Original Research Article

Gold Jewellery Demand and Gold Price Volatility: A Global Perspective

Abstract

Profound changes have occurred in the gold jewellery market which has experienced a secular decline in demand over the last twenty years. Despite the apparent growth in gold jewellery demand in India and China over the last two decades there has been a more than compensatory decline in demand for gold jewellery in the rest of the world. This has meant that the industrial uses of gold have been in decline with other traditional uses in dentistry declining even more rapidly than that of jewellery. As a result, the investment uses of gold in the form of gold bars coins and Exchange-Traded Funds (ETFs) have had to absorb the increased supply that resulted from the price boom of 2011-2012. The paper argues that the demise of gold jewellery demand along with other traditional uses has resulted in a significant increase in the long term gold price volatility.

Key words: Gold, jewellery, price volatility

Introduction & Background

The global market for gold has undergone a fundamental and profound change stemming from the rise of India and China as key markets and, more importantly, the rapid and secular decline in gold jewellery demand in the rest of the world over a period of twenty years as depicted in Figure 1 & 2 [1]. The decline in demand has been driven by a shift in demand for luxury goods by Millennials[2] away from gold jewellery consumption (GFMS Thomson Reuters, 2017; Williams, 2017; World Gold Council, 2016;World Gold Council 2016a, Zheng, 2017.). This decline, while certainly not as pronounced is even true in the traditional Asian markets where urban elites in first tier cities have recently shown an increasing preference for other luxury products, much like that being experienced in more developed countries. This together with the decrease in the demand for gold as a result of changes in dentistry along with the static demand for gold in electronics has meant that total manufacturing demand has gone into decline over the last twenty years (GFMS Thomson Reuters, 2017). A number of studies have noted the decline in industrial demand for gold in developed as well as in many developing countries (Krijger, 2011; Liu, 2016; Marchia,, Leeb, & Gereffic, 2013) .

The purpose of this paper is to examine the impact on gold price volatility of the decline in gold jewellery demand and the concomitant increase in investment demand for gold. As we shall see below much of the discussion of gold price volatility addresses the issue of short term fluctuations whereas this paper is concerned primarily with long term trends. This new long term focus has been driven, in part, by the argument that even small differences in long-term commodity demand lead to huge differences in the market dynamics over time that may exceed the impact of transitory cyclical change. Therefore economic implications in terms of a multiplier effect are arguably more important.

[1] Aggregate data for the twenty year period 1997-2016 is only available from the World Gold Council. However disaggregated data which includes India and China is only available from the World Gold Council from 2000 onwards.

[2] There is no formal definition of what constitutes a Millennial but it is generally understood to mean someone born between the early 1980's and the early 200's. They are also referred to as generation Y.

Figure 1
Composition of Gold Demand (1997-2016)

Figure 2 shows the trend in gold jewellery demand both globally and in the two largest markets of India[3] and China. This is supported by Starr (2008) who reported that the global gold demand has decline amid the abandonment of the gold standard. As is evident aggregate demand is in steady state decline just as depicted in Figure 1 and the decreases were particularly pronounced in the wake of the 2008-9 crisis where there was a step-wise decline in demand from which there has yet to be a recovery (World Gold Council, 2017). This is a result of the twin effects of the economic crisis post-2009 and the rise in gold jewellery prices over the period. What has compensated for the decline in demand in ROW demand has been the rising demand in China and the steady and moderately rising demand in India. I most developed as well as relatively advanced developing countries like Turkey the trend has been for a decrease in demand even in investment.

The geographic distribution of consumer demand for gold has also changed. Five countries together are responsible for some 65% of global consumer demand. China and India together represent 51% of world consumer demand for gold. With the rise of India and China the market has shifted significantly towards Asia over the past 20 years. While most other sources of demand for gold have been in progressive decline, it has been the surge in investment demand in the form of bars and coins that has buoyed the overall demand for gold over the last decade. In no small measure the decline in demand has been caused by a structural shift in demand for jewellery outside India and China. Even in India and China, a younger generation of urban 'Millennials' is entering the market and have a greater range of possible luxury goods to consume than previous generations. As a result of this structural change the position of gold is becoming more precarious.

Figure 2
Gold usage in the Production of Jewellery

Source: World Gold Council and author's estimates.

There has been considerable debate in the literature in Minerals Economics as to whether the long bull market that occurred in many commodities in the first decade of the current century has been part of a commodity price super-cycle stemming from an increased intensity of use of commodities stemming in turn from the transition of China to a developed economy. While this may be the case with regard to base metals, the evidence of an increased intensity of use of gold does not exist and what evidence does exist suggests that the global intensity of use of gold for industrial purposes for the period 1997-2016 actually halved per dollar of global GDP. This depicted in Figure 3. Disaggregated data on a country basis does exist from GFMS and it demonstrates that while the intensity of use remained largely unchanged in China over the period it has declined dramatically in India falling to a third of 2003 levels. It should be noted that 2016 was a particularly bad year for gold demand and usage is widely expected to increase in the coming years as India recovers from the imposition of value added taxes and other measures applied in the gold sector.

[3] Indian data on gold usage is inflated and unreliable because of the phenomenon of round tripping caused by incentives given the Indian government to the jewellery manufacturing sector Round tripping' is the act of exporting gold, be it jewellery bars or coins, with the sole purpose of melting it down before re-importing it back to the original exporting country. The process results in a circular flow of gold between different countries, serving to inflate trade statistics. The levels involved can be significant and this is one reason why trade statistics should not be taken at face value.' – World Gold Council. (2016). India's Gold Market: Evolution and Innovation. Page 41.

Figure 3
Intensity of Gold Use in Manufacturing (tonnes/ GDP)

Source: GFMS Thompson Reuters Annual Gold Survey, various years and authors' estimates. It should be noted that GFMS and WGC data are not always consistent. GFMS data is only available from 2003 onwards

According to several authors in the area (Bernanke, 1983; Dixit & Pindyck, 1994; Pindyck, 1991), price volatility affects the global economy is two broad ways. Firstly, developing countries that are heavily dependent on the primary industry are adversely affected in terms of their income and their terms of trade. This will ultimately have adverse implications toward economic agents' consumption and investment decisions. Second, commodities from the primary industry plays a pivotal role as input in the manufacturing sector, persistent price volatility may trigger an increase in the production cost in the manufacturing sector.

The gold price has increased from USD 35.00 per ounce under the Bretton Woods system to USD 631.10 per ounce in 1980 and reached a peak in 2011 to USD 1917.90 per ounce. This high price was mainly attributed to the downgrade of the S&P rating on US Treasury bond from AAA to AA+ (Hashim, Ramlan, Razali & Nordin, 2017) though the structural change in the market caused by very substantial increases in demand from liberalized markets in India and China strengthened the bull market. This downgrade in the midst of the recession caused many investors to lose confidence in US currency, and subsequently they shifted their investment towards gold. However, the gold price has experienced a sharp decline since the 2011 peak.

By 2016 jewellery and other industrial uses had decreased to 55% of gold end use and the balance made up by demand for financial instruments (bars, coins, ETF and net official purchases)[4]. The structural shift in the demand for gold from a commodity that was principally used in industrial processes some thirty years ago to one which is now dominated by more speculative end uses suggests that there will be an increase in volatility of demand and price. This issue of the shifting composition of gold demand and its impact upon gold price volatility is of great significance that needs further attention to find out how it is affecting gold price volatility as consumers change preferences with new uses of gold and other luxuries competing.

Gold is considered widely as being an economic hedge against risks (for example inflation). Today's advancement in financial markets and money has led to golds prominence in 'investment'. 'Investment' due to the different methods that people demand or hold gold, with the major difference being cultural motive. In certain countries, demand for gold is done via the acquisition of jewellery as is the case in India and China where gold jewellery collections are considered a sign of wealth.

In other parts of the world, the demand is commonly in the form of gold bars or bullion. Also accumulating wealth but with different methods or practices. Today gold is traded on several exchanges that include among others: the London Over the Counter (OTC) market, Commodity Exchange (COMEX - New York), Shanghai and in Dubai: Based on GFMS calculations, Over the Counter (OTC) transactions nudged up slightly in 2016, but in general remain in a sideways trend when considered over the last decade. Gold trading on COMEX on the other hand has gained considerable traction over the years, jumping in 2016 year by 38% to represent almost one third of annual OTC trading activity; it's highest on record. However, not all of this demand is of actual gold but speculation on gold prices. As mentioned above, gold is an asset traded globally, which leads to the question of whether there is a relationship between price volatility and several aspects of demand, among others.

[4] GFMS Thompson Reuters (2017)

The concern of gold price volatility has led researchers to investigate the determinants. However, as the discussion above suggests the structural change of consumption and the downward trend of consumption of gold jewellery is evident. One of the principle driving factors has been rising price. However, given the nature of this precious metal a better understanding of the factors affecting price or its volatility are integral as that would then shed more light in understanding how a commodity of such allure could be in such decline, especially in terms of Jewellery. Whereas the inclusion of other uses apart from jewellery in analyzing the structural shift and declining demand is the limited literature on several practical uses for gold, especially in one study. The main objective is to examine the determinants of gold price volatility resulting from structural shift in demand and the downward trend of consumption of gold globally. To observe if and how demand or consumption of gold affects price volatility of gold and to observe any spillover effects or contagion from the stock markets to gold price volatility.

The rest of the paper is organized as follows: the second part presents the literature review on volatility in general and gold price volatility in particular. The methodology is presented in the third section and lastly the results and policy discussion.

Literature review

The theoretical analysis of commodity price volatility normally revolve around the issues of economic uncertainty and therefore tends to be focused on short-term price volatility. While these are considered, this paper is focused on the long term determinants of price volatility which is not commonly the subject of economic theorizing.

According to Bernanke (1983), Pindyck (1991), Dixit and Pindyck (1994), price volatility increases economic volatility which hampers investment decisions and thus negatively affecting the macroeconomic fundamentals. This view is also embedded in the 'real options' channel that argues that persistent commodity price volatility causes fluctuations on economic fundamentals , that increases uncertainty over expected future cash-flows. This triggers a wait and see approach where entities may defer investment as risk increases (Bloom, 2009). Moreover price volatility has negative implication on demand side effect. This is attributed to the reasoning that persistent volatility increase uncertainty of future prices which may impede the macroeconomic fundamentals through a diametrical effect on consumer demand. In analyzing volatility and more specifically gold price volatility, the Autoregressive Conditional Heteroskedastic/Generalized Autoregressive Conditional Heteroskedastic (ARCH/GARCH) models are particularly popular as measures of volatility. Their range varies and specific models in the family are better suited to different data and objectives being pursued. The variation with the models used to model volatility is illustrated in studies by Tully and Lucey (2007), used an Asymmetric Power GARCH (APGARCH) model (of which they were the first to use an APGARCH investigation of the gold price as they investigated macroeconomic influences on gold); while Toraman, Başarır and Bayramoğlu (2011) used a Multivariate GARCH (M-GARCH) model; with Harper, Jin, Sokunle, and Wadhwa (2013), using a host of models from the ARCH family, namely: they used a GARCH (1, 1), an Exponential GARCH (EGARCH), (1, 1), and a Threshold GARCH (TGARCH), (1, 1).

With respect to empirical literature on gold price volatility, Lin (2016) has argued that while gold has been studied by economists extensively over many decades little is known about its consumption characteristics: more so reasons for purchasing gold and the qualities consumers' desire, among other things. This study seeks to understand the long term structural shift of gold demand particularly jewellery demand as it pertains to gold price volatility and seeks to shed light on the phenomenon with variables that explain to an extent consumption characteristics and or trends that affect gold price volatility.

Tully and Lucey (2007), investigated macroeconomic influences on gold prices volatility using the asymmetric power GARCH model (APGARCH) in which the power term in the model was estimated within the model rather than specified by the authors. To estimate the goodness of fit of each model, likelihood ratio tests were used to assess the significance of each model and provide the best fit for the data. They found that the APGARCH model was a good fit for investigating the conditional volatility of gold prices in the UK. Furthermore, among the variables studied, the US dollar was the only one found to significantly impact the gold price. In the same vein, Domanski and Heath (2007) echoed how commodities have attracted interest as financial instruments over time. In their article, 'financial investors and commodity markets', they discuss some factors behind the growing appeal of commodities to investors and assess the extent to which market characteristics, such as price volatility have changed. They find that it is not clear that growing investor activity can have a systematic direct effect on inventory decisions. They suggest that it is more likely that financial investors could indirectly affect inventory decisions through futures prices. However, they find that they remain open, depending on how spot prices respond to possible inventory decisions. They conclude that while physical characteristics such as inventory levels and marginal costs of production remain important, commodity markets have become more like financial markets in terms of the motivations and strategies of participants.

Toraman, Başarır and Bayramoğlu (2011) modeled the conditional variance of US gold price using M-GARCH model for the period 1992 to 2010 in which monthly data was used. In which they found, a negative and significant relationship between the return of gold and the return of USA Dollar, with the rest of the variables found to have no significant relationship with the return of gold.

Harper, Jin, Sokunle, and Wadhwa (2013), examined the price volatility in the silver spot (cash) market. In which a host of models from the ARCH family were used to analyze and gain a better understanding of the volatility of silver prices. They found the TGARCH (1,1) model indicated that both positive and negative shocks do not have a significant effect on volatility in the silver spot market, while both the GARCH (1,1) and EGARCH (1,1) models indicated that past silver spot price volatility is significant and that volatility is observed to not be constant over time. The results provided evidence that both good and bad news have no significant effect on silver price volatility.

Gencer and Musoglu (2014) investigated the shock and volatility transmission mechanisms between gold, and stock/bond markets in Turkey, applying bivariate BEKK-GARCH modeling for gold-stocks and gold bonds pairs respectively. Overall, they observed some significant shock and volatility transmissions at varying magnitudes.

Ayele, Gabreyohannes and Tesfay (2017) modeled and forecast the gold price volatility using the exponentially weighted moving average (EWMA) and the generalized autoregressive conditional heteroscedasticity (GARCH) models for the period from 1998 to 2014 in Ethiopia. Among the GARCH-type models, GARCH-M (2, 2) with Student's t distribution for the residuals was found to be the best-fit model. The results indicated that exchange rate, saving interest rate and price of crude oil have a significant effect, while inflation was found to be insignificant in determining price. Additionally, previous prices from the last two months were also found to be significant in determining current prices. The risk premium effect was found to be positive and statistically significant, suggesting increased volatility was followed by a higher mean.

Natchimuthu, Ram and Hemanth (2017) sought to determine whether gold price volatility in India was leveraged[5]. Their study also examined the impact of US gold price

[5] Leverage – In this context the use of leverage means the use of various financial instruments or borrowed capital to increase the return of an investment. Gold importation in India is subsidized as a measure to spur the development of the jewellery sector.

return on the volatility of gold price in India. The results suggested that conditional volatility of gold price in all the six cities in India carried volatility clustering features. They also found that the United States gold returns had a significant influence on the gold price volatility in five out of six Indian cities studied.

The literature has thus provided several effects of gold price volatility. However, there is no consensus on the determinants of gold price volatility. The veracity of this, needs to be determined with further empirical work. Examining the underlying long term factors is important to develop well-tailored policy instruments in a volatile market environment. Examining the determinants of gold price volatility is therefore imperative.

Methodology

Generally the price of gold is a function of gold demand. However, there are different drivers that influence the demand for gold. According to literature (Hashim et al; 2017), demand for gold is determined by activities that use gold (jewellery, medals, electrical components, etc.) and the asset/investment demand for gold. To examine the determinants of gold price volatility, the study adopts the gold price volatility function of Hashim et al (2017) which is stated in equation 1. The gold price volatility function in equation 1 encompasses both two attributes of gold demand i.e. uses of gold and investment demand of gold. Limitations of the model include its inability to disaggregate the various uses of gold due to data limitations. The paper uses quarterly time series data from 1998 quarter one to 2017 quarter three. The period is chosen not only because of data considerations but because it also covers the full trade cycle for gold including the nine year bull run from 2002-2011 as well as the long subsequent decline in gold prices. The quarterly data used is purposeful as it avoids the daily fluctuations in gold prices which are not the subject of this analysis. The data used was collected from various sources including the World Gold Council (WGC), the Federal Reserve Bank of St. Louis, S&P Global and the Bullion vault. The gold price, Jewellery demand and gold uses were extracted from the World Gold Council; the price of silver from the Bullion vault; the Dow Jones Index from S&P Global; whereas, the treasury holdings (that represents quantitative easing) used data from the Federal Reserve Bank of St. Louis

$$lnGPVol_t = \beta_0 + \beta_1 lnJDD_t + \beta_2 lnQE + \beta_3 lnINV_t + \beta_4 lnPSIL + \beta_5 lnDJI_t + \beta_6 lnCDD_t + \xi_t \quad (1)$$

Where:

- $GPVol$ -Gold price volatility
- JDD - Total world jewellery demand
- QE - Quantitative easing
- INV - Gold for investment use
- PSIL -Silver price
- DJI -Dow Jones Index
- CDD -China gold demand
- ξ - Error term

Economic theory suggests that β_1 is expected to be negative. An increase in jewellery demand is expected to stabilize gold price volatility while the impact of increased demand for gold for investment purposes would have a positive sign. Whereas the rest of the parameters can carry any sign.

Most macroeconomic time series data have been found to have a unit root which means that they are non-stationary and therefore their variances increases with time. If these data are used in regression equations, they yield spurious results. So it is imperative to pre-

test all the variables for unit roots before doing any analysis. In this study the Augmented Dickey Fuller (ADF) test was used to test for the stationarity of the variables and the variables were found to be all stationary at first difference. Results are tabulated in Table 1 bellow:

Table 1: Unit Root Test

GARCH Measure of Volatility

The ARCH and GARCH models have become the mostly used tools for measuring or analysing volatility. However, the ARCH model has certain limitations. Brooks (2008) stated that it might be difficult to decide on the number of the squared residual lags to include in the model and non-negativity constraints might be violated. Hence the GARCH model, an extension of the ARCH that allows the conditional variance to be dependent on both the lagged squared residual terms and its own past lags is preferred (Brooks, 2008). In measuring gold price volatility, the study uses an extension of the ARCH model, the Generalised Autoregressive Conditional Heteroscedasticity (GARCH) model, which incorporates moving average processes. A $GARCH(p,q)$ model is specified as:

$$\sigma^2(\varepsilon_t) = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \cdots + \alpha_q\varepsilon_{t-q}^2 + \beta_1\sigma_{t-1}^2 + \cdots + \beta_p\sigma_{t-p}^2$$
$$= \alpha_0 + \sum_{i=1}^{q}\alpha_i\varepsilon_{t-i}^2 + \sum_{i=1}^{p}\beta_i\sigma_{t-i}^2$$

Where p is the order of the GARCH terms σ^2 and q is the order of the ARCH terms ε^2.

To model a GARCH process, first of all the gold price series is run as an Autoregressive Process (AR) in order to obtain the residuals that are used to generate the volatility series. To determine the appropriate lag length for the model, we use the general to specific methodology, where we start with a lag length of 4 and then trim down the model by the t-test and also using the Akaike Information Criterion (AIC). The AR (p) process is of the form:

$$Goldprice_t = \alpha_0 + \alpha_1 Goldprice_{t-1} + \alpha_2 Goldprice_{t-2} + \cdots + \alpha_p Goldprice_{t-p}$$

Table 2: Gold price autoregressive processes

From the Table 2 above, is it evident that gold price series can be modelled as an AR (2) process. For the second stage is to estimate several low order GARCH estimates of the gold price process and compare their goodness of fit statistics and significance levels. The results are outlined in Table 3 below:

Table 3: GARCH estimates

From the above table, gold price volatility can be modelled as a GARCH (1, 1) process which is stated as $\sigma_t^2 = \alpha_0 + \alpha_1\varepsilon_{t-1}^2 + \beta_1\sigma_{t-1}^2$. The results are summarized in the Table 4 below:

Table 4: GARCH Model Results for gold price volatility

*** , * indicates significance at the 1% and 5% level respectively*

The sum of the ARCH and GARCH terms are the ones that reveal the magnitude of volatility in a model (α+β). The rule of thumb as laid by Chowdhury (2005) is that if:

- $\alpha + \beta$ is close to unity (1), then volatility is present and persistent.
- $\alpha + \beta < 0.5$ it indicates that there is no volatility.

It is evident from the table above that the sum of ARCH and GARCH coefficients (α+β) is around unity (1.07), this indicates that gold price is volatile and furthermore the volatility persistent. The results of the long –run specification to analyze the determinants of gold price volatility as expressed in equation in (1) are given in the Table 5.:

Empirical results and discussion

After deriving the volatility series, the model in equation 1 was estimated to examine the determinants of gold price volatility. The results are reported in Table 5. From the general statistics it can observed that the value of the F-statistics is 117.28 Prob > F = 0.0000, this

shows that the overall fit of the regression is good. Moreover it indicates that the model is significant at 1% significance level, thus, we can proceed with analysis as the parameters are jointly statistically significant different from zero. Table 5 further reports that the goodness of fit is relatively high, as given by the R^2 of about 93%. Majority of the variables are also significant at 5% significance level.

Table 5: Long-run regression estimates

The estimated results report that there is an inverse relationship between gold price volatility and jewellery demand, 1% increase in total jewellery demand will leads to a fall in gold price volatility by about 1.32%, ceteris paribus. This indicates that a decline in jewellery demand will exacerbate gold price volatility while the increases in the investment use of gold will also increase volatility. A current decline in global jewellery demand is therefore among the factors that exacerbates gold price volatility. Whereas a positive relationship was reported from quantitative easing, the Dow-Jones index, silver price, demand for gold by China and gold investment demand. The results of the modeling suggest that neither the effects of QE nor the impact of Dow-Jones as a proxy for alternative financial instruments are statistically significant in explaining long term gold price volatility.

The analysis does not, like many previous studies focus on short term price volatility but that which stems from a long term structural change in the composition of demand. The statistically most significant factors in explaining long term volatility are China demand, global investment demand and the demand for gold for jewellery consumption. That India is not included stems from the unreliability of Indian gold and jewellery data which is in turn driven by round tripping.

Post estimation analysis

The residual diagnostic tests for normality, autocorrelation and heteroscedasticity are reported in Table 6, 7 and 8 respectively. Table 6 depicts that the normality assumption of the residual term has been supported. However, the model suffers from autocorrelation as evidenced from the d-statistics in Table 5 and the Breusch-Godfrey Serial Correlation LM Test in Table 8. To address the problem of autocorrelation the study uses the Newey-West standard errors that are robust to autocorrelation. There is however no evidence of the presence of heteroscedasticity as presented in Tables 8.

Table 6 Normality test

Conclusion and implications

The results of the analysis confirm that the long term decline of gold jewellery demand over the last twenty years has a statistically significant and adverse effect on gold price volatility. The move away from gold uses in terms jewellery by the current generation of Millennials consumers in a range of countries will mean that the demand for gold will become increasingly dependent upon investment demand. There exists a positive relationship between investment demand for gold and gold price volatility. This implies that a shift in uses of gold demand towards investment demand will lead to an increase in volatility of gold prices. The two most statistically significant factors driving gold price volatility are declining global jewellery demand and investment demand. The emphasis which gold industry stake-holders such as the World Gold Council and the mining industry in general have traditionally placed on promoting gold jewellery consumption is therefore entirely justifiable but increasingly difficult in light of the changing patterns of luxury good consumption. Clearly an enhanced marketing strategy by key players lead by the World Gold Council in the gold jewellery sector is now essential to avoid a worsening of gold market instability.

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Tables

Table 1: Unit Root Test

Variable	Unit Roots Augmented Dickey-Fuller (ADF)			Degree of Integration
	Level	1st Difference	0.05 Critical Value	
JDD	-2.21	-11.34	-2.90	1
QE	-0.57	-4.48	-2.90	1
INV	-2.30	-9.59	-2.90	1
PSIL	-0.82	-6.90	-2.90	1
DJI	-0.82	-6.90	-2.90	1
CDD	-0.60	-8.94	-2.90	1

Table2: Gold Price Autoregressive Process

Coefficients	AR (4)	AR (3)	AR (2)
α_1	1.29 (10.81)**	1.29 (10.99)**	1.29 (10.64)**
α_2	-0.319(-1.63)*	-0.322 (-1.71)*	-0.30 (-2.73)**
α_3	0.00881 (0.041)	0.015 (0.13)	-
α_4	-0.005 (0.0045)	-	-
AIC	11.10	11.06	11.03

Table 3: GARCH Estimates

Coefficients	GARCH (1,0)	GARCH (1,1)	GARCH (1,2)	GARCH (2,1)
α_1	0.52 (0.03)**	0.24 (0.13)	-0.36 (0.13)	0.3 (0.21)
α_2	-	-	-	-0.11 (0.66)
β_1	-	0.82 (0.0000)**	0.084 (0.75)	0.0.86 (0000)**
β_2	-	-	0.65 (0.06)*	-
AIC	10.96	10.53	10.53	10.76

Table4: GARCH Model Results for gold price volatility

	Coefficient	***Std Errors***	***Z-Statistics***	***Prob.***
Constant (c)	*12.97*	*36.15*	*0.36*	*0.7196*

ARCH (α)	*0.24*	*0.16*	*1.51*	*0.1318*
GARCH (β)	*0.83*	*0.12*	*7.1*	*0.0000***
α + β	***1.02***			
R^2	*0.985``````*			
`tg bnm,	*1.94*			

Table 5: Long –run regression estimates

Dependent variable: Gold price volatility

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNJDD	-1.322198	0.527378	-2.507117	0.0153
LNQE	0.078099	0.331181	0.235821	0.8145
LNINV	0.766444	0.332546	2.304777	0.0252
LNPSIL	0.686479	0.263082	2.609369	0.0118
LNDJI	0.254708	0.677248	0.376092	0.7084
LNCDD	0.798522	0.443450	1.800702	0.0776
C	3.373015	6.063228	0.556307	0.5804
R-squared	0.931187	Durbin-Watson stat		0.739572
F-statistic	117.2784	Prob(F-statistic)		0.000000

Table 6 Normality test

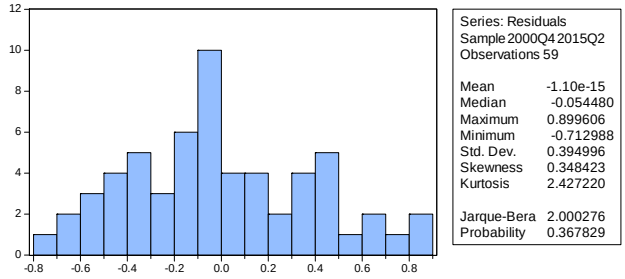

Table 7: Autocorrelation and Heteroskesdasticity Test

Table 7: Breusch-Godfrey Serial Correlation LM Test:

F-statistic	17.39546	Prob. F(2,50)	0.0000
Obs*R-squared	24.20854	Prob. Chi-Square(2)	0.0000

Table 8: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.423104	Prob. F(6,52)	0.2236
Obs*R-squared	8.321612	Prob. Chi-Square(6)	0.2155
Scaled explained SS	4.612869	Prob. Chi-Square(6)	0.5943

Figures

Figure 1: Gold Composition Demand (1997-2016)

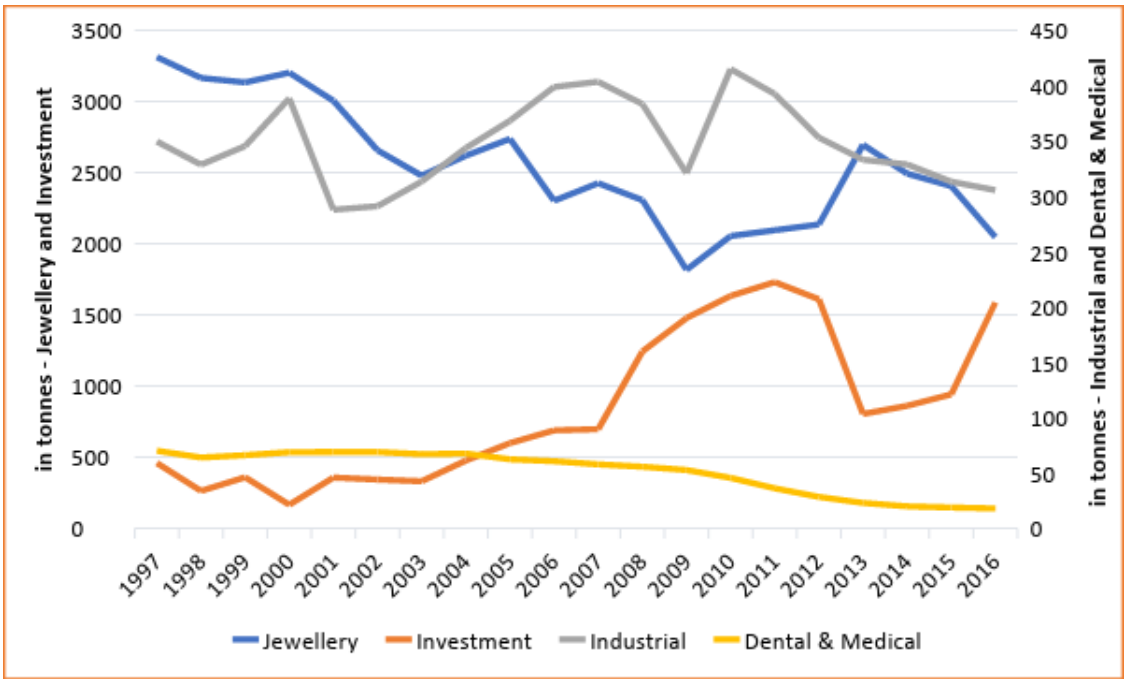

Figure 2: Gold usage in the production of jewellery

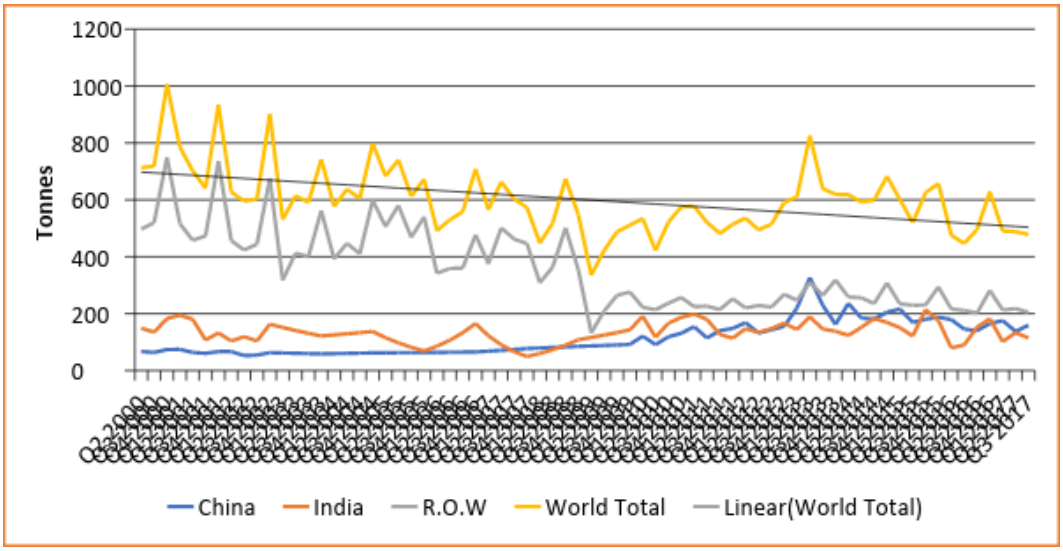

Figure 3: **Intensity of Gold Use in Manufacturing (tonnes/ GDP)**