"To access the relationship among Gold, Dollar, Crude Oil & SENSEX"

A project study submitted in partial fulfilment for the requirement of the two years management program 2011-2013

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Certificate

This is to certify that the thesis entitled **"To access the relationship among Gold, Dollar, Crude Oil and SENSEX"** is the bona fide work carried out by Pushendra Agarwal (2K11/MBA/37), student of Delhi School of Management, Delhi Technological University, who carried out the project under my supervision.

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Declaration

I hereby declare that the thesis entitled **"To access the relationship among Gold, Dollar, Crude Oil and SENSEX"** submitted by me in partial fulfilment of management program to Delhi School of Management, DTUis my original work and has not been submitted earlier either to DSM or to any other institution for the fulfilment of the requirement of the course of study.

I also declare that no chapter of this manuscript in whole or in part is lifted and incorporated in this report from any earlier / other work done by me or others.

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Executive Summary

Gold is a monetary metal whose price is determined by inflation, by fluctuations in the dollar and U.S. stocks, by currency-related crises, interest rate volatility and international tensions, and by increases or decreases in the prices of other commodities. The price of gold reacts to supply and demand changes and can be influenced by consumer spending and overall levels of affluence.

Gold is bought and sold in U.S. dollars, so any decline in the value of the dollar causes the price of gold to rise. The U.S. dollar is the world's reserve currency - the primary medium for international transactions, the principal store of value for savings, the currency in which the worth of commodities and equities are calculated, and the currency primarily held as reserves by the world's central banks. However, now that it has been stripped of its gold backing, the dollar is nothing more than a fancy piece of paper.

Although the prices of gold and oil don't exactly mirror one another, there is no question that oil prices do affect gold prices. If oil prices rise or fall sharply, investors can expect a corresponding reaction in gold prices, often with a lag.

From an Indian perspective, Gold which traditionally viewed as a safe haven in uncertain times, hit record highs in post-2000. The current bull-run in gold has lasted for more than a decade from Rs. 4473.60 per 10 gms in 2000-01 to record highs of over Rs. 30,000.00 per 10 gms during 2012-13. Before 2000, the demand for gold was elastic. However, now the gold market seems entirely inelastic, as the appetite for the metal is high even as the prices move higher.

In this paper the efforts are made to analyze the reasons for rising gold demand and prices in Indian market and its relationship with the foreign exchange market, the fluctuations in the stock market and the soaring crude oil price in the international market.

1. **INTRODUCTION**

In India, gold standard was treated as one of the most important measures or instruments of monetary system. The gold standard ceased to function a long time back but gold bullion still retains some of its old halo. Gold bullion still figures in the discussions of the monetary system. Gold bullion is prized even in the age of demat-trading and plastic money, because of its inherent quality as the original currency for trading, and therefore, a symbol of financial security. Paper money has been known to become worthless in a matter of days and stocks in a matter of hours. But gold hardly loses its glitter. Since 1980s, the perception of gold has slowly changed from an asset that must be hoarded to guard against a rainy day to a commodity that can be traded. This may be one of the reasons why India is the world's largest consumer of gold, importing around 800 tones annually. As gold which traditionally is viewed as a safe heaven in uncertain times, hit record highs in post-2000. The current bull-run in gold has lasted for a decade from 4473.60 per 10 gms in 2000-01 to record highs of 30,000 per 10gms during 2012-13 as can be seen from table 1. It is seen that, before 2000, the demand for gold was elastic, however. now the gold market seems entirely inelastic, as the appetite for the metal is high even as the prices move higher. The table below shows the gold prices during 1980-81 to

TABLE 1

Year	India Gold Prices (per 10 gram) (in Rs.)	UK Gold Prices (per 10 gram) (in Rs)	Spread	Percentage Rise during Decade
1981	1,522.4	1,484.7	37.8	112%
1982	1,719.2	1,209.9	509.2	
1983	1,722.5	1,250.4	472.2	
1984	1,858.5	1,342.1	516.4	
1985	1,983.9	1,293.8	690.1	
1986	2,125.5	1,289.8	835.7	
1987	2,323.5	1,577.0	746.5	
1988	3,082.4	1,912.5	1,169.9	
1989	3,175.2	1,960.4	1,214.8	
1990	3,229.3	2,063.0	1,166.3	

1991	3,451.5	2,164.3	1,287.3	27%
1992	4,297.6	2,841.1	1,456.6	
1993	4,103.7	3,333.0	770.7	
1994	4,531.9	3,766.3	765.6	
1995	4,667.2	3,864.2	803.1	
1996	4,957.6	4,188.6	769.0	
1997	5,070.7	4,283.9	786.8	
1998	4,347.1	3,775.9	571.2	
1999	4,268.0	3,952.0	316.0	
2000	4,393.6	3,896.7	496.9	
2001	4,473.6	4,007.8	465.8	226%
2002	4,579.1	4,260.2	318.9	
2003	5,332.4	5,062.1	270.3	
2004	5,719.0	5,573.5	145.4	
2005	6,145.4	5,976.1	169.2	
2006	6,900.3	6,790.3	110.1	
2007	9,240.3	9,137.8	102.5	
2008	9,995.6	9,897.1	98.5	
2009	12,889.7	12,816.8	72.9	
2010	14,578.1	14,449.3	128.8	

Source: Gold.org & rbi.gov.in

From the table it can be seen that the prices of gold have increased by 112.11 percent during 1980-81 to 1989-90,36.05 percent **during** 1989-90 to 1999-00 and again it rose sharply by 231.80 **percent** during 1999-00 to 2009-10. The percentage rise in gold prices during 1989-90 to 1999-00 was less as compared to the previous decade and last decade. The prices of gold plummeted sharply during 1996 to 1999 due to the following reasons. Firstly, the dollar price of gold has gone by 25 percent in the same period. Secondly, the Indian gold import regulations have been liberalized and some benefits of globalization have been passed on to the consumers in the form of lower rupee prices. The higher demand for gold in India is the reason why prices of gold in India are higher as compared to the international market as can be seen from the chart above.

The **following** table shows the consumer demand of gold in India and world by use **during** 2001 to 2012.

TABLE 2

Year	World	India	Percentage to world total
2001	3370.1	702	21%
2002	3026.4	547.3	18%
2003	2848.4	568.7	20%
2004	2236	617.7	28%
2005	3098.5	721.6	23%
2006	2662	715.5	27%
2007	2810.9	769.2	27%
2008	3048.2	712.6	23%
2009	2423.5	480	20%
2010	2059.6	745.7	36%
2011	3487.5	986.3	28%
2012	3163.6	864	27%

Source: Gold.org

From the tables it can be seen that the consumption of gold in India is very high and India is largest consumer of gold in the entire world. The import of gold was 715.5 tones in the year 2006 and it rose to 769.2 tones during the year 2007 (Jan to June) i.e., rise of around 7.50 percent and was expected to reach 880 tones by the end of the year 2010 which represents the growth of 25.35 percent as compared to the year 2001. Also if we look at the consumption of gold in India as compared to the world consumption it is appreciably high and lies in the range of 18 percent to 27.6 percent. Thus, when one thinks of gold one think of India - world's largest consumer of gold.

2. **OBJECTIVES OF THE STUDY**

The main objective of the study is to explore the reasons and relationships among gold, crude oil, price of dollar and SENSEX:

- ✓ To conduct hypothesis testing under following conditions:

  - o Case 1: When SENSEX - Relatively volatile

  - o Case 2: When Value of Rs/Dollar - Relatively Stable

  - o Case 3: When Crude Oil Prices - Relatively volatile

  - o Case 4: When SENSEX - Relatively Volatile and Value of Rupees/Dollar - Relatively Stable

  - o Case 5: When SENSEX - Relatively volatile; Value of Rupees/Dollar - relatively stable and Crude Oil Prices - relatively volatile

  - o Case 6: When SENSEX - Relatively Stable

  - o Case 7: When Value of Rupees/Dollar – Relatively Volatile

  - o Case 8: When Crude Oil Prices - Relatively Stable

  - o Case 9: When SENSEX - Relatively stable and Value of Rupees/Dollar - relatively volatile

  - o Case 10: When SENSEX - Relatively stable; Value of Rupees/Dollar - relatively volatile and Crude Oil Prices - relatively stable

- ✓ To explore the factors that influence relation among gold, crude oil, SENSEX and value of dollar.

3. <u>REVIEW OF LITERATURE</u>

Wang M Letal (2010) have studied the relationship between the fluctuations in crude oil prices, gold price and exchange rate of US dollar with various currencies on the stock price indices of the US, Germany, Japan, Taiwan and China for the period 2006 to 2009. The results show that there exists a significant relationship between gold prices and the exchange rate. Taormina C. et al (2011) have analyzed the factors affecting gold prices in USA for the period 1992 to2010. The factors considered for the study are Oil prices, USA exchange rate, USA inflation rate and USA real interest rates. They have found highest negative correlation between gold prices and oil prices in USA. Also the study proved that there exists a high degree of correlation between gold prices and USA dollar. The other variables have no significant relationship with the gold prices. Kalra N. et al(2012), has carried out the research to study for the period2008 to 2011 to analyze the impact of various global and domestic factors on the Indian stock market. They have shown that there exists a positive and significant relationship of gold prices with BSE SENSEX. In Indian context, the rally in gold prices were triggered by the global trend which normally sets prices in domestic bullion markets, is closely linked with the forex market and moves in the opposite direction of the US dollar. Secondly, the soaring crude oil price is another factor which pushes demands and prices of gold. Thirdly, the fluctuation in the stock market, which causes economic uncertainty, favours the investment demand of gold. In this paper theimpact of BSE SENSEX, FOREX and crude oil prices on movement of prices of gold in India are analyzed through an econometric enquiry.

3.1 GOLD

Gold is a dense, soft, shiny, malleable and ductile metal and is a chemical element with the symbol Au and atomic number 79.

Pure gold has a bright yellow color and luster traditionally considered attractive, which it maintains without oxidizing in air or water. Chemically, gold is a transition metal and a group 11 element. It is one of the least reactive chemical elements solid under standard conditions. The metal therefore occurs often in free elemental (native) form, as nuggets or grains in rocks, in veins and in alluvial deposits

MONETARY EXCHANGE

Gold has been widely used throughout the world as a vehicle for monetary exchange, either by issuance and recognition of gold coins or other bare metal quantities, or through gold-convertible paper instruments by establishing gold standards in which the total value of issued money is represented in a store of gold reserves.

However, production has not grown in relation to the world's economies. Today, gold mining output is declining. With the sharp growth of economies in the 20th century, and increasing foreign exchange, the world's gold reserves and their trading market have become a small fraction of all markets and fixed exchange rates of currencies to gold were no longer sustained.

At the beginning of World War I the warring nations moved to a fractional gold standard, inflating their currencies to finance the war effort. After World War II gold was replaced by a system of convertible currency following the Bretton Woods system.

In 1946, after World War II ended, the Bretton Woods conference fixed the price of gold at $35 per ounce—and created a gold standard in the United States, meaning that gold backed the U.S. dollar. With the price of gold fixed, trading gold was pointless.

In 1971, the United States, under the leadership of President Nixon, abandoned this system, paving the way for gold trading (although central banks around the world still hold gold for use in times of emergency). This action culminated in 1974, when the United States lifted a 41-year

ban on the private ownership of gold by U.S. citizens, allowing individuals to profit from trading gold.

In the nine years following the abandonment of the gold standard, gold prices skyrocketed, rising 2,200% in U.S. dollar terms and peaking higher than $800 in the early 80's much to the glee of gold traders around the world. But gold trading wasn't as easy as it seemed: This gold market rally was followed by a 19-year bear market for gold, when gold prices dropped as low as $260 in 1999, much to the gold traders' chagrin. But the gold market, like other markets, is cyclical, and despite the fact that gold has now reached new all time highs in excess of $1600, in real terms—that is, adjusted for inflation—this is still well below the $850 peak reached in 1980.

Gold standards and the direct convertibility of currencies to gold have been abandoned by world governments, being replaced by fiat currency in their stead. Switzerland was the last country to tie its currency to gold; it backed 40% of its value until the Swiss joined the International Monetary Fund in 1999.

GOLD AS A CURRENCY

As a commodity the price of gold depends upon the market forces of demand and supply.

On the supply-side 62% of the supply came from mining and the remaining 38% of supplied came from gold scraps. These scraps for the most part just refer to recycled jewelry and are likely made up of people who own jewelry and who needed cash, or liked the price of gold at the time and decided to sell their jewelry for cash, thereby supplying gold for the market.

On the demand side a full 53% of global demand is for jewelry. The jewelry demand from India, China and the Middle East together contributes up to 70% of all jewelry demand in the world. This is because in these three regions Gold has a different cultural significance. Often when people in these regions have some extra money, instead of putting in the bank, they buy jewelry as they see the jewelry as a store of value. The Gold in India, China and the Middle East tends to be of a much higher purity the new gold elsewhere in the world. The reason is because people are really seeing it as a store of value.

The next largest source of demand from gold is for bars and coins and these are typically bought by private investors who are also looking for store of wealth. The same is true for demand coming from ETFs (ETFs are exchange traded funds which are an easy way to buy gold).

The next largest source of demand for gold is for industrial uses which cover dentistry, electronics things like that.

Finally the last source demand for gold is the official sector. After all the currencies became unlinked from gold the central banks have all this gold lying around which was no longer explicitly linked to their currency. Most of them kept these reserves constant for about twenty years and starting around 1991 began started selling the gold. In fact in 1989 an agreement called the Central Bank Gold Agreement (CBGA) was reached that specified how much of gold could be sold in any given year. Around 1999, the central banks around the world started selling their gold and started diversifying into the currencies of other countries: mostly US Dollars and some Euros. The central banks are net sellers of gold until about 2008 when they are neither sellers nor buyers and then in 2009 they become net buyers of gold.

So if we take the chart which shows the officials sector gold holdings across time and we break it out into the official sector gold reserves for advanced economies and the official second gold across developing economies we see a graph that looks like this.

So we see that the advanced economies in blue has steadily been selling gold as can be shown by the declining line and then in about 2009 they stop selling gold and are now neither sellers no buyers. On the other hand the developing economies have been re-balancing their reserves and had been buying more gold shown by this pink line over here and the fact that it's spikes up in about 2009. Now this change in developing economies behavior of buying gold and trying to re-balance their reserves coincides with a loss in the value of the US dollar which is what they were mostly holding.

Out of all the people who are demanding gold, Jewelry owners, Private investors and Central Banks are looking for store of value and when they are looking for a store of value they will compare gold to other currencies and this is why it mostly makes sense to think of gold as the currency.

INVESTMENT TOOL

Of all the precious metals, gold is the most popular as an investment. Investors generally buy gold as a hedge or harbor against economic, political, or social fiat currency crises (including investment market declines, burgeoning national debt, currency failure, inflation, war and social unrest). The gold market is subject to speculation as are other markets, especially through the use of futures contracts and derivatives. The history of the gold standard, the role of gold reserves in central banking, gold's low correlation with other commodity prices, and its pricing in relation to fiat currencies during the Late-2000s financial crisis, suggest that gold behaves more like a currency than a commodity.

Factors affecting the Gold Prices

Today, like most commodities, the price of gold is driven by supply and demand as well as speculation. However unlike most other commodities, saving and disposal plays a larger role in affecting its price than its consumption. Most of the gold ever mined still exists in accessible form, such as bullion and mass-produced jewelry, with little value over its fine weight — and is thus potentially able to come back onto the gold market for the right price.

Central banks

Central banks and the International Monetary Fund play an important role in the gold price. At the end of 2004 central banks and official organizations held 19 percent of all above-ground gold as official gold reserves. The ten year Washington Agreement on Gold (WAG), which dates from September 1999, limits gold sales by its members (Europe, United States, Japan, Australia, Bank for International Settlements and the International Monetary Fund) to less than 500 tones a year. European central banks, such as the Bank of England and Swiss National Bank, were key sellers of gold over this period. In 2009, this agreement was extended for a further five years, but with a smaller annual sales limit of 400 tones.

It is generally accepted that interest rates are closely related to the price of gold. As interest rates rise the general tendency is for the gold price, which earns no interest, to fall, and as rates dip, for gold price to rise. As a result, gold price can be closely correlated to central banks via the monetary policy decisions made by them related to interest rates. For example if market signals

indicate the possibility of prolonged inflation, central banks may decide to enact policies such as a hike in interest rates that could affect the price of gold in order to quell the inflation. An opposite reaction to this general principle can be seen after the European Central bank raised its interest rate on April 7, 2011 for the first time since 2008.The price of gold responded with a muted response and then drove higher to hit new highs one day later. A similar situation happened in India: In August 2011 when the interest rate were at their highest in two years, the gold prices peaked as well.

Hedge against financial stress

Gold, like all precious metals, may be used as a hedge against inflation, deflation or currency devaluation.

As Joe Foster, portfolio manager of the New York-based Van Eck International Gold Fund, explained in September 2010:

"The currencies of all the major countries, including ours, are under severe pressure because of massive government deficits. The more money that is pumped into these economies – the printing of money basically – then the less valuable the currencies become."

If the return on bonds, equities and real estate is not adequately compensating for risk and inflation then the demand for gold and other alternative investments such as commodities increases.

Jewelry and industrial demand

Jewelry consistently accounts for over two-thirds of annual gold demand. India is the largest consumer in volume terms, accounting for 27% of demand in 2009, followed by China and the USA.

Industrial, dentistry and medical uses account for around 12% of gold demand. Gold has high thermal and electrical conductivity properties, along with a high resistance to corrosion and bacterial colonization. Jewelry and industrial demand has fluctuated over the past few years due to the steady expansion in emerging markets of middle classes aspiring to Western lifestyles, offset by the financial crisis of 2007–2010.

Gold jewelry recycling

In recent years the amount of second-hand jewelry being recycled has become a multi-billion dollar industry. Some companies have been offering good prices and fair services for their customers. However there are many companies that have been caught taking advantage of their customers, paying a fraction of what the gold or silver is really worth, leading to distrust in many companies.

Short selling

The price of gold is also affected by various well-documented mechanisms of artificial price suppression, arising from fractional reserve banking and naked short selling in gold, and particularly involving the London Bullion Market Association, the United States Federal Reserve System, and the banks HSBC and JPMorgan Chase. Gold market observers have noted for many years that the price of gold tends to fall artificially at the start of New York trading. Andrew Maguire, a former Goldman Sachs trader, went public in April 2010 with assertions of market manipulation by JPMorgan Chase and HSBC of the gold and silver markets, prompting a number of lawsuits

War, invasion and national emergency

When dollars were fully convertible into gold via the gold standard, both were regarded as money. However, most people preferred to carry around paper banknotes rather than the somewhat heavier and less divisible gold coins. If people feared their bank would fail, a bank run might result. This happened in the USA during the Great Depression of the 1930s, leading President Roosevelt to impose a national emergency and issue Executive Order 6102 outlawing the "hoarding" of gold by US citizens. There was only one prosecution under the order, and in that case the order was ruled invalid by federal judge John M. Woolsey, on the technical grounds that the order was signed by the President, not the Secretary of the Treasury as required.

Investment vehicles

Bars

The most traditional way of investing in gold is by buying bullion gold bars. In some countries, like Canada, Argentina, Austria, Liechtenstein and Switzerland, these can easily be bought or sold at the major banks. Alternatively, there are bullion dealers that provide the same service. Bars are available in various sizes.

Coins

Gold coins are a common way of owning gold. Bullion coins are priced according to their fine weight, plus a small premium based on supply and demand. Coins may be purchased from a variety of dealers both large and small. Fake gold coins are not uncommon, and are usually made of gold-plated lead

Exchange Traded Products

Gold exchange-traded products may include ETFs, ETNs, and CEFs which are traded like shares on the major stock exchanges. The first gold ETF, Gold Bullion Securities (ticker symbol "GOLD"), was launched in March 2003 on the Australian Stock Exchange, and originally represented exactly 0.1 troy ounces (3.1 g) of gold. As of November 2010, SPDR Gold Shares is the second-largest exchange-traded fund (ETF) in the world by market capitalization.

Exchange-traded funds, or ETFs, are investment companies that are legally classified as open-end companies or Unit Investment Trusts (UITs), but that differ from traditional open-end companies and UITs. The main differences are that ETFs do not sell directly to investors and they issue their shares in what are called "Creation Units" (large blocks such as blocks of 50,000 shares). Also, the Creation Units may not be purchased with cash but a basket of securities that mirrors the ETF's portfolio. Usually, the Creation Units are split up and re-sold on a secondary market.

ETF shares can be sold in basically two ways. The investors can sell the individual shares to other investors, or they can sell the Creation Units back to the ETF. In addition, ETFs generally redeem Creation Units by giving investors the securities that comprise the portfolio instead of

cash. Because of the limited redeem ability of ETF shares, ETFs are not considered to be and may not call themselves mutual funds. In India several gold ETFs are available such as Goldman Sach's – Goldbees , Axis Bank's – Axis Gold ETF are available on the NSE(National Stock Exchange).

Certificates

Gold certificates allow gold investors to avoid the risks and costs associated with the transfer and storage of physical bullion (such as theft, large bid-offer spread, and metallurgical assay costs) by taking on a different set of risks and costs associated with the certificate itself (such as commissions, storage fees, and various types of credit risk).

Banks may issue gold certificates for gold which is allocated (fully reserved) or unallocated (pooled). Unallocated gold certificates are a form of fractional reserve banking and do not guarantee an equal exchange for metal in the event of a run on the issuing bank's gold on deposit. Allocated gold certificates should be correlated with specific numbered bars, although it is difficult to determine whether a bank is improperly allocating a single bar to more than one party.

Derivatives

Derivatives, such as gold forwards, futures and options, currently trade on various exchanges around the world and over-the-counter (OTC) directly in the private market. In the U.S., gold futures are primarily traded on the New York Commodities Exchange (COMEX) and Euronext.liffe. In India, gold futures are traded on the National Commodity and Derivatives Exchange (NCDEX) and Multi Commodity Exchange (MCX).

Mining Companies

Instead of buying gold itself, investors can buy the companies that produce the gold as shares in gold mining companies. If the gold price rises, the profits of the gold mining company could be expected to rise and the worth of the company will rise and presumably the share price will also rise. However, there are many factors to take into account and it is not always the case that a share price will rise when the gold price increases.

3.2 **BRENT CRUDE OIL**

Brent Crude is a major trading classification of sweet light crude oil comprising Brent Blend, Forties Blend, Oseberg and Ekofisk crudes (also known as the BFOE Quotation). Brent Crude is sourced from the North Sea. The Brent Crude oil marker is also known as Brent Blend, London Brent and Brent petroleum.

The other well-known classifications (also called references or benchmarks) are the OPEC Reference Basket, Dubai Crude and West Texas Intermediate. Brent is the leading global price benchmark for Atlantic basin crude oils. It is used to price two thirds of the world's internationally traded crude oil supplies.

Brent blend is a light crude oil (LCO), though not as light as West Texas Intermediate (WTI). It contains approximately 0.37% of sulphur, classifying it as sweet crude, yet again not as sweet as WTI. Brent is suitable for production of petrol and middle distillates. It is typically refined in Northwest Europe.

Brent Crude has an API gravity of around 38.06 and a specific gravity of around 0.835.

The price of a barrel of oil is highly dependent on both its grade, determined by factors such as its specific gravity or API and its sulphur content, and its location. Other important benchmarks include Dubai, Tapis, and the OPEC basket. The Energy Information Administration (EIA) uses the imported refiner acquisition cost, the weighted average cost of all oil imported into the US, as its "world oil price".

The demand for oil is highly dependent on global macroeconomic conditions. According to the International Energy Agency, high oil prices generally have a large negative impact on the global economic growth.

Brent Crude Oil futures contracts declined 13 dollars or 10.67 percent during the last 12 months. Historically, from 1983 until 2012, Brent Crude Oil averaged 37.2 USD/BBL reaching an all time high of 146.1 USD/BBL in July of 2008 and a record low of 9.8 USD/BBL in December of 1998.

The Global Scenario

- Oil accounts for 40 per cent of the world's total energy demand.
- The world consumes about 76 million bbl/day of oil.
- United States (20 million bbl/d), followed by China (5.6 million bbl/d) and Japan (5.4 million bbl/d) are the top oil consuming countries.
- Balance recoverable reserve was estimated at about 142.7 billion tones (in 2002), of which OPEC was 112 billion tones.

Indian Scenario

- India ranks among the top 10 largest oil-consuming countries.
- Oil accounts for about 30 per cent of India's total energy consumption. The country's total oil consumption is about 2.2 million barrels per day. India imports about 70 per cent of its total oil consumption and it makes no exports.
- India faces a large supply deficit, as domestic oil production is unlikely to keep pace with demand. India's rough production was only 0.8 million barrels per day.
- The oil reserves of the country (about 5.4 billion barrels) are located primarily in Mumbai High, Upper Assam, Cambay, Krishna-Godavari and Cauvery basins.
- Balance recoverable reserve was about 733 million tones (in 2003) of which offshore was 394 million tones and on shore was 339 million tones.
- India had a total of 2.1 million barrels per day in refining capacity.
- Government has permitted foreign participation in oil exploration, an activity restricted earlier to state owned entities.
- Indian government in 2002 officially ended the Administered Pricing Mechanism (APM). Now crude price is having a high correlation with the international market price. As on date, even the prices of crude bi-products are allowed to vary +/- 10% keeping in line with international crude price, subject to certain government laid down norms/ formulae.
- Disinvestment/restructuring of public sector units and complete deregulation of Indian retail petroleum products sector is under way.

Factors affecting the price of the oil

There are many factors that influence the global crude oil prices including technology to increase production, storage of crude oil by richer nations (one major indicator that is tracked closely is the US crude oil inventory data), changes in tax policy, political issues etc. In the recent past, we have seen many factors influencing the prices of global crude oil.

These are some of the important factors that influence crude oil prices globally:

Production

A large part of the world's crude oil share is produced by OPEC (Organisation of Petroleum Exporting Countries) nations. Any decisions made by OPEC countries to raise the prices or reduce production, immediately impacts the prices of crude oil in the global commodity markets.

Natural causes

In the recent past, we have seen many events driving volatility in the crude oil prices. Events like a hurricane hitting the oil producing areas in the US have driven the crude oil prices in global markets.

Inventory

Oil producers and consumers build a storage capacity to store crude oil for immediate future needs. They also build some inventories to speculate on the price expectations and sale/arbitrage opportunities in case of any unexpected changes in supply and demand equations. Any change in these inventory levels triggers volatility in crude oil's prices which in turn creates ripples in the stock markets.

Demand

The demand of crude oil is rising sharply due to high growth and demand from the emerging economies. On the supply side, the major sources of supplies are still the same as they were in the last decade. This is another factor that is influencing the prices of crude oil upwards.

Crude oil inventories have demonstrated a highly cyclical pattern in the recent past. Usually, crude oil inventories increase in the summer months and decrease in the winter months. This is because cold temperatures in the winter increase the use of energy for heating in many cold countries. The demand for fuel goes above supply and results in a need to tap inventories.

Likewise, during warm summer months, supply generally exceeds demand and petroleum inventories build up. Hence, the crude oil prices drop. Crude inventory levels provide a good signal of the price direction. India imports more than 80 percent of crude requirements from oil producing countries and therefore fluctuations in oil prices are being tracked more closely in the domestic markets.

Prices of essential commodities like crude are also one of the prime drivers of inflation in the global economy. As we get more globalised, domestic firms and investors need to understand the world economy and financial markets well, in order to respond to the new realities of India as an open economy better.

3.3 USD

The **United States dollar** (sign: $; code: **USD**; also abbreviated **US$**), also referred to as the **U.S. dollar** or **American dollar**, is the official currency of the United States of America and its overseas territories. It is divided into 100 smaller units called cents.

The U.S. dollar is the currency most used in international transactions and is one of the world's dominant reserve currencies. Several countries use it as their official currency, and in many others it is the *de facto* currency. It is also used as the sole currency in some British Overseas Territories, the British Virgin Islands and the Turks and Caicos islands.

Besides being the main currency of the United States, the American dollar is used as the standard unit of currency in international markets for commodities such as gold and petroleum (the latter sometimes called petrocurrency is the source of the term petrodollar). Some non-U.S. companies dealing in globalized markets, such as Airbus, list their prices in dollars.

The U.S. dollar is the world's foremost reserve currency. In addition to holdings by central banks and other institutions, there are many private holdings, which are believed to be mostly in one-hundred-dollar banknotes (indeed, most American banknotes actually are held outside the United States). All holdings of U.S.-dollar bank deposits held by non-residents of the United States are known as "eurodollars" (not to be confused with the euro), regardless of the location of the bank holding the deposit (which may be inside or outside the U.S.).

Economist Paul Samuelson and others (including, at his death, Milton Friedman) have maintained that the overseas demand for dollars allows the United States to maintain persistent trade deficits without causing the value of the currency to depreciate or the flow of trade to readjust. But Samuelson stated in 2005 that at some uncertain future period these pressures would precipitate a run against the U.S. dollar with serious global financial consequences.

3.4 <u>SENSEX</u>

The **BSE Sensex** or **Bombay Stock Exchange Sensitivity Index** is a free-float market capitalization-weighted stock market index of 30 well-established and financially sound companies listed on BSE Ltd.. The 30 component companies which are some of the largest and most actively traded stocks, are representative of various industrial sectors of the Indian economy. Published since 1 January 1986, the S&P BSE SENSEX is regarded as the pulse of the domestic stock markets in India. The base value of the S&P BSE SENSEX is taken as *100* on 1 April 1979, and its base year as *1978–79*. On 25 July 2001 BSE launched **DOLLEX-30**, a dollar-linked version of S&P BSE SENSEX. As of 21 April 2011, the market capitalization of S&P BSE SENSEX was about ₹29733 billion (US$544 billion) (47.68% of market capitalization of BSE), while its free-float market capitalization was ₹15690 billion (US$287 billion).

4. DATA COLLECTION

The data are collected for the fluctuations in the BSE SENSEX, gold prices and value of Rupees/Dollar during 30th January 2008 to 14th March 2008 and 3rd June 2010 to 4th August 2010. The above period is selected to study the relationship between the SENSEX, gold prices and the value of Rupees/Dollar as the SENSEX was relatively volatile and the value of Rupees/Dollar was relatively stable during the first period and the SENSEX was relatively stable and the value of Rupees/Dollar was relatively volatile during the second period. From the table 3 and chart, it can be seen that when SENSEX falls gold price increases and vice versa, but it is not true always. Whenever there are high fluctuations in the market, people prefer to make investment in gold and seasonal demand is the anotherfactor. Also when the value of Rupees/Dollar appreciates demand for gold increases and vice versa as can be seen from chart. When dollar depreciates in value in international market, demand for gold increases in our country. Thus, it seems that there exists an inverse relationship between value of dollar and gold prices (and also demand) in India. Finally, the soaring crude oil price in international market increases the demand and price of gold in the country. This is evident from the fact that soaring crude oil prices and falling dollar pushed gold to an all-time high of Rs. 13,030 on March 14, 2008. This paper analyses these facts with the help of an econometric enquiry about whether these facts hold true statistically or are mere coincidences at different occasions. Let us consider the following tables showing the comparison between BSE SENSEX, Gold prices and Value of Rupees/Dollar during 30th Jan to 14th Mar 2008 and 3th June to 4thAugust 2010 and the comparison between BSE SENSEX, Gold prices. Value of Rupees/Dollar and Crude Oil Prices during the same period (Table 3 and Table 4).

TABLE 3

Part (a) Sensex – Relatively Volatile Value of ₹/Dollar – Relatively Stable				Part (b) Sensex – Relatively Stable Value of ₹/Dollar – Relativel			
Day	BSE Sensex	Gold price/ 10 gms	Value of Rs/ dollar	Day	BSE Sensex	Gold price/ 10 gms	Value of Rs/ dollar
30 Jan, 08	17,759	11,785	39.39	3 June, 10	16,742	18,725	46.99
31 Jan, 08	17,649	11,785	39.37	8 June, '10	16,781	18,645	47.10
1 Feb, 08	18,233	11,890	39.36	9 June, '10	16,617	19,050	46.95
4 Feb, 08	18,660	11,515	39.44	11 June, '10	16,922	18,725	46.97
5 Feb, 08	18,663	11,405	39.55	12 June, '10	17,065	18,640	46.85
6 Feb, 08	18,139	11,470	39.50	15 June, '10	17,338	18,615	46.49
7 Feb, 08	17,527	11,630	39.53	16 June, '10	17,413	18,580	46.57
8 Feb, 08	17,465	11,710	39.63	18 June, '10	17,617	18,690	46.32
11 Feb, 08	16,631	11,895	39.69	19 June, '10	17,571	18,790	46.17
12 Feb, 08	16,608	11,835	39.69	22 June, '10	17,877	18,790	45.75
13 Feb, 08	16,949	11,620	39.75	23 June, '10	17,750	18,615	46.25
14 Feb, 08	17,766	11,685	39.60	24 June, '10	17,756	18,735	46.19
15 Feb, 08	18,115	11,788	39.67	25 June, '10	17,730	18,665	46.49
18 Feb, 08	18,048	11,650	39.78	26 June, '10	17,575	18,820	46.29
19 Feb, 08	18,076	11,650	39.93	29 June, '10	17,774	18,895	46.21
20 Feb, 08	17,613	12,005	40.20	30 June, '10	17,534	18,770	46.49
21 Feb, 08	17,735	12,200	39.92	1 July, '10	17,701	18,830	46.45
22 Feb, 08	17,349	12,230	40.03	3 July, '10	17,461	18,465	46.77
25 Feb, 08	17,651	12,265	39.96	7 July, '10	17,614	18,495	46.91
26 Feb, 08	17,806	12,055	39.90	8 July, '10	17,471	18,290	47.04
27 Feb, 08	17,826	12,345	39.78	13 July, '10	17,937	18,390	46.78
28 Feb, 08	17,824	12,325	39.87	14 July, '10	17,986	18,410	46.77
29 Feb, 08	17,578	12,520	40.01	15 July, '10	17,938	18,460	46.70
3 Mar, 08	16,678	12,745	40.14	17 July, '10	17,956	18,395	46.77
4 Mar, 08	16,340	12,805	40.31	20 July, '10	17,928	18,290	47.13
5 Mar, 08	16,542	12,585	40.29	21 July, '10	17,878	18,220	47.36
7 Mar, 08	15,976	12,855	40.52	27 July, '10	18,020	18,245	47.05
10 Mar, 08	15,924	12,740	40.50	28 July, '10	18,078	18,065	46.68
11 Mar, 08	16,123	12,845	40.45	29 July, '10	17,957	17,765	46.77
12 Mar, 08	16,128	12,725	40.33	30 July, '10	17,992	17,445	46.54
13 Mar, 08	15,357	12,965	40.44	3 Aug, '10	18,081	17,810	46.25
14 Mar, 08	15,761	13,030	40.44	4 Aug, '10	18,115	17,905	46.17

Source: RBI.GOV.IN; GOLD.ORG & Money Control

TABLE 4

Part (a) :Sensex – Relatively Volatile; Value of ₹/Dollar – Relatively Stable; Crude Oil Prices – Relatively Volatile				
Day	BSE Sensex	Gold Price/10 gms	Value of ₹/dollar	Crude Oil Prices ($)
1 Feb, 08	18,233	11,890	39.36	88.96
8 Feb, 08	17,465	11,710	39.63	91.77
15 Feb, 08	18,115	11,788	39.67	95.50
22 Feb, 08	17,349	12,230	40.03	98.81
29 Feb, 08	17,578	12,520	40.01	101.84
7 Mar, 08	15,976	12,855	40.52	105.15
14 Mar, 08	15,761	13,030	40.44	110.21
Part (b):Sensex – Relatively Stable; Value of ₹/Dollar – Relatively Volatile; Crude Oil Prices – Relatively Stable				
Day	BSE Sensex	Gold price/10 gms	Value of Rs/dollar	Crude Oil Prices ($)
3 June, 10	16,742	18,725	46.99	71.51
11 June, 10	16,922	18,725	46.97	73.78
18 June, '10	17,617	18,690	46.32	77.18
25 June, '10	17,730	18,665	46.49	78.86
1 July, '10	17,701	18,830	46.45	72.14
8 July, '10	17,471	18,290	47.04	76.09
15 July, '10	17,938	18,460	46.70	76.01
21 July, '10	17,878	18,220	47.36	78.89

Source: RBI.GOV.IN; GOLD.ORG & Money Control

5. DATA ANALYSIS

Case 1: When SENSEX - Relatively volatile

H_0: There is no relationship between gold prices and SENSEX.

H_1; There exists a relationship between gold prices and SENSEX.

The output generated for the regression equation between gold prices and BSE Sensex when Sensex is relatively volatile using Analyse-it tool-pack of EXCEL, is given as below: As seen in table 5, the slope coefficient of regression equation indicates that as BSE Sensex increases by 1 unit, gold price decreases by 0.4543 units. Since Sensex is an index measured in 100s, the coefficient of Sensex implies that gold price decreases by Rs. 45.43 for every 100 extra BSE Sensex rise. Similarly, when Sensex = 0, the price of gold is determined at Rs. 19,986. Secondly, the value of adj 'R' comes to be 0.63 and R- comes to be 0.64 which is moderately high. Thus, we can conclude that the explanatory variable (Sensex) is relatively good measure of gold prices as it explains 64 percent influence in the fluctuation in gold prices. But the model is unable to determine 36 percent influence of the other extraneous variables. The value of t given corresponding to intercept comes to be 18.77 which is much greater as compared to t value of 1.96 at 5 percent level of significance and 30 degrees of freedom. Thus, we reject H_0 (null hypothesis) and conclude that there exists a relationship between gold prices and Sensex. Also the value of p is 0.0001 which is too small to reject H_1. Thus there exists a relationship between gold prices and Sensex when BSE Sensex is relatively volatile. The value of F statistics comes to be 54.40 which is much greater as compared to $F_{0.05}$ (4.1709) at (1, 30) degrees of freedom, hence the variation between gold prices and SENSEX is significant.

Thus, when SENSEX is relatively volatile there exists an inverse relationship between gold prices and SENSEX. So we can conclude that, when SENSEX goes up gold prices comes down and vice versa.

TABLE 5 (Regression Analysis: Gold Prices Vs SENSEX)

n						32
R^2						0.64
Adjusted R^2						0.63
SE						304.7
Term	Coefficient	95% CI	SE	t statistic	DF	p
Intercept	19986	17811 to 22160	1065	18.77	30	<0.0001
Slope	-0.4543	-0.5801 to -0.3285	0.06159	-7.38	30	<0.0001
	Gold price/ 10 gms = 19986 - 0.4543 BSE Sensex					
Source of Variation	Sum squares	DF	Mean Square	F statistic	p	
Model	5,051,131.0	1	5,051,131.0	54.40	<0.0001	
Residual	2,785,481.5	30	92,849.4			
Total	7,836,612.5	31				

Case 2: When Value of Rs/Dollar - Relatively Stable

H_0: There is no relationship between gold prices and Value of Rupees/Dollar.

H_1: There exists a relationship between gold prices and Value of Rupees/Dollar.

The output generated for the regression equation between gold prices and value of Rupees/Dollar when value of Rupees/Dollar is relatively stable using Analyse-it tool pack of EXCEL is given as below:

TABLE 6 (Regression Analysis: Gold Prices Vs Value of $/Rs)

n						32
R^2						0.78
Adjusted R^2						0.77
SE						239.7
Term	Coefficient	95% CI	SE	t statistic	DF	P
Intercept	-36375	-45981 to -26769	4703	-7.73	30	<0.0001
Slope	1216	975 to 1457	117.9	10.32	30	<0.0001

Gold price/ 10 gms = -36375 + 1216 Value of ₹/ dollar

Source of Variation	Sum squares	DF	Mean Square	F statistic	p
Model	6,113,146.6	1	6,113,146.6	106.41	<0.0001
Residual	1,723,465.9	30	57,448.9		
Total	7,836,612.5	31			

As seen in table 6, the slope coefficient of regression equation indicates that as value of Rupees/Dollar increases by 1 unit, gold price increases by 1216 units. Since value of Rupees/Dollar is measured in Rupees/Dollar, the coefficient of value of Rupees/Dollar implies that there is an increment of Rs. 1216 in gold prices every extra fall in the value of Rupees/Dollar rise. Considering the value of Rupees/Dollar = 0, doesn't give any meaningful result as the value of intercept is negative. The value of adjR comes to be 0.77 and R- comes to

be 0.78 which is relatively high as compared to Case 1. Thus, we can conclude that the explanatory variable (value of Rupees/Dollar) is relatively better measure of gold prices as it explains 78percent influence of the fluctuation in gold prices. The value of t given corresponding to intercept comes to be -7.73 which is much lesser as compared to t value of -1.96 at 5 percent level of significance and 30 degrees of freedom. Thus, we reject H_0 (null hypothesis) and conclude that there exists a relationship between gold prices and value of Rupees/Dollar. Also the value of p is less than0.0001 which is too small to reject H_1. Thus there exists a relationship between gold prices and value of Rupees/Dollar when value of Rupees/Dollar is relatively stable. The value of F statistics comes to be 106.41 which are much greater as **compared to $F_{0.05}$ (4.1709) at (1,** 30) degrees of **freedom,** hence the variation between gold prices and value of Rupees/Dollar is significant. Thus, when value of Rupees/Dollar is relatively stable there exists a direct relationship between gold prices and value of Rupees/Dollar. Here we conclude that, when value of Rupees/Dollar goes up gold prices goes up and vice versa.

Case 3: When Crude Oil Prices - Relatively volatile

H_0: There is no relationship between gold prices and Crude Oil Prices.

H_1: There exists a relationship between gold prices and Crude Oil Prices.

The output generated for the regression equation between gold prices and Crude Oil Prices when Crude Oil Prices are relatively volatile using 'Analyse - it' tool-pack of EXCELis given as below:

TABLE 7 (Regression Analysis: Gold Prices Vs Value of $/Rs)

n						7
R^2						0.89
Adjusted R^2						0.87
SE						190.8
Term	Coefficient	95% CI	SE	t statistic	DF	P
Intercept	5712	3063 to 8362	1030.6	5.54	5	0.0026
Slope	66.5	39.8 to 93.2	10.40	6.40	5	0.0014
	Gold Price/10 gms = 5712 + 66.5 Crude Oil Prices ($)					
Source of Variation	Sum squares	DF	Mean Square	F statistic	p	
Model	1,489,704.1	1	1,489,704.1	40.92	0.0014	
Residual	182,017.9	5	36,403.6			
Total	1,671,722.0	6				

As seen in table 7, the slope coefficient of regression equation indicates that as Crude Oil Price increases by 1unit, gold price increases by 66.5 units. Since Crude Oil Price is measured in dollars, the coefficient of Crude Oil Price implies that gold price increases by Rs. 66.5 for every

extra dollar of Crude Oil Price rise. When Crude Oil Price= 0, the price of gold is determined at Rs 5712. The value of adj R comes to be 0.87 and R- comes to be 0.89 which is moderately on higher side. Thus, we can conclude that the explanatory variable (Crude Oil Price) is relatively better measure of gold prices as it explains 89 percent influence in the fluctuation in gold prices.

But the model is unable to determine only 11 percent influence of the other extraneous variables. The value of t given corresponding to intercept comes to be 5.54 which is greater as compared to t value of 1.96at 5 percent level of significance and 5 degrees of freedom. Thus, we reject H_0 (null hypothesis) and conclude that there exists a relationship between gold prices and Crude Oil Price. Also the value of p is 0.0026 which is too small to reject H_1. Thus there exists a relationship between gold prices and Crude Oil Price when Crude Oil Price is relatively volatile. The value of F statistics comes to be 40.92 which is much greater as compared to $F_{0.05}$ (6.6079) at (1, 5) degrees of freedom, hence the variation between gold prices and Crude Oil Price issignificant.Thus, when Crude Oil Price is relatively volatile there exist a direct relationship between gold prices and Crude Oil Price. So we conclude that, when Crude Oil price goes up gold prices goes up and vice versa.

Case 4: When SENSEX - Relatively Volatile and Value of Rupees/Dollar - Relatively Stable

H_0: The variation between gold prices, SENSEX and Value of Rupees/Dollar is not significant.

H_1: The variation between gold prices, SENSEX and Value of Rupees/Dollar is significant.

The output generated for the regression equation between gold prices, SENSEX and Value of Rupees/Dollar when SENSEX is relatively volatile and Value of Rupees/Dollaris relatively stable using 'Analyse-it' tool-pack of EXCEL**is** given as below:

As seen in table 8, the slope coefficient of regression equation indicates that as BSE SENSEX increases by 1unit, gold price decreases by 0.1565 units and value of Rupees/Dollar increases by 914.10 units. Since SENSEX is an index measured in 100s, the coefficient of SENSE implies that gold price changes (decreases) by Rs15.65 times SENSEX and Rs 914.1 times value of Rupees/Dollar. Similarly, when SENSEX = 0, the price of gold is negative.

Secondly, the value of adj R^2 comes to be 0.80 and R^2 comes to be 0.81 which is moderately high. Thus, we can conclude that the explanatory variables (SENSEX and value of Rupees/Dollar) is relatively good measure of gold prices as it explains 81 percent influence in the fluctuation in gold prices. But the model is unable to determine only **19percent** influence of the other extraneous variables.

The value of F statistics comes to be 61.23 which is much greater as compared to $F_{0.05}(3.3277)$ at (2, 29) degrees of freedom. Thus, we reject H_0 (null hypothesis) and conclude that the variation between gold prices, SENSEX and value of Rupees/Dollar is significant. Thus there exists a relationship between gold prices, SENSEX and value of Rupees/Dollar when BSE SENSEX is relatively volatile and value of Rupees/Dollar is relatively stable.

Thus, when SENSEX is relatively volatile and Value of Rupees/Dollar is relatively stable there exist an inverse relationship between gold prices and SENSEX. When SENSEX goes up gold prices come down and vice versa when value of Rupees/Dollar is relatively stable.

TABLE 8 (Regression Analysis: Gold Prices, SENSEX & Value of $)

n						32
R²						0.81
Adjusted R²						0.80
SE						227.5
Term	Coefficient	95% CI	SE	t Statistic	DF	P
Intercept	-21631	-38788 to -4474	8389	-2.58	29	0.0153
Sensex	-0.1565	-0.3107 to -0.0023	0.07539	-2.08	29	0.0469
₹/$	914.1	538.9 to 1289.2	183.42	4.98	29	<0.0001

$$Gold = -21631 - 0.1565 \text{ Sensex} + 914.1 \text{ ₹/\$}$$

Source of Variation	Sum Squares	DF	Mean Square	F Statistic	p
Model	6,336,092.6	2	3,168,046.3	61.23	<0.0001
Residual	1,500,519.8	29	51,742.1		
Total	7,836,612.5	31			

Case 5: When SENSEX - Relatively volatile; Value of Rupees/Dollar - relatively stable and Crude Oil Prices - relatively volatile.

H_0:The variation between gold prices, SENSEX. Value of Rupees/Dollar and Crude oil prices is not significant.

H_1: The variation between gold prices, SENSEX, Value of Rupees/Dollar and Crude oil prices is significant.

The output generated for the regression equation between gold prices, SENSEX, Value of Rupees/Dollar and Crude Oil Prices when SENSEX is relatively volatile. Value of Rupees/Dollar is relatively stable and Crude Oil Prices are relatively volatile using 'Analyse-it' tool-pack of Excels given as below:

As seen in table 9, the slope coefficient of regression equation indicates that as BSE SENSEX increases by 1unit, gold price decreases by 0.1093 units, value of Rupees/Dollar increases by 75.56 units and crude oil prices Increases by 50.02 units. Since SENSEX is an index measured in 100s, the coefficient of SENSEX implies that gold price changes (decreases) by Rs 10.93 times SENSEX, Rs75.56 time's value of Rupees/dollar and Rs 50.02 times crude oil prices. Similarly, when SENSEX = 0, i.e., when it remains stable, the price of gold is determined at Rs6,205 at market prices. Secondly, the value of adj R- comes to be 0.81 and R^2 comes to be 0.90 which is moderately high. Thus, we can conclude that the explanatory variables (SENSEX, value of Rupees/Dollar and crude oil prices) is relatively good measure of gold prices as it explains 90percent influence in the fluctuation in gold prices. But the model is unable to determine only 10 percent influence of the other extraneous variables.

The value of F statistics comes to be 9.40 which is greater as compared to $F_{0.05}$ (9.2766) at (3, 3) degrees of freedom. Thus, we accept H_0(null hypothesis) and conclude that the variation between gold prices, SENSEX, Value of Rupees/dollar and Crude oil prices is significant. Thus
T here exists a relationship between gold prices, SENSEX,value of Rupees/dollar and crude oil prices when BSESENSEX is relatively volatile. Value of Rupees/Dollar is relatively stable and Crude Oil Prices are relatively volatile.

Thus, when SENSEX is relatively volatile and Value of Rupees/Dollar is relatively stable there exist an inverse relationship between gold prices and SENSEX. WhenSENSEX goes up gold prices come down and vice versa when value of Rupees/Dollar is relatively stable and Crude Oil Prices are relatively volatile.

TABLE 9 (Regression Analysis: Gold Prices, SENSEX, Value of $, & Crude Oil Prices)

n						7
R^2						0.90
Adjusted R^2						0.81
SE						231.5
Term	Coefficient	95% CI	SE	t Statistic	DF	P
Intercept	6205	-113484 to 125894	37609.1	0.16	3	0.8795
Sensex	-0.1093	-0.9183 to 0.6998	0.25422	-0.43	3	0.6963
₹/$	75.56	-2923.61 to 3034.72	942.408	0.08	3	0.9411
Crude Oil	50.02	-82.77 to 182.81	41.727	1.20	3	0.3167

$$Gold = 6205 - 0.1093\ Sensex + 75.56\ ₹/\$ + 50.02\ Crude\ Oil$$

Source of Variation	Sum Squares	DF	Mean Square	F Statistic	p
Model	1,510,977.2	3	503,659.1	9.40	0.0491
Residual	160,744.8	3	53,581.6		
Total	1,671,722.0	6			

Case 6: When SENSEX - Relatively Stable

H_0: There is no relationship between gold prices and SENSEX.

H_1: There exists a relationship between gold prices and SENSEX.

The output generated for the regression equation between gold prices and BSE Sensex when Sensex is relatively volatile using Analyse-it tool-pack of EXCEL is given as below:

As seen in table 10, the slope coefficient of regression equation indicates that as BSE SENSEX increases by 1unit, gold price decreases by 0.5185 units. Since SENSEX is an index measured in 100s, the coefficient of SENSEX implies that gold price decreases by Rs 51.85 for every 100extra BSE SENSEX rise. Similarly, when SENSEX = 0,i.e., when it remains stable, the price of gold is determined at Rs 27,618 at market prices. Secondly, the value of adj R^2comesto be 0.32 and R^2 comes to be 0.34 which is considerably low. Thus, we can conclude that the explanatory variable (SENSEX) is relatively bad measure of gold prices as it explains only 34 percent influence in the fluctuation in gold prices and unable to determine 66percent influence of the other extraneous variables.

TABLE 10 (Regression Analysis: Gold Prices Vs SENSEX)

n						32
R^2						0.34
Adjusted R^2						0.32
SE						300.1
Term	Coefficient	95% CI	SE	t statistic	DF	P
Intercept	27618	22917 to 32319	2302	12.00	30	<0.0001
Slope	-0.5185	-0.7851 to -0.2520	0.13053	-3.97	30	0.0004

Gold price/ 10 gms = 27618 - 0.5185BSE Sensex

Source of Variation	Sum squares	DF	Mean Square	F statistic	P	
Model	1,421,636.9	1	1,421,636.9	15.78	0.0004	
Residual	2,702,334.9	30	90,077.8			
Total	4,123,971.9	31				

The value of t given corresponding to intercept comes to be 12.00 which is much greater as compared to t value of1.96 at five percent level of significance and 30 degrees of freedom. Thus, we reject H_0 (null hypothesis) and conclude that there exists a relationship between gold prices and SENSEX. Also the value of p is less than 0.0001 which is too small to reject H_0. Thus there exists a relationship between gold prices and SENSEX when BSE SENSEX is relatively stable, but the correlation between gold prices and BSE SENSEX is less. The value of F statistics comes to be 15.78, which is much greater as compared to $F_{0.05}(4.1709)$ at (1, 30) degrees of freedom, hence the variation between gold prices and SENSEX is significant.

Thus, when SENSEX is relatively stable there exists an inverse relationship between gold prices and SENSEX, but the relationship between them is considerably weak when BSE Sensex is relatively stable.

Case 7: When Value of Rupees/Dollar – RelativelyVolatile

H_0: There is no relationship between gold prices and Value of Rupees/Dollar.

H_1: There exists a relationship between gold prices and Value of Rupees/Dollar.

The output generated for the regression equation between gold prices and value of Rupees/Dollar when value of Rupees/Dollar is relatively stable using Analyse-it toolpack of EXCEL is given as below:

As seen in table 11, the slope coefficient of regression equation indicates that as value of Rupees/Dollar increases by 1 unit, gold price decreases by 152.6 units. Since value of Rupees/Dollar is measured in Rupees/Dollar, the coefficient of value of Rupees/Dollar implies that there is an increment of Rs 152.6 in gold prices every extra rise/falling the value of Rupees/Dollar rise.

TABLE 11 (Computation Values: Gold Prices Vs Value of \$)

n						32
R^2						0.02
Adjusted R^2						-0.01
SE						366.4
Term	Coefficient	95% CI	SE	t Statistic	DF	P
Intercept	25591	8360 to 42823	8437	3.03	30	0.0050
Slope	-152.6	-522.1 to 216.9	180.93	-0.84	30	0.4057

Gold Price/ 10 gms = 25591 - 152.6Value of ₹/ Dollar

Source of Variation	Sum squares	DF	Mean Square	F Statistic	P	
Model	95,506.9	1	95,506.9	0.71	0.4057	
Residual	4,028,465.0	30	134,282.2			
Total	4,123,971.9	31				

Considering the value of Rupees/Dollar = 0, the value of intercept comes to be Rs 25,591. The value of adj R^2 comes to be -0.01 and R^2 comes to be 0.02 which comes to be very low. Thus, we

can conclude that the explanatory variable (value of Rupees/Dollar) cannot be used as a measure of gold prices when value of Rupees/Dollar is relatively volatile as it gives misleading values for meaningful interpretation.

The value of t given corresponding to intercept comes to be 3.03 which is greater as compared to t value of 1.96 at 5percent level of significance and 30 degrees of freedom. Thus, we reject H_0 (null hypothesis) and conclude that there exists a relationship between gold prices and value of Rupees/Dollar though it is weak. The value of p is 0.005which is too small (less than 0.05) to reject H_0. Thus there exists a relationship between gold prices and value of Rupees/Dollar when value of Rupees/Dollar is relatively volatile. The value of F statistics comes to be 0.71 which is lesser as compared to $F_{0.05}$ (4.1709) at (1, 30) degrees of freedom, hence the variation between gold prices and value of Rupees/Dollar is not significant.

Thus, when Rupees/Dollar is relatively volatile, there exists a relationship between gold prices and value of Rupees/Dollar, but the degree of correlation is very weak to draw any meaningful interpretation. Also the variation between them is not significant.

Case 8: When Crude Oil Prices - Relatively Stable

H_0: There is no relationship between gold prices and Crude Oil Prices.

H_1: There exists a relationship between gold prices and Crude Oil Prices.

The output generated for the regression equation between gold prices and Crude Oil Prices when Crude Oil Prices are relatively volatile using 'Analyse-it' tool-pack of EXCELis given as below:

As seen in table 12, the slope coefficient of regression equation indicates that as Crude Oil Price increases by 1unit, gold price decreases by 46.99 units. Since Crude Oil Price is measured in dollars, the coefficient of Crude Oil Price implies that gold price decreases by Rs 46.99 for every extra dollar of Crude Oil Price rise. When Crude Oil Price= 0, the price of gold is determined at Rs 22,126 at market prices. The value of adj R_0 comes to be 0.25 and R_0 comes to be 0.35 which is very less. Thus, we can conclude that the explanatory variable (Crude Oil Price) is not a good measure of gold prices as it explains only 35 percent influence in the fluctuation in gold prices. But the model is unable to determine 65 percent influence of the other extraneous variables.

TABLE 12 (Computation Values: Gold Prices Vs Crude Oil Prices)

n						8
R^2						0.35
Adjusted R^2						0.25
SE						194.7
Term	Coefficient	95% CI	SE	t Statistic	DF	P
Intercept	22126	17329 to 26924	1961	11.29	6	<0.0001
Slope	-46.99	-110.45 to 16.46	25.932	-1.81	6	0.1199
		Gold Price/10 gms = 22126 - 46.99 Crude Oil Prices ($)				
Source of Variation	Sum squares	DF	Mean Square	F statistic	P	
Model	124,448.5	1	124,448.5	3.28	0.1199	
Residual	227,373.4	6	37,895.6			
Total	351,821.9	7				

The value of **t** given corresponding to intercept comes to be 11.29 which is greater as compared to t value of 1.96 at5 percent level of significance and 6 degrees of freedom. Thus, we reject

H_0(null hypothesis) and conclude that there exists a relationship between gold prices and Crude Oil Price. Also the value of p is less than 0.0001 which is too small to reject H_1. Thus there exists a relationship between gold prices and Crude Oil Price when Crude Oil Price is relatively stable. The value of F statistics comes to be 3.28 which is less as compared to $F_{0.05}$ (5.9874) with (1, 6) degrees of freedom, hence the variation between gold prices and Crude Oil Price is not significant.

Thus, when Crude Oil Price is stable there exists in general an inverse relationship between gold prices and Crude Oil Price, but the variation in them is not significant. Also the crude oil price cannot be a good measure of gold prices when crude oil prices are stable.

Case 9: When SENSEX - Relatively stable and Value of Rupees/Dollar - relatively volatile

H_0: The variation between gold prices, SENSEX and Value of Rupees/Dollar is not significant.

H_1: The variation between gold prices, SENSEX and Value of Rupees/Dollar is significant.

The output generated for the regression equation between gold prices, SENSEX and Value of Rupees/Dollar when SENSEX is relatively stable and Value of Rupees/Dollar is relatively volatile using'Analyse-it' tool-pack of EXCEL is given as below:

As seen in table 13, the slope coefficient of regression equation indicates that as BSE SENSEX increases by 1unit, gold price decreases by 0.6258 units of SENSEX and by 380.2 units of value of Rupees/Dollar. Since SENSEX is an index measured in 100s, the coefficient of SENSEX implies that gold price changes (decreases) by Rs 62.58 times SENSEX and Rs 380.2 times the value of Rupees/Dollar. Similarly, when SENSEX = 0, i.e., when it remains stable, the price of gold is Rs47, 236. Secondly, the value of adj R^2 comes to be 0.44and R^2 comes to be 0.47 which is relatively low.

TABLE 13 (Computation Values: Gold Prices, SENSEX, & Value of Dollar)

n						32
R^2						0.47
Adjusted R^2						0.44
SE						273.6
Term	Coefficient	95% CI	SE	t Statistic	DF	P
Intercept	47236	31587 to 62886	7652	6.17	29	<0.0001
Sensex	-0.6258	-0.8826 to -0.3689	0.12559	-4.98	29	<0.0001
₹/$	-380.2	-671.8 to -88.5	142.59	-2.67	29	0.0124

Gold = 47236 – 0.6258 Sensex - 380.2 ₹/$

Source of Variation	Sum Squares	DF	Mean Square	F Statistic	p
Model	1,953,621.8	2	976,810.9	13.05	<0.0001
Residual	2,170,350.0	29	74,839.7		
Total	4,123,971.9	31			

Thus, we can conclude that the explanatory variables (SENSEX and value of Rupees/Dollar) are relatively bad measures of gold prices as it explains only 47percent influence in the fluctuation in gold prices.

But the model is unable to determine 53 percent influence of the other extraneous variables. This implies that there are some other extraneous variables influencing the prices of gold.

The value of F statistics comes to be 13.05 which is much greater as compared to $F_{0.05}$ (3.3277) at (2, 29) degrees of freedom. Thus, we reject H_0, (null hypothesis) and conclude that the variation between gold prices, SENSEX and value of Rupees/Dollar is significant. Thus there exists relationship between gold prices, SENSEX and value of Rupees/Dollar when BSE SENSEX is relatively stable and value of Rupees/Dollar is relatively volatile.

Thus, when SENSEX is relatively stable and Value of Rupees/Dollar is relatively volatile there exists an inverse relationship between gold prices and SENSEX, but these extraneous variables are not that effective in predicting the prices of gold due **to** bad coefficient of determination.

Case 10: When SENSEX - Relatively stable; Value of Rupees/Dollar - relatively volatile and Crude Oil Prices - relatively stable

H_0: The variation between gold prices, SENSEX, Value of Rupees/Dollar and Crude oil prices is not significant.

H_1: The variation between gold prices, SENSEX, Value of Rupees/Dollar and Crude oil prices is significant.

The output generated for the regression equation between gold prices, SENSEX, Value of Rupees/Dollar and Crude Oil Prices when SENSEX is relatively stable. Value of Rupees/Dollar is relatively volatile and Crude Oil Prices are relatively stable using 'Analyse-it' tool-pack of EXCEL is given as below:

As seen in table 14, the slope coefficient of regression equation indicates that as BSE SENSEX increases by 1unit, gold price decreases by 0.2204 units of SENSEX, decreases 480.3 units of value of Rupees/Dollar rise and by 22 units of crude oil prices increase. Since SENSEX is an index measured in 100s, the coefficient of SENSEX implies that gold price changes (decreases) by Rs 22.04times SENSEX, Rs 480.3 times value of **Rupees/Dollar** andRs 22 times crude oil prices. Similarly, when SENSEX =0, i.e., when it remains stable, the price of gold is determined at Rs 46,566 at market prices. Secondly, the value of adjR^2 comes to be 0.75 and R^2 comes to be 0.86 which is moderately high. Thus, we can conclude that the explanatory variables (SENSEX, value of Rupees/Dollar and crude oil prices) are relatively good measure of gold prices as it explains 86 percent influence in the fluctuation in gold prices. But the model is unable to determine only14 percent influence of the other extraneous variables.

The value of F statistics comes to be 8.10 which is greater as compared to $F_{0.05}$(6.5914) at (3, 4) degrees of freedom. Thus, we reject H_0, (null hypothesis) and conclude that the variation between gold prices, SENSEX, Value of Rupees/Dollar and Crude oil prices is significant. Thus there exists a relationship between gold prices, SENSEX, value of Rupees/Dollar and crude oil prices when BSESENSEX is relatively stable. Value of Rupees/Dollar is relatively volatile and Crude Oil Prices are relatively stable.

Thus, when SENSEX is relatively stable and Value of Rupees/Dollar is relatively volatile there exists an inverse relationship between gold prices and SENSEX. When SENSEX goes up gold prices comes down and vice versa when value of Rupees/Dollar is relatively volatile and crude Oil Prices are relatively stable.

TABLE 14 (Computation Values: Gold Prices, SENSEX, Value of Dollar, & Crude oil Prices)

n						8
R^2						0.86
Adjusted R^2						0.75
SE						111.5
Term	Coefficient	95% CI	SE	t Statistic	DF	P
Intercept	46566	28164 to 64968	6628	7.03	4	0.0022
Sensex	-0.2204	-0.6048 to 0.1641	0.13847	-1.59	4	0.1867
₹/$	-480.3	-833.6 to -127.0	127.25	-3.77	4	0.0195
Crude Oil	-22	-80 to 36	20.8	-1.06	4	0.3489

Gold = 46566 – 0.2204 Sensex - 480.3 ₹/$ - 22 Crude Oil

Source of Variation	Sum Squares	DF	Mean Square	F Statistic	p
Model	302,074.3	3	100,691.4	8.10	0.0357
Residual	49,747.6	4	12,436.9		
Total	351,821.9	7			

6. CONCLUSION

The above cases are summarised in the table given below. From the table it is observed that the value of R^2 is moderately high for Cases 1, 2, 3, 4, 5 and 10. Thus we can infer from the above table that when SENSEX is relatively volatile; Value of Rupees/Dollar is relatively stable and Crude Oil Prices are relatively volatile, the coefficient of determination R^2 is moderately high for all the cases i.e. Case 1 to Case 5. Similarly when SENSEX is relatively stable; Value of Rupees/Dollar is relatively volatile and Crude Oil Prices are relatively stable, then also these three variables are useful in predicting the value of gold prices. But for rest of the cases the variables are not very useful and cannot be used for predicting the value of gold price even though the variation between them and gold prices comes to be significant as discussed above for each case.

TABLE 15 Summaries of Cases

When SENSEX – Relatively Volatile; Value of ₹/Dollar – Relatively Stable and Crude Oil Prices – Relatively Volatile				
Case	Variable(s)	Stable/Volatile	R^2	Relationship with gold prices
Case 1	SENSEX	Volatile	0.64	Inverse
Case 2	Value of Rs/dollar	Stable	0.78	Direct
Case 3	Crude Oil Price	Volatile	0.89	Direct
Case 4	SENSEX, Value of ₹/dollar	Volatile, Stable	0.81	Inverse
Case 5	SENSEX, Value of ₹/dollar, Crude Oil Price	Volatile, Stable, Volatile	0.90	Inverse
When SENSEX – Relatively Stable; Value of ₹/Dollar – Relatively Volatile and Crude Oil Prices – Relatively Stable				
Case 6	SENSEX	Stable	0.34	Inverse
Case 7	Value of Rs/dollar	Volatile	0.02	Inverse
Case 8	Crude Oil Price	Stable	0.35	Inverse
Case 9	SENSEX, Value of Rs/dollar	Stable, Volatile	0.47	Inverse
Case 10	SENSEX, Value of Rs/dollar, Crude Oil Price	Stable, Volatile, Stable	0.86	Inverse

Thus, we conclude that, when SENSEX is relatively volatile; Value of Rupees/Dollar is relatively stable and Crude Oil Prices are relatively volatile, i.e. Table3 (a) part and Table 4(a) part, the individual value of SENSEX determines only 64 percent influence on gold prices, individual value of Rupees/Dollar determines 78percent influence and crude oil price determines 89 percent influence. If two variables SENSEX and Value of Rupees/Dollar are taken into consideration together into an econometric relationship, it determines 81 percent influence of these variables. But when SENSEX is relatively stable; Value of Rupees/Dollar is relatively volatile and Crude Oil Prices are relatively stable, i.e. Table3(b) part and Table 4(b) part, the individual value of SENSEX determines only 34 percent influence on gold prices, individual value of Rupees/Dollar determines 2percent influence and crude oil price determines 35 percent influence. If two variables SENSEX and Value of Rupees/Dollar are taken into consideration together into an econometric relationship, it determines only 47 percent influence of these variables. Hence if all the three variables are taken into consideration for determining gold prices then irrespective of the occasions as mentioned in Part (a) or (b) of Tables 4, the econometric model determines 90percent influence of the relationship and 86 percent influence of the relationship which is highly appreciable and reliable.

Thus, in a nutshell, we conclude on the basis of an econometric analysis and enquiry that for determination of gold prices if individual values are taken for consideration for formulating an econometric model, they may give misleading figures at different occasions. Hence the best method is to take all the three variables viz., SENSEX, Value of Rupees/Dollar and Crude Oil Price for determination of gold prices irrespective of whether one is volatile and others are stable and vice versa as the coefficient of determination are moderately high for their econometric relationship with gold prices.

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