  $\beta_1$ ) and a DW superior to 2. The high value of  $\beta_1$  means that the volatility of gold returns is persistent during the period of the study. The conditional standard deviation plot confirms the high volatility of the gold markets, further, it shows the highest spikes from 2008 to 2009, the global financial crisis period.



The findings above show that the gold market reacted positively and quickly to the negative shocks, high spikes are shown in 2001(September 11<sup>th</sup> explosion), 2003(War in Iraq) and 2006 then the highest one is of 2008( the global financial crisis).

We focus on the global financial crisis period, the graph below provides the trend of daily gold returns during the sub-period (03/09/2007 to 31/08/2009), it shows clearly high fluctuations over all the period:



#### CONCLUDING REMARKS

Our paper analyzed the trend of the price of gold during 2000-2012 and showed the effect of the global financial crisis of 2008 on the gold market. Using the univariate GARCH(1.1) econometric model, we modeled the volatility of the gold return series. Our results indicated the existence of high volatility in the return series over the period 4/01/ 2000 to 31/05/2012 but the most volatile period was the financial crisis phase.

The empirical results confirmed the theoretical view of the impact of global financial crisis on the gold market. This market reacted positively to the crisis and this reaction is caused by the characteristics of the gold as a financial asset and as an alternative investment during the financial turmoil periods.

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