

Department of Economics and Finance

Chair of Principles of Economics

MARKET SENTIMENT AND GOLD: INVESTORS' AND MINERS' BET

SUPERVISOR

Prof. Marco Spallone

CANDIDATE

Federico Giovanni Garone

ID: 224861

ACADEMIC YEAR 2019 - 2020

## CONTENTS

<b>Introduction:</b> What This Thesis Expects to Accomplish .....	4
<b>Chapter 1</b>	
1.1 The Investor and Market Fluctuations.....	6
1.2 Implied Volatility .....	7
1.3 The VIX Index .....	10
1.3.1 A Chronicle of Calamity .....	11
1.3.2 Methodology .....	13
1.3.3 News Sentiment .....	14
<b>Chapter 2</b>	
2.1 Fligh-to-Quality .....	16
2.2 The Gold Asset Market: An Insight Into the Demand Side .....	18
2.3 Real Drivers of Gold Price .....	21
2.4 VIX and Gold Investment Demand: Historical Evidence from SPDR Gold Shares (GLD) .....	22
<b>Chapter 3</b>	
3.1 The Real Economy: Gold Aggregate Supply .....	27
3.2 Recycling .....	28
3.3 Mining .....	31
3.3.1 Responsible Mining: The Benefits for The Society and The Economy .....	35
<b>Conclusions</b> .....	38
<b>Bibliography</b> .....	39



## **Introduction : What This Thesis Expects to Accomplish**

The purpose of this thesis is to supply in a suitable form guidance in the dynamics of the gold market, from financial history to the real economy. It is an unintuitive but complex market that has impulses, variables and at times contrasting characteristics. Comparatively little will be said here about the function and properties of the asset; attention will be paid to the role of gold as a safe heaven during market turmoil and massive sell-off in risky assets, with meaningful consequences for both intelligent investors and producers. Similarities and differences will be clarified and emphasized across two relevant periods: the Great Financial Crisis (2007-2009) and the COVID-19 pandemic (2020).

In the first chapter, much of the space is devoted to the analytical study of the VIX Index which is the barometer that commands great interest to market participants as it depicts the level of uncertainty and fear sentiment prevailing during times of economic distress. Consequently, to seize the investors' attitude toward the gold asset, the reader is forearmed with an adequate knowledge of the nature, historical pattern and degree of reliability of that market index.

The second chapter focuses on the flight-to-quality phenomenon which follows adverse events driving market volatility and worsening the flow of information and transparency within different markets. In particular, the spillover effect on the gold market is defined as a result of higher investment inflows through gold-backed ETFs whose accessibility and properties encourage the exposure to the tangible asset. Historical evidence from SPDR Gold Shares (GLD) is enlightened to seize how the level of increase in the VIX is expected to capture portfolio rebalancing behaviour toward gold during times of financial turmoil.

The last chapter is centred around the spillover effect of higher gold price on its production and global supply, examining either recycling levels and mining companies' margins. Finally,

the economic benefits of increasing gold production are considered: the great mining companies strengthen the extension of physical, financial and legal infrastructure in the countries in which they operate when they strive to perform their basic business activities responsibly.

# CHAPTER 1

## *1.1 The Investor and Market Fluctuations*

One of Benjamin Graham's most powerful insights is this: "The investor who permits himself to be stampeded or unduly worried by unjustified market declines in his holdings is perversely transforming his basic advantage into a basic disadvantage".<sup>1</sup> Constantly diversifying and rebalancing, forecasting returns, controlling brokerage and ownership costs, all put emphasis on the intelligent investor's way of timing and way of pricing to the extent that securities, even of investment grade, are subject to wide fluctuations in their prices and offer profitable opportunities. Though, the natural tendency of trends to reverse over time and the cumulative increasing adoption of stock-picking scheme by leading money managers, alongside the rapid advancement in the information technology, heavily undermined the flow of abnormal gains. Additionally, the ability to set long-term financial goals and to nurture reliable predictions, often, do not tune out the market mood swings over the relevant horizon. Indeed, when the market is plunging, the potential forthcoming losses impact the amygdala, which is identified as the part of the brain that stimulates the *fight* or *flight* response to fearful and anxious events, which is common to all cornered animals.<sup>2</sup> The burden of losing money is rooted in an emotional drawback which is so painful that rational human beings perceive it more than twice as intense as the pleasure of an equivalent gain.

It is reasonable to argue that short-term fluctuations are negligible to a smart investor pursuing a long-pull holding strategy. Greater importance should be conferred to longer-term systemic changes due to the inherent persistent market rises and declines and their implications on the

---

<sup>1</sup> " Benjamin Graham: Thoughts on Security Analysis", *Financial History*, magazine, no.42, March,1991.

<sup>2</sup> Jason Zweig, "Are you wired for Wealth?" *Money*, October, 2002.

financial and psychological elements concerning the market participants whom stand ready to vary the proportion of safe bonds to riskier equity of their portfolios and to break into a safe heaven during a bear market atmosphere, whenever terrified by the prospect of any further loss.

## *1.2 Implied Volatility*

Rational investors are mean-variance optimizers: they strive to acquire and hold suitable securities at suitable prices, providing them with the maximum expected return for any given level of risk. Market movements are instrumental in alternately forging low price levels at which it would be wise to buy and high price levels when the general market level is much higher than can be justified by well-established standards of value.

The riskiness of an investment is defined by its volatility which is an estimated measure of the dispersion of returns. Two types of volatility can be discerned: historical volatility and implied volatility. The former captures the fluctuations of underlying securities by measuring the changes in price over a relevant horizon. That is adopted as a backward-looking metric of future volatility, serving mostly as a benchmarking basis for gauging change. The latter, instead, is a forward looking one: it captures the investors' forecast of securities' risk. The quantification of the overall market sentiment is of help in determining a viable investment strategy, even though it is not based on rigid fundamentals and news events impact heavily.

The Black, Scholes and Merton (BSM) model provides a mathematical framework for implied volatility, unleashing the volatility that properly prices a traded European call option. The derivation of the Black-Scholes pricing formula depends on the following two assumptions :

1. *The price of the stock (S) follows a Geometric Brownian Motion<sup>3</sup>.*

- The continuously compounded risk-free rate of return is constant. It is used to discount the expected value of the call option on the expiration date.
- The volatility ( $\sigma$ ) is constant. Otherwise, changes in the value of the option may occur even if the stock price is unchanged.
- There are no jumps in the price of the stock (no dividends are paid) as the price of the underlying asset follows a continuous path over time and its returns are normally distributed.

2. *There are no transactions costs or taxes, assets can be sold short, are divisible and continuously traded on the market.*

Therefore, the Black-Scholes formula for an European call on a non-dividend-paying stock is:

$$C(0) = S(0)N(d_1) - e^{-rt}KN(d_2); d_1 = \frac{\ln\left(\frac{S(0)}{K}\right) + \left(r + \frac{1}{2}\sigma^2\right)T}{\sigma\sqrt{T}} ; d_2 = d_1 - \sigma\sqrt{T}$$

where:

- $C$  is the price of the call option at time  $t = 0$
- $S(0)$  is the current price of the underlying asset.
- $N(d)$  is the cumulative probability distribution for a variable that has a standard normal distribution with mean of zero and standard deviation of one.
- $e^{-rt}$  is the discounting factor.
- $t$  is the time to maturity on a yearly basis.
- $K$  is the strike price.

---

<sup>3</sup> The geometric Brownian motion is represented by the following stochastic differential equation:

$$dS = \mu dt + \sigma S dz$$

where  $dz$  is a standard Wiener process,  $\mu$  is the constant expected rate of return and  $\sigma$  is the constant variance.



- $r$  is the continuously compounded risk-free rate of interest.
- $\sigma^2$  is the variance of the continuously compounded rate of return on the underlying asset.

The implied volatility can be found via an iterative process. Plugging all the other variables, including the option price, into the Black-Scholes equation yields the implied volatility estimate.

It shall be noted that the model might generate an inaccurate result as assumption of lognormal asset prices is not supported by empirical evidence. Fatter tails than what a Gaussian distribution predicts more often occur in the market. As a result, the latter prices in a higher likelihood of sharp decline, leading to an implied volatility which varies, being lower for at-the-money options and higher for in-the-money options (volatility smiles). Furthermore, several studies have found that the option-implied volatility is a biased estimate of future volatility, due to its inability to seize all the information available in the past returns. Those works used as the assets under study the weekly S&P 100 OEX (Day and Lewis, 1992; Canina and Figlewski, 1993), and the S&P CNX Nifty index (Dixit, Yadav and Jain, 2010).

On the other hand, the model free implied volatility does not depend on any option pricing model. Britten-Jones and Neuberger (2000) found out that the basket of option prices with the same maturity is enough to derive the risk neutral expected sum of the squared returns of the underlying asset between the current date and the option maturity. No assumptions regarding the return dynamics are made except the fact that both the asset and the volatility exhibit no jump.

The authors demonstrated that the risk-neutral expected value of the average variance of the returns of an asset  $S$ , between time 0 and T can be derived using the prices of the full set of options maturing at time T:

$$E^Q \left[ \int_{T_1}^{T_2} \left( \frac{dS_t}{S_t} \right)^2 \right] = 2 \int_0^\infty \frac{C(K, T_2) - \max(S_0 - K, 0)}{K^2} dK$$

Where  $C(K, T)$  is the price of a call option having strike price  $K$  and maturity date  $T$ ,  $S(0)$  is the price of the underlying asset at time 0 and the domain of integration is over all the observed strike prices in the market.

Consequently, the model – free implied volatility is given by:

$$MFIV = \sqrt{2 \int_0^\infty \frac{C(K, T_2) - \max(S_0 - K, 0)}{K^2} dK}$$

The MFIV can be easily estimated by taking a cross section of call option values over a big range of strike prices with observable call option prices in the market and numerically integrating the above expression to get a single value for the model free implied volatility.

### 1.3 The Vix Index

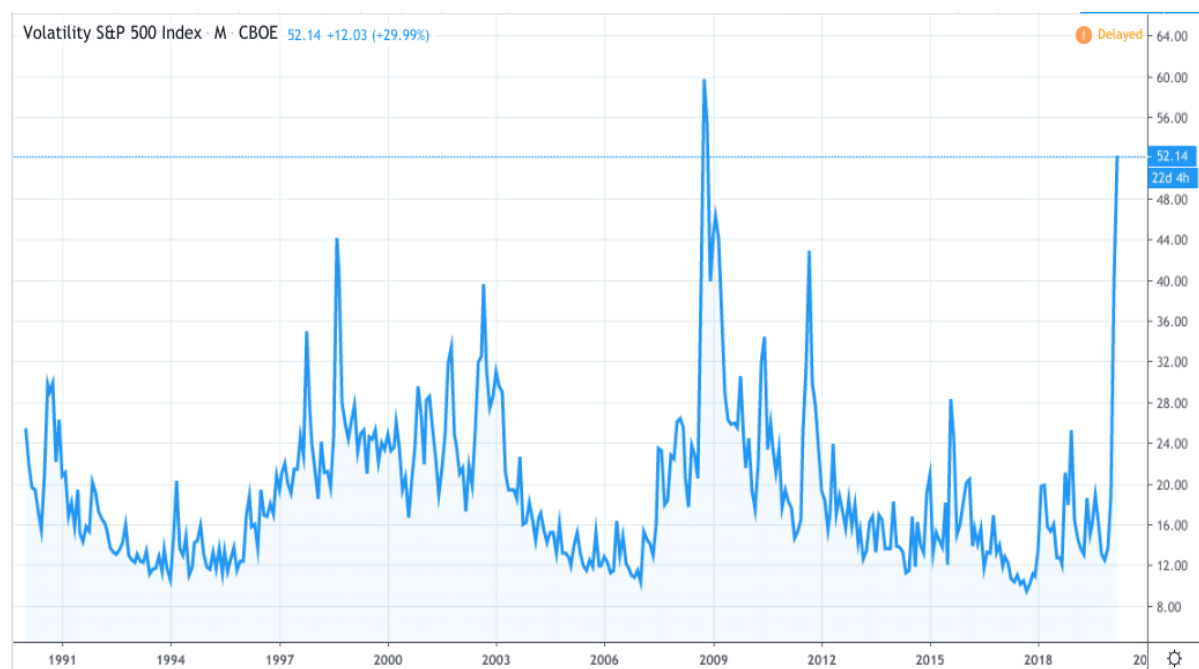
The VIX has been the first implied volatility index. Established in 1994, it measures the expectation of stock market volatility over the next 30 days implied by S&P 500 index options. Until 2003, the index was a weighted average of the implied volatilities iteratively found with the Black-Scholes option pricing model. After major changes made by the Chicago Board Options Exchange to the way the VIX is constructed, the index has shifted to a model-free approach similar to the one proposed by Britten-Jones and Neuberger.

The VIX is perceived as a barometer of the overall market sentiment as to what concerns investors' risk appetite, considering also that there are many trading strategies that rely on the VIX index for hedging and speculative purposes. In particular, relevant macroeconomic variables are regarded as leading indicators of regime shifts in the VIX index using a regime-

switching approach. It is possible to seize three distinct regimes in the VIX over a relevant horizon: tranquil regime with low volatility, turmoil regime with high volatility and crisis regime with extremely high volatility. In periods of stress levels of 30 or more are not uncommon.

### 1.3.1 A Chronicle of Calamity

Now let us take a look at some of the major events and relevant implications on the VIX regime during the past few years:



VIX volatility index 1990-present. Source: TradingView

- In July 1997, the Asian financial crisis occurred. Even after it ended, fear still towered over global financial markets. It started a localized currency and financial crisis in Thailand and soon dissaminated to other Southeast Asian countries, including Malaysia, Indonesia and the Philippines. By the fall of 1997, the spillover effect extended its coverage to South Korea, Hong Kong and China. In 1998, Russia and

Brazil saw their economies take a run for the worse, and international stock markets, from New York to Tokyo, hit record lows as investors' confidence was undermined by the volatility and uncertainty in the world's financial markets<sup>4</sup>

- The September 11 attacks in 2001 created turmoil and uncertainty among investors, leading to a massive sell-off and a sharp drop in equity prices and returns. The flow of financial capital between nations alongside with income and company yields were also significantly affected.
- In 2002 equity prices declined dramatically across the United States, Canada, Asia, and Europe. Relevant improvements in computer and telecommunications technology had been one of the most important sources of changes in supply conditions within the economic environment and had stimulated financial innovation by lowering the cost of processing financial transactions and making it easier for investors to acquire information in the market, whilst fostering their confidence in base technology advancements. The excessive speculation in Internet-related companies in the late 1990s led to a stock market bubble due to market participants overlooking traditional metrics. Massive sell-off took place at the bursting of the bubble and stocks lost \$5 trillion in market capitalization since the peak, eroding investors' long-pull holding confidence and paving the way for the VIX index to raise above its 90% threshold (29.9).
- In 2007 the crisis in the U.S subprime mortgage market developed into an international banking crisis with the collapse of the investment bank Lehman Brothers on September 15, 2008. In the United States, the stock market declined wiping out nearly \$8 trillion in value between 2007 and 2009 and, in all, the Great

---

<sup>4</sup> "Timeline Of The Crash | The Crash | FRONTLINE | PBS." *PBS: Public Broadcasting Service*, <https://www.pbs.org/wgbh/pages/frontline/shows/crash/etc/cron.html>

Recession led to a loss of more than \$2 trillion in global economic growth. As a result, the VIX peaked to its highest level since its inception<sup>5</sup>.

- The global effects of the euro debt crisis in 2010-2013 created a surgical rise in global risk aversion accompanied by fall in equity returns in advanced countries. As stock markets dried up, the overall market uncertainty generated an higher demand for safer assets, including fixed income and money market portfolios.
- In 2020, the spread of COVID-19 has severely impacted the global economy, with countries around the world suffering its destabilizing effects. The VIX Index has risen sharply but pricing suggests daily implied volatility of less than 2.5%, compared to levels around 5% to 6% during the 2007-2008 global financial crisis.

### *1.3.2 Methodology*

The VIX Index calculation involves a detailed range of steps. Firstly, near- and next-term put and call options with more than 23 days and less than 37 days to expiration are selected. Secondly, the forward value of the S&P 500 index,  $F$ , is found for both classes of options by identifying the strike price at which the absolute difference between the call and put prices is smallest.

The general formula is:

$$F = \text{Strike Price} + e^{RT} (\text{Call Price} - \text{Put Price})$$

---

<sup>5</sup> "The Fall of the Market in the Fall of 2008." Investopedia, <https://www.investopedia.com/articles/economics/09/subprime-market-2008.asp>.

Next, it must be determined the strike price ( $K_0$ ) equal or immediately below the forward index level,  $F$ , and the market prices of all the out the money options <sup>6</sup>- the call options with strike prices  $>K_0$ , and the put options with strike prices  $<K_0$  - are used to calculate  $\sigma_1^2$  and  $\sigma_2^2$ , respectively for near-term and next-term options with time to expiration of  $T_1$  and  $T_2$ .

$$\sigma_1^2 = \frac{2}{T_1} \sum_i \frac{\Delta K_i}{K_i^2} E^{R_1 T_1} Q(K_i) - \frac{1}{T_1} \left[ \frac{F_1}{K_0} - 1 \right]^2$$

$$\sigma_2^2 = \frac{2}{T_2} \sum_i \frac{\Delta K_i}{K_i^2} E^{R_2 T_2} Q(K_i) - \frac{1}{T_2} \left[ \frac{F_2}{K_0} - 1 \right]^2$$

Where:

- $\Delta K_i$  is the interval between strike prices (half the difference between the strike on either side of  $K_i$ ).
- $Q(K_i)$  is the midpoint of the bid-ask spread for each option with strike  $K_i$ .

Finally, the 30-day weighted average of  $\sigma_1^2$  and  $\sigma_2^2$  can be derived. Then the square root of that value is taken and multiplied by 100 to compute the VIX value<sup>7</sup>.

### 1.3.3 News Sentiment

The available literature on the reliability of the predictive power of the VIX Index is extensive and confirms the option-based implied volatility as a better estimate of future market movements rather than historical volatility.

---

<sup>6</sup> Any put/call option that has a bid price of zero is excluded. The average value between put and call is used if  $K_i=K_0$ .

<sup>7</sup> VIX methodology: <https://www.cboe.com/micro/vix/vixwhite.pdf>

For example, Canina and Figlewski (1993) found that implied volatility derived from S&P 100 index options has no correlation with future volatility at all. However, the methodology they had employed was heavily criticized by Christensen and Prahbala (1998), attributing the results to a problem of overlapping data that was not adequately managed. By solving the issue, the authors confirmed that implied volatility outperforms historical volatility in forecasting future volatility, and this provided stronger evidence when compared to previous studies. Further confutations are made by Becker et al. (2007) who found that the VIX index does not contain incremental information when compared to a combination of modelbased volatility forecasts. As in the study conducted by Canina and Figlewski (1993), this empirical study presents a problem of overlapping observations.

Therefore, VIX is empowered with notable predictive information. More specifically, using recent market volatility, typical premiums, and an expectation for mean reversion in volatility can provide a measure of where VIX ought to be. Comparing the actual VIX levels to those that might be expected is helpful in identifying whether VIX is “high” or “low” and can provide clearer indications of what the market is predicting about future realized volatility. The fact that similar results can be observed in various VIX indices for different equity, currency, and fixed income markets globally offers further practical applications.

## CHAPTER 2

### *2.1 Flight To Quality*

“... Policy practitioners operating under a risk-management paradigm may, at times, be led to undertake actions intended to provide insurance against especially adverse outcomes..... When confronted with uncertainty, especially Knightian<sup>8</sup> uncertainty, human beings invariably attempt to disengage from medium to long-term commitments in favor of safety and liquidity.... The immediate response on the part of the central bank to such financial implosions must be to inject large quantities of liquidity...” Alan Greenspan (2004).

Flight-to-quality is an expression used to track defensive investors’ response to market uncertainty and economic stress by tactically rebalancing portfolios toward less-risky, more liquid and more tangible assets. From a broader perspective, flight-to-quality episodes involve an increase in perceived risk which centers around the financial system. Massive sell-off makes prices of illiquid assets fall and losses grow in commercial banks, investment banks, and hedge funds, leading investors to question the safety of the financial sector. As a result, investors withdraw risk-capital from the affected markets and institutions and move into short-term and liquid assets. Interlopers in the movement of capital emerged as sophisticated parts of the financial system are compromised while other sectors of the economy are relatively unaffected.

---

<sup>8</sup> Knightian uncertainty is a lack of any quantifiable knowledge about some possible occurrence, as opposed to the presence of quantifiable risk



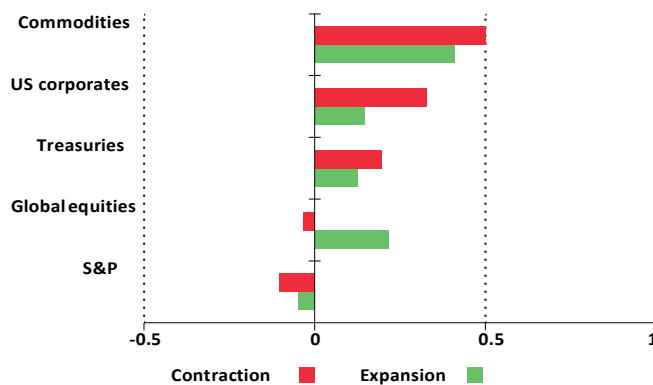
Indeed, when a substantial decline in the price level sets in, firms' net worth deteriorates due to the increased burden of indebtedness. In economies with moderate inflation, many debt contracts with fixed interest rates are typically of fairly long maturities. Because debt payments are contractually fixed in nominal terms, an anticipated decline in the price level raises the value of the borrowing firms' liabilities in real terms but does not raise the real value of borrowing firms' assets. Thus, the borrowing firms' net worth in real terms (the difference between assets and liabilities in real terms) declines. If borrowers default, losses on loans begin to mount and the value of the loans falls relative to liabilities, thereby driving down the net worth of banks and other financial institutions, which causes them to deleverage (lending contraction), steepening the decline in economic activity. With less capital, banks and other financial institutions become riskier, causing lenders to these institutions to pull out their funds. As loans become scarce, entrepreneurs are no longer able to fund their productive investment opportunities, and they decrease their spending, causing economic activity to contract.

Adverse events driving market volatility may also worsen the flow of information and transparency within different markets. Asymmetric information, adverse selection and moral hazard are crucial problems for different industries, such as the insurance industry. Moreover, flight-to-quality phenomenon seriously damage emerging market economies and expose them to risk of default and currency crisis. To maximize their profits, economic agents (firms and individuals) develop new products to satisfy their own needs as well as those of their customers. A change in the general environment will stimulate a search by agents for innovations that are likely to be profitable. Responses to changes in demand conditions and responses to changes in supply conditions stimulate the research and development of new ways of doing business and new products and services that would meet changing customers'

needs, whom are more sensitive to the overall economic conditions. Still, relying on traditional, intangible assets is a strategic move to hedge against risks and market fear.

## 2.2 The Gold Asset Market: An insight into the Investment Demand Side

Gold has consistently benefited from “flight-to-quality” inflows during periods of heightened risk. It is particularly effective during times of systemic risk, delivering positive long-term returns, reducing overall portfolio losses and providing liquidity with no credit risk. At the same time, gold allows investors to meet liabilities when less liquid assets in their portfolio are difficult to sell and is an great diversifier in periods of economic expansion and contraction<sup>9</sup>. In the following graph the correlation between gold and major assets is represented<sup>10</sup>.



Source: Bloomberg, NBER, World Gold Council

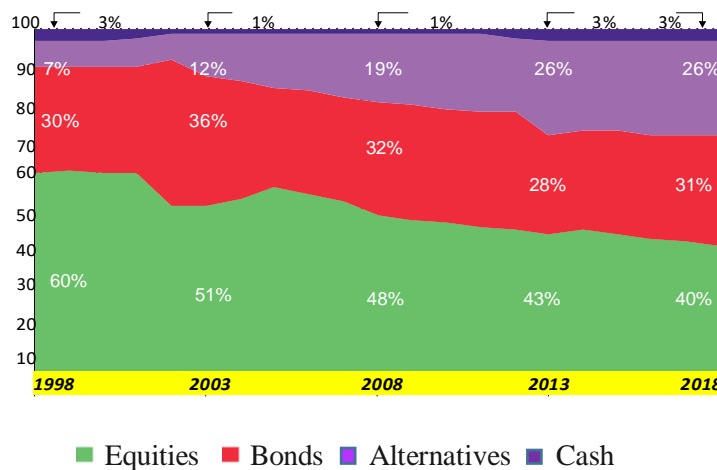
It can be noted that gold has little correlation to all the major components of a typical investment portfolio in both good and bad economic environments. In particular it has negative correlation with global equities, which are the most

<sup>9</sup> <https://www.gold.org/goldhub/research/relevance-of-gold-as-a-strategic-asset-2020-individual>.

<sup>10</sup> Based on monthly returns between 1 January 1971 and 31 December 2019. Economic expansions and contractions as determined by the National Bureau of Economic Research.

volatile asset class, during periods of economic contraction. That makes it a valuable and low-cost hedge for defensive investors looking for sound portfolio protection.

Global investment demand has grown by an average of 14% per year since 2001 and the gold price has increased by almost six-fold over the same period, said the World Gold Council report titled “*The relevance of gold as a strategic asset | US Edition*”. Low interest rates and continued financial market uncertainty ranging from geopolitical tensions to expectations of diverging global economic growth and an increase in asset volatility, have reinforced the traditional role of gold as safe-heaven asset. Systemic risk, in particular in relation to US and eurozone economies, has been a key driver of the gold price. After the 2008 financial crisis, gold has maintained its steady climb in prices due to ongoing concerns surrounding the eurozone sovereign debt crisis and the US debt ceiling. As a result, investors continue to add alternative investments, including gold, to their portfolios.



Source: Willis Tower Watson

Surely, the accessibility to that tangible asset has been playing a key role for its growing importance. Gold-backed ETFs and similar regulated financial products have had a material

impact on demand for and exposure to gold. Institutional and retail investors are given the access to the properties and security of owning physical gold with the flexibility and ease of stock-market trading. Each share in a similar fund tracking the price of gold corresponds to a specific amount of it. In particular, they offer:

- *Lower management fees*: ETFs fees are typically 40bps or less because their structures get the benefit of economies of scale.
- *Reduction of premiums*: ETFs offered investors of all sizes wholesale prices for the first time, while offering shares at fractional units of an ounce of gold, resulting in a much cheaper cost per purchase than bullion.
- *Elimination of separate storage and vaulting costs*: investors who hold gold bullion and coins bear the expense of storage and vaulting directly or through a third-party.
- *Standardisation in quality and security*: gold-backed ETFs generally hold a standard form of gold bullion in troy ounces, kilograms, or grams. Additionally, these bars are typically stored at custodian or bullion banks that have experience, networks, and facilities to properly secure the gold.
- *Added liquidity*: gold is very liquid and can be easily converted into cash on a short notice and at a fair price.
- *Increased operational efficiency and transparency*: gold ETFs provide transparency and security through an approved custodian, typically a bullion bank or dealer, with experience in managing gold accounts. Additionally, gold ETFs must meet strict regulatory requirements similar to publically traded equities and publish daily reports.

### *2.3 Real Drivers of Gold Price*

Many investors view gold as a safe haven, one that is only relevant when there is potential for high uncertainty and systemic risk. Still, gold's role in an investment portfolio is even more strategic. Investors can benefit from modest, long-pull holdings of gold instead of short-term positions only. As a result, the asset price is the final outcome of the interplay between market volatility, currencies, economic growth and tactical flows.

The VIX index, which tracks the volatility of the S&P 500 index, mirror changes in the gold price. This means that volatility dynamics in the equity markets influence gold price dynamics and this is examined in the next section of this chapter.

Concerning currencies dynamics, US dollar has historically been linked to driving the gold price. Indeed, numerous studies point to the US dollar as a real driver of gold price. For example, Capie et. al. (2005) concluded that the US dollar is negatively correlated with the gold price and that a weekly movement in the US dollar would generate an opposite movement in the gold price. The period under study for the research done by Capie et. al (2005) was 1971 to 2002. According to Sindhu's (2013) own research on gold price drivers for the 5-year period from November 2006 to December 2011, 22% of the variations in gold price are due to the US dollar while the R-squared is 0.227, clearly indicating significant correlation.

Periods of economic expansion are very supportive of jewellery, technology and long-term savings. During an expansionary period, a good portion of investment demand for gold falls. However, the gold market does not collapse. Part of gold investment demand increases alongside longterm savings rates. These, in turn, benefit from positive economic growth. At the same time, rising incomes boost jewellery demand. In the last five years, jewellery demand averaged 58% compared to 35% for investment demand and a 1% increase in GDP

lifted jewellery consumption by an average of 5% (ceteris paribus)<sup>11</sup>. Technology demand is significant and devoted to grow and technology itself is also closely correlated to growth: every 1% increase in global GDP raised electronics' demand for gold by 5.1% (ceteris paribus) and it responds little to the gold price<sup>12</sup>.

Moreover, unlike financial assets, gold is a real asset and is supported by rising inflation which negatively affects bonds and assets that derive value from future cash flows. Inflation also damages the real economy and creates risk aversion driving up risk premiums.

Finally, short-term capital flows, positioning and price trends can significantly ignite or dampen gold's performance.

#### *2.4 VIX and Gold Investment Demand: Historical Evidence form SPDR Gold Shares (GLD)*

As previously mentioned, in recent years gold ETFs have provided a popular alternative to directly investing in gold as they are designed to provide investors the potential benefits of owning gold without the added costs of delivery, storage and insurance. On November 12, 2004 SPDR Gold shares were introduced as the first gold ETF and have grown to become the largest of the gold ETFs with \$57.8 billion worth of AUM. It is provided by SPDR State Street Global Advisors and holds gold bars with the aim of tracking the performance of gold bullion<sup>13</sup>. The market reaction in the GLD ETF, following substantial increases in the VIX index is examined to seize how the level of increase in the VIX is expected to capture the

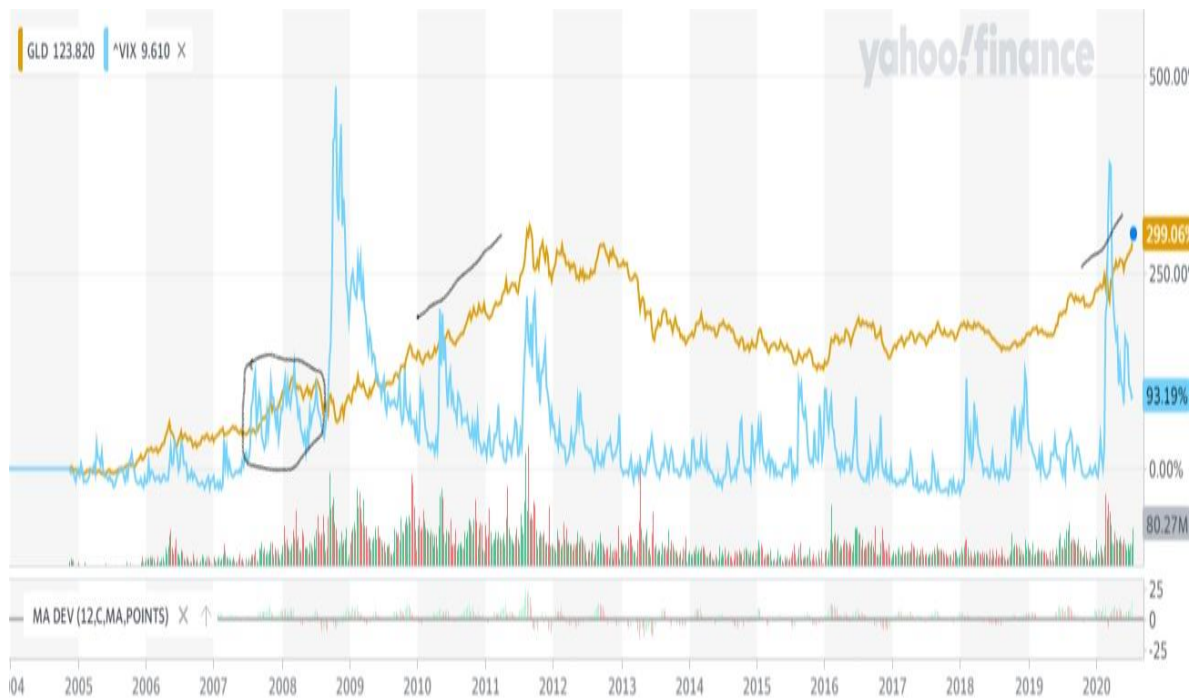
---

<sup>11</sup> Source: Avinash Persaud, World Gold Council

<sup>12</sup> Source: GFMS-Thomson Reuters, World Gold Council

<sup>13</sup> More informations on <https://www.spdrgoldshares.com/>

degree of market uncertainty. Consequently, flight-to-quality behaviour occurs during times of financial turmoil.



*Source: Yahoo Finance*

The benefits of gold came into clear focus during the 2008-2009 financial crisis and did so again during the subsequent European sovereign debt crisis and the most recent COVID-19 pandemic. Historically, gold prices have not increased as rapidly in tail events as in hedges that track market volatility indices. In fact, that commodity does not get consumed, nor does it disappear. It gets accumulated over intermediate-to-long horizon. But, importantly, it has served as a safe haven, improving risk-adjusted returns and adding needed liquidity during times of crisis, without the the difficulties of market timing.

The beginning of the financial crisis was August 7, 2007 when news from French bank BNP Paribas boosted a sharp rise in the cost of credit, and made the financial world aware of the systemic risk. The GLD ETF share price was trading around \$86 in December of 2008, reflecting a substantial increase in demand from the original offering in November 2004

where trading was below \$50. Additionally, it saw inflows rise during 2009, with holdings increasing to 1,133.62 metric tons as of Dec. 31, 2009, versus 780.23 on Dec. 31, 2008, again with holdings rising toward year end<sup>14</sup>.

As of June 25, 2010, assets under management in the trust totaled more than \$53 billion, making it the second largest ETF by assets in the world. On June 29, Jason Toussaint, managing director, Investments, at World Gold Trust Services LLC, stated: “Strategic asset allocation will continue to play a central role in investors’ portfolio performance moving forward, and portfolios that contain even a small allocation in gold have the potential to better cope with varying market scenarios. This milestone for GLD underscores that investors have embraced gold as a viable core holding over the long-term”. Therefore, gold has received a huge amount of attention of late due to the role that it has played as a safe haven asset throughout the financial crisis. Its price rose by 6% in 2008 while domestic and world equities declined by 40%. In the first quarter of 2009, the gold prices increased by a further 4% while stocks have fallen by another 11%. One of the reasons that the financial crisis and fear sentiment have proved so terrible for investors’ portfolios is that many alternative assets which were marketed as effective portfolio diversifiers failed to meet expectations.

In 2013 gold price fell as investors reacted to Fed streamlining expectations, and money stepped back into equities due to monetary policy normalisation. Investors sold approximately 900 tonnes (32%) of gold via gold-backed ETFs during that year.

Similarly, as the 2020 coronavirus outbreak continues to spread in the markets, the safe haven of precious metals is in high demand, especially for exchange-traded funds (ETFs) that are backed by gold. ETFs have been accumulating gold as more coronavirus news continues to invade the financial markets. The pandemic is having a bad effect on the global economy.

---

<sup>14</sup> <https://www.gold.org/goldhub/data/global-gold-backed-etf-holdings-and-flows>



The International Monetary Fund is forecasting a 4.9% contraction in global growth in 2020, with high levels of unemployment and wealth destruction. VIX climbed to over 80 in March 2020, signalling a crisis of confidence and uncertainty similar to those in the Global Financial Crisis. It subsequently settled below 50, a level not touched since 2008. Volatility in global financial markets raised in February as the spread of COVID-19 accelerated around the world. Stock markets suffered a profound sell-off. Global holdings of physically-backed gold ETFs and similar products raised by 298 tonnes during the first quarter of the year, which is the highest quarterly inflows for four years. In value terms, assets under management (AUM) in these products increased by a record US\$23bn over the quarter combined with a 6% quarterly increase in the gold price. SDPR Gold Shares flows was 17,263.0 as of July 2020 in value terms (US\$m)! This is a comprehensive list of the top 10 ETF positive flows<sup>15</sup> during COVID – 19:

Top 10 flows	Country	Holdings (tonnes)	Change tonnes	Flows (US\$m)	Flows (% AUM)
SPDR Gold Shares	US	1,206.7	313.7	17,263.0	39.5%
iShares Gold Trust	US	468.7	108.7	5,977.5	33.9%
iShares Physical Gold ETC	UK	234.1	90.6	4,843.7	68.9%
Invesco Physical Gold ETC	UK	206.1	60.2	3,245.1	45.4%
Amundi Physical Gold ETC	France	62.1	40.2	2,122.2	198.5%
SPDR Gold MiniShares Trust	US	46.8	23.7	1,273.1	112.4%
Xetra-Gold	Germany	226.5	23.0	1,263.9	12.7%
Sprott Physical Gold Trust	US	72.9	22.7	1,230.1	50.0%
Aberdeen Standard Physical Gold Shares	US	39.6	15.2	824.5	68.9%
ZKB Gold ETF	Switzerland	74.9	8.2	430.0	13.2%

*Source: World Gold Council*

<sup>15</sup> Year to date 17 July 2020

Thus, fears over the economic and social impact of the virus increased flight-to-quality activities by raising the demand for many safer investment products, most notably gold ETFs, fuelling the gold price.

## CHAPTER 3

### *3.1 The Real Economy: Gold Aggregate Supply*

After discussing how market volatility and fear sentiment (VIX) have been impacted the gold investment demand and its price, significant attention should be devoted on figuring out what are the relevant effects on the asset aggregate supply and, ultimately, the real economy.

The gold supply chain, with all its components, enables the smooth functioning of the gold market; it allows gold to flow to where it is needed and in the desired form. Gold has to be released from other minerals to produce a semi-pure bar. A dorè bar<sup>16</sup> produced at a mine site is transported to refiners, who then ship refined gold to the markets. Four of the largest gold refineries are located in Switzerland, making it an important hub. Once it is refined, gold travels to financial hubs around the world. London is the largest one with many vaults dedicated to it and other precious metals.

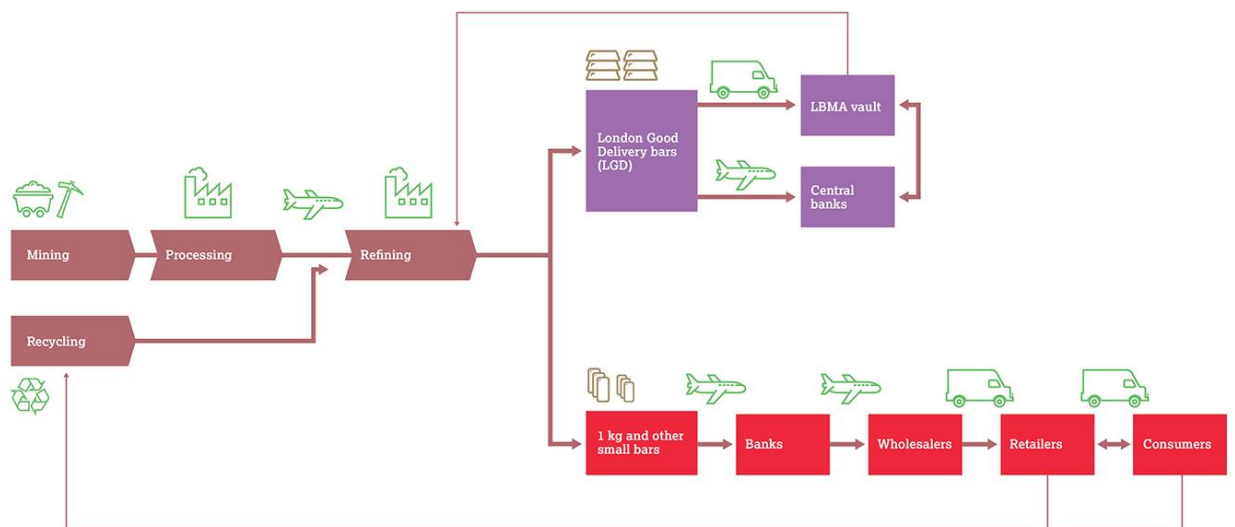
Mine production accounts for the largest part of gold supply – typically, 75% each year. Usually, it does not respond to price variations quickly but it takes a long lead time for gold mining and related activities to enter into production after new gold deposits are explored and tracked. Usually, newly mined gold cannot satisfy the entire annual demand and, thus, recycling captures the resulting shortage. As it is for all intents and purposes indestructible, about the entirety of the gold at any point mined is still available in some form and conceivably accessible for recycling.

---

<sup>16</sup> A doré bar is a semi-pure alloy of gold that needs further purification to meet investment standards.

Recycling is the source of gold supply that immediately reacts to gold price and economic shocks. Around 90% of recycled gold comes from jewellery and gold extracted from technology gives the remaining 10%.

The following graph illustrates the entire supply chain along which gold ore goes through before being ready for the markets.



Source : World Gold Council

Now let us see more precisely how recycling and mining volumes vary in response to market turmoil and increasing gold price.

### 3.2 Recycling

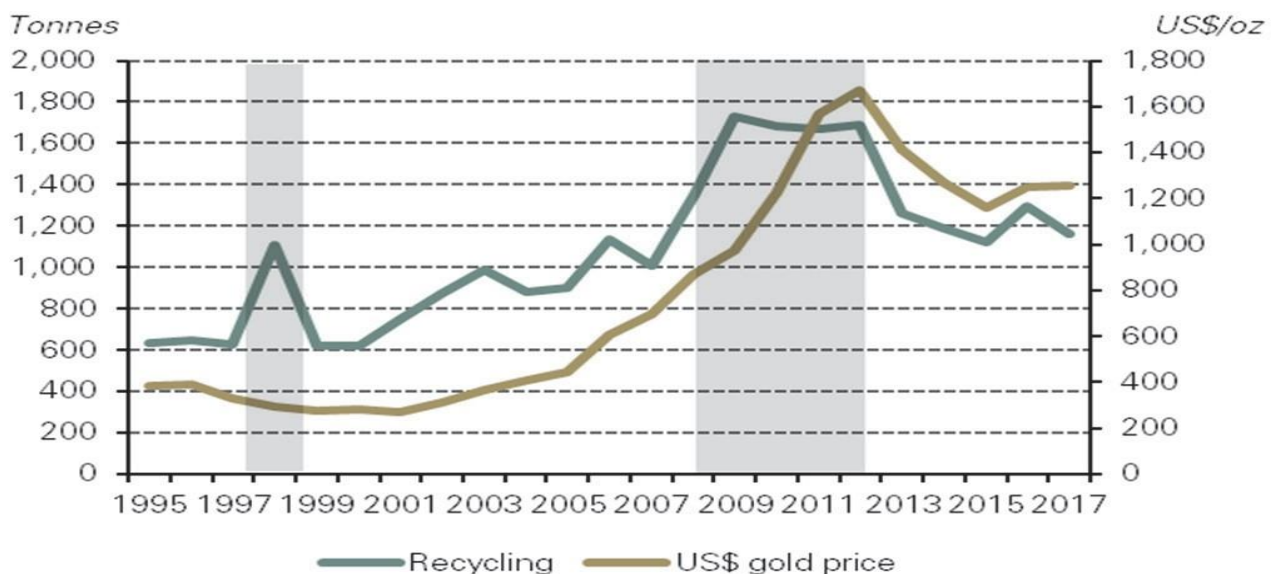
Gold recycling comprise two distinct markets, each with its own value chain:

- Jewellery accounts for roughly 90 percent of the total supply of recycled gold. It is generally served locally. Indeed, many melters and refiners focus on one key region,

such as the Canadian Mint and Ohio Precious Metals in North America, Tanaka and the Perth Mint in Asia, and Rand in Africa.

- Industrial recycled gold makes up the remaining 10%. It consists of gold found in waste electrical and electronic equipment (WEEE), such as computers, tablets and mobile phones. It is served globally as it requires large sites and complex equipment, so recyclers reinforce their operations in one location to serve the global market.

According to Thomson Reuters GMFS, between 1995 and 2017 recycled gold accounted for about one third of total supply, on average. Gold recycling fluctuates with gold prices and economic conditions. Price changes account for around 75% of annual changes in gold recycling, and thus economic crises can boost recycling. This high responsiveness helps stabilize the global gold market. Notable examples include the Asian financial crisis in 1997 and the 2008-2009 global financial crisis, either fuelling significantly the gold investment demand and its price through increasing flows in ETFs. As a result, the former boosted recycling by 19 percent, mostly in Asian countries. The latter exerted a broader impact increasing global recycling by 25 percent.



Source: World Gold Council

It can be noted that in 2009, recycled gold hit a record of 1728 metric tons, following global economic distress and higher gold prices.

In 2014 gold recycling fell to a seven-year low (1122 metric tons) and remained low in 2015. This is partly a result of low gold prices, leading to less market sell-off as a result of greater economic stability, and the depletion of near-market gold recycling materials.

Recycling activity was also affected in the first quarter of 2020, falling 4% to its lowest level for two years. The price-sensitive nature of gold recycling was weakened by the lockdown measures worldwide. Indeed, the normal physical exchange of gold for cash was virtually suspended as consumers were instructed to stay at home and jewellery retailers were temporarily forced to close. This reduced the amount of gold that may have come onto the market. Border closures and the reduction in commercial flights have negatively affected the regular movement of gold, reducing both gold recycling and mining production. Moreover, fewer flights caused a significant drop in available cargo space. This has led to intense competition for that space, with essential goods, such as medical equipment, often being prioritised. Consequently, the cost of transporting gold between various hubs has substantially increased and left the supply chain looking for alternative means of transportation, said managing director of Malta-Amit Singapore Pte. Ariel Kohelet, including chartering cargo-only aircraft<sup>17</sup>. As lockdown measures are being eliminated, gold recycling levels are likely to rise as consumers look to manage the economic impact of COVID-19.

---

<sup>17</sup> [www.bloomberg.com/news/articles/2020-05-03/gold-bars-fight-covid-kitsfor-space-on-the-plane?sref=3W4oJZsn](https://www.bloomberg.com/news/articles/2020-05-03/gold-bars-fight-covid-kitsfor-space-on-the-plane?sref=3W4oJZsn)

### *3.3 Mining*

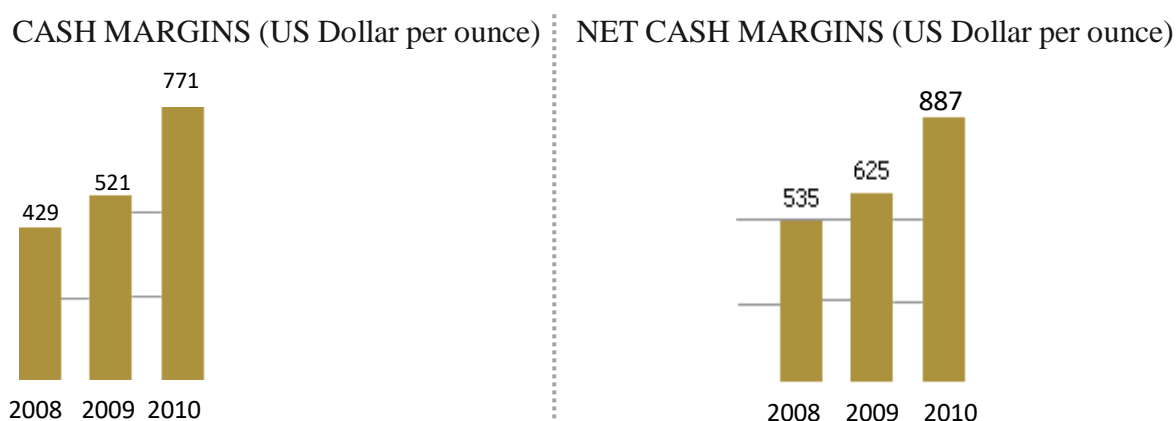
Gold mining is the procedure of extracting ore from the Earth's crust in areas where there is an important cluster of gold-bearing ore. It is a global business with operations worldwide. The vast majority of the world's gold was mined in the modern, post-war era. And as the industry has evolved, it has become more geographically diverse. More countries have emerged as substantial gold producers over recent decades, which means mine supply has become less geographically concentrated and therefore more stable. Large-scale gold mining is extremely capital-intensive, requiring high levels of mechanisation and expertise. Indeed, the life-cycle of a gold mine is long. Before any gold can be extracted, significant exploration and development needs to take place. On average, it takes between 10-20 years before a mine is ready to produce material that can be refined. Finally, when bringing gold to the market, mining companies have two options. They can either sell newly mined gold now at the current price or sell gold which has not yet been mined now.

Market volatility has a significant impact on gold prices and, ultimately, gold miners. Gold companies showed their strength as a safe haven during the economic turmoil. As we saw, during 2009 gold consistently traded at levels above \$1,000 per ounce and reached an all time high of \$1,214 per ounce in December. At the same time, the market capitalisation of gold companies increased by 47% or \$64 billion. This follows a lower decline than the wider industry in 2008, showing gold appears to be seen as a place of relative stability in difficult times. Gold, on the back of a 7% production increase and a 12% increase in the average price from 2008 to 2009, saw its share – within the global mining industry- of total sale revenue increase from 10% to 14% in 2009<sup>18</sup>.

---

<sup>18</sup> <https://www.pwc.co.uk/assets/pdf/mine-back-to-the-boom.pdf>

In particular, already at that time Barrick<sup>19</sup> was confident about future gold prices and completed \$6 billion of debt and equity offerings, utilised specifically to eliminate the group's gold hedge positions. The company delivered a strong operating performance in 2010 by increasing gold production and lowering total cash costs, and achieved record financial deliverables as the gold price ramped up.



*Source: Barrick Gold Corporation Annual Report 2010*

In 2010, the company accomplished its fifth consecutive year of margin expansion with record edges of \$771 per ounce or \$887 per ounce on a net cash cost basis, reflecting money edge raise of 48% versus gold's 26% growth. Alongside with higher production of 7.8 million ounces, this brought about 2010 adjusted earnings and adjusted operating cash flows of respectively \$3.3 billion and \$4.8 billion, plus free cash flow of \$1.5 billion, despite making considerable investments in the business activities. The 'A' credit rating and the gained robust financial position provided Barrick with the flexibility to pursue several high return value creation opportunities and to keep on executing aspiring project development plans. The demonstrated excellent financial results reinforced growth in the return on equity to 19% and

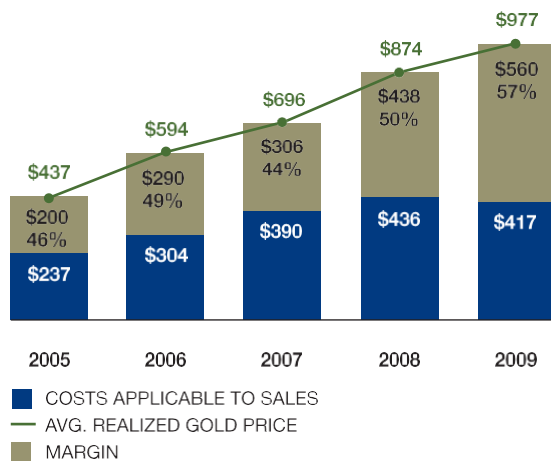
<sup>19</sup> Barrick Gold Corporation, headquartered in Toronto, Canada, originated from Barrick Resources founded in 1980s, is a mining company that produces gold and copper with 16 operating sites in 13 countries.



enabled the company to return additional capital to shareholders, while continuing to invest in other profitable projects. Barrick raised its dividend by nearly 120% over the period 2005-2010 as gold prices appreciated, including a 20% increase in 2010. This steady dividend growth reflected both the Company's continued financial strength and the favorable outlook for gold at that time.

Prior to 2009, in the absence of significant exploration success and stagnating profit margins, many investors opted to obtain their gold exposure through the abovementioned exchange traded funds. However, in 2009 things began to change for gold mining companies, and in particular for Newmont<sup>20</sup>, as its operating costs began to stabilize when gold prices began to increase significantly. In 2009 Newmont's operating costs declined by 4% and the average realized gold sales price increased by 12%. As a result, gold operating edge increased by 28%, resulting in an increase in profitability of almost 2.3times the average annual gold price.

Margin Expansion 2005-2009



Source: Newmont Mining Corporation Annual Report 2009

<sup>20</sup> Newmont Corporation, based in Greenwood Village, Colorado, USA, is the world's largest gold mining company.

In 2009, through operating scale and disciplined execution, Newmont delivered significant gold price leverage in the financial performance by achieving record revenues, record earnings and record cash flows.

As of 2020, the flow of gold along the supply chain was mined by border closures and drastic reduction in the number of commercial flights worldwide, thus compelling more costly delivery. However, the geographical dispersion of gold mining was instrumental in preventing the global supply of gold from experiencing a total slow down, as certain countries continued to operate their gold mining activities<sup>21</sup>. For the few carriers still operating, any space was reserved to medical devices and personal protective equipment. Hence, the Covid-19 pandemic disrupted the gold market by altering substantially the global supply chain just when investor demand increased exponentially<sup>22</sup>.

Profound disturbances to the gold supply chain, starting from production, spilled over into higher prices facing end-users:

- Gold mining operations were suspended in several countries as a result of national restrictions aimed at reducing the virus spread and exposure. Consequently, the total supply of gold coming onto the market has been shortened.
- Delivery: the shipment of gold was shortened due to stricter travel requirements and personal protective equipment and medical items often being prioritized, forcing more expensive delivery.

---

<sup>21</sup> <https://www.gold.org/goldhub/research/market-update/gold-market-supply-chain-shows-resilience-amid-disruption>

<sup>22</sup> <https://www.visualcapitalist.com/impact-of-covid-19-on-the-gold-supply-chain/>

- Refinery: the volume of refineries' work depends on gold being produced. As production levels fell significantly and labor work was suspended, the total supply of refined gold has been reduced.
- Metal traders: traders faced both diminished supply and higher cost of delivery. These increased costs have been passed on to end-users.
- Consumers: as investors demand ramped up, global supply lowered and delivery costs increased, buyers of gold have been facing higher prices.

### *3.3.1 Responsible Mining: The Benefits for the Economy*

Clearly, gold mining activities do have a positive impact on the countries in which they are performed and, ultimately, on the wider economy.

Every country has resources at its disposal. These "resources" can be "natural resources", such as land suitable for a certain type of agriculture or mineral wealth. They can be other advantages such as proximity to a key transport route or hub, a landscape or history that attracts tourists or geographical proximity to a richer country. The advancement trajectory varies from country to country but it is common in history for a country to grow economically once it is able to start exploiting a resource effectively and efficiently. In the earliest stages of development a country is normally dominated by agriculture, much of which is grown for local needs. Mining activities at this stage are typically of small-scale. The development of a formal mining industry is often associated with a marked development and can be the first stage in industrialisation. Mining of coal and iron was instrumental in the early stages of the industrial revolution in Britain and, subsequently, the rest of Europe in the late 18th and early 19th centuries. Gold mining in particular was

closely associated with the development of California and other parts of the American West, Australia and, of course, South Africa. In a country that has been primarily agricultural, the development of a formal mining industry can strengthen the growth of a more formal element to the economy and strengthen the extension of physical, financial, administrative and legal infrastructures. Usually, the poorest developing countries face serious shortages of capital and infrastructure; governments struggle to obtain revenue and many, even after the debt relief initiatives of recent years, remain heavily indebted. In these circumstances the development of a new mining venture can bring a number of benefits:

- Foreign exchange earnings from exports.
- Inflows of foreign direct investment and associated high technology and capital spending.
- Provision of physical and human infrastructure associated with mining projects
- Higher fiscal revenues through royalties and taxes.
- Higher employment and increased demand through multiplier effects.
- Assistance in the development of a legal, technical and financial infrastructure.

Nowadays, the great mining companies have in place comprehensive policies to meet their environmental, corporate and social responsibilities. They strive to perform their basic business activities responsibly, thereby supporting the development of a strong community while respecting human rights and labour rights. This includes aiming for high standards of environmental management through all stages of operation from exploration through to reclamation once a mine has ended. Major mining companies seek to follow best employment practices in respect of wages and benefits, working conditions, health and safety and training. They are committed to working with the local community and carrying out extensive consultations from development onwards. As far as possible, they will employ local labour

and source goods and services locally. They will contribute to local social facilities such as schools and medical services and can support the development of other local industry. Companies are increasingly placing these issues daily into business decision making. Considerable data on environmental and social responsibility strategy and practices are normally published on companies' websites. Progressively, gold mining organizations are completing customary or on-going social responsibility evaluations so as to track and improve their own performance, and to learn from best practice in other organizations. Certain companies have now started, partly in line with Global Reporting Initiative guidelines for sustainable development, to provide an annual report (often with independent auditing) on their practices, such as Placer Dome's Sustainability Reports, Newmont's 'Now and Beyond' report, Barrick's 'Environmental, Health, Safety and Social Responsibility Reports', or AngloGold Ashanti's 'Report to Society'. In addition, the International Council on Mining and Metals<sup>23</sup>, with major mining companies as members, supports programmes for mining, minerals and sustainable development and protection of human rights, and seeks to promote the spread of best practice.

---

<sup>23</sup> The International Council on Mining and Metals (ICMM) was founded in 2001 to improve sustainable development performance in the mining and metals industry.

## Conclusions

Investing in gold is an extremely efficient way of preserving purchasing power over time as it continues to increase portfolios' resilience and strengthen diversity in asset allocations. As pointed out, the outlook for gold depends on the continued shift in balance from physical consumption to financial demand from investors and viceversa. To this end, the thesis has made the following three points:

- The VIX index represents a meaningful key for investors to seize the level of uncertainty in the wider economy, empowered with notable predictive information.
- As volatility ramps up, investors withdraw risk-capital from the affected markets and institutions and move into short-term and liquid assets such as gold, historically fuelling gold-backed ETFs inflows, which provide superior returns alongside the sharp increase in the asset price.
- As a result of higher prices, the flow of gold supply increases boosting producers' margins. In turn, mining activities require a massive amount of capital and infrastructure, benefiting the countries in which they take place and providing real benefits to the economy.

In short, there is still a role for gold in the modern world, creating prospective opportunities within financial and productive territories.

## Bibliography

- Graham Benjamin. *The Intelligent Investor*, Rev. Ed. Harper Collins, 2009.
- Luenberger David G. *Investment Science*. International Edition, Oxford University Press, 2009.
- Mohamad Azhar, and Ajmi Ismail Murad Samsudin. *Implied Volatility Forecasting in the Options Market: A Survey*. Mar. 2016.
- Jiang George, *Model Free Implied Volatility and Information Content*. University of Arizona and Yisong Tian, York University, Mar. 2003.
- Edwards Tim and Preston Hamish, *A Practitioner's Guide to Reading VIX*. EDUCATION Strategy 201, Dec. 2017.
- Bongiovanni Alessio, De Vincentiis Paola and Isaia Eleonora, *The VIX Index: Forecasting Power and Performance in a Risk Management Framework*. Journal of Financial Management, Markets and Institutions, Dec. 2016.
- Mishkin Frederic S. and Stanley G. Eakins. *Financial Markets and Institutions*, Global Edition, 2018.
- Boscaljon Brian L. and Clark John Michael, *Do Large Shocks in VIX Signal Liability Management Strategies?*. Journal of Applied Finance, Vol. 23, No. 2, 2013.
- World Gold Council, *Investment Update: Gold, an efficient hedge*. WGC, Apr. 2020.
- Sipkova Hana, and Jurai Sipko, *What Are the Real Drivers of Gold Prices?* International Journal of Business and Social Science Vol. 5, No. 8(1), 2014.
- Hewitt Alistair, Keel Trevor, Tauber Matthias, and Le-Fiedler Trinh, *The Ups and Downs of Gold Recycling*. Boston Consulting Group (BCG), Mar. 2015
- Marsden, John, and Iain House, *The Chemistry of Gold Extraction*. SME, 2006.
- Barrick Gold Corporation (NYSE: ABX)(TSX: ABX), *2010 Annual Report*. Mar. 2011.
- Newmon Mining Corporation (NYSE: NEM), *2009 Annual Report*. Mar. 2010.
- Eggert, Roderick, *Mining and Economic Sustainability: National Economies and Local Communities*. Mining, Minerals and Sustainable Development, Oct. 2001.