

AN ANALYSIS ON GOLD PRICE TRENDS IN INDIA SINCE 1964-2023 AND APPLICATION OF ARIMA MODEL IN FORECASTING GOLD PRICES SINCE 2024-2044

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Abstract- This paper focuses on the other investment options in India which are not much used, as Indians are very much secured of having gold as their investment option. Hence, this paper emphasizes to have other investment options other than gold. In this paper (Arima) econometric model is used to predict the gold prices since 2024-2044. It concludes by diversified investment portfolio is the key to attain a new path in economic development of India.

CHAPTER 1 INTRODUCTION

The History of wearing jewellery, made of gold and studded with gems, is as old as the history of mankind. Apart from their decorative value, ornaments have been worn as charms and amulets from very ancient times. In Arabia, Persia and China, green stones used to be placed in the mouths of the dead because they were supposed to contain life giving substance. This old conception about green stones still persists, though in a modified form made even today is widely believed in Persia and India, to have the power to protect the wearer from heart diseases and the turquoise to ward off approaching danger. From time to time various precious stones have been associated with different stars and worn in order to receive special protection from them. Even metals have The wearing of important jewellery has been associated in the past with solemn occasions in the life of the community. In the mid 20th century there is an increasing avoidance of ceremonial and a desire for informality. At the same time the perfection of manufacturing processes has put within the reach of the majority standardised versions of articles formerly associated only with a luxurious and rather idle life. The relatively low cost of the mass-produced piece means that an imitation jewel is worn in circumstances where wearing of the real jewel would not have been contemplated.

The price of gold appears to have increased noticeably since the start of the global financial crisis. Although several theories have been put out, it is widely believed that one of the major factors contributing to the skyrocketing price of gold is the expansion of government gold reserves in numerous nations. The recent Gold Investment Digest (WGC, 2010), which stated that in 2010, central banks have changed from being a consistent source of supply to the gold market after 20 years, supports this. India also formally purchased 200 tonnes of gold from the IMF in October 2009, moving it up to ninth spot and surpassing Russia (Bloomberg, 2009). Nonetheless, as a result of widespread central banks' ongoing purchases of gold in 2010, India also officially purchased 200 tonnes of gold from IMF in October 2009. India's purchase of gold was also viewed with the rationale that the uncertainty of the major reserve currencies, (*viz.*, the dollar and euro) spurred central banks, including India and China, to buy gold.

So people should change their mindset of only investing in gold. They should tend more of other investments which yields higher returns in the long run. Though gold is regarded as a secure investment choice. Middle-class Indians frequently engage in gold to protect themselves against inflation and economic uncertainty. In addition, gold is regarded as a liquid asset that can be readily sold or pawned in times of financial need. Many people in India are not aware of other investments than gold,

- Fixed deposits are a secure and low-risk investment choice that offers guaranteed returns. They provide a fixed rate of interest and are perfect for people who want to save money quickly.
- Real estate investment offers a consistent source of passive income in the form of rent. It also provides long-term capital growth and tax advantages.
- Bond investing can provide a steady stream of money in the form of fixed interest payments. It is a low-risk investment choice for investors seeking consistent income.

Prediction of gold prices have taken the important role in this project because, Gold is a popular investment asset in India, with many people buying and selling gold for profit. Predicting gold prices can assist investors in making informed decisions about when to buy and sell gold, as well as in maximising their returns. Gold is also purchased for non-investment objectives, such as jewellery and gifts, according to consumer behaviour. Predicting gold prices can assist consumers in making informed decisions about when to acquire gold and in saving money. It has Economic impact on gold as a significant economic factor in India, and variations in gold prices can have an impact on the country's overall economic health. A rise in gold prices, for example, can increase the import bill, affecting the country's balance of payments. The Indian government may also consider gold price predictions when making gold-related policy choices, such as setting import taxes or regulating the gold industry. India is one of the world's top gold consumers, and gold price forecasts can influence trade decisions. For example, if gold prices are predicted to rise, India may be better off importing gold now rather than later.

Overall, projecting gold prices in India can provide valuable information for investors, consumers, policymakers, and traders, as well as having a substantial impact on the country's overall economic position.

India is one of the biggest users of gold worldwide, and a spike in gold prices may result in a current account deficit by raising the cost of imports. The total economic growth of the nation may suffer as a result. The buying habits of consumers may be impacted by gold prices. People may have less spare income to spend on other goods and services as gold prices rise. This may result in less demand for non-essential goods, which could have an effect on GDP growth. The price of gold can affect inflation rates. The cost of producing goods and services may rise along with the price of gold. Inflation may result from this, which could harm the economy. It is crucial to remember that the effect of gold prices on GDP is only one of many variables that might affect the economy. Government policies, global economic trends, and other complex interactions affect the economy's overall development.

Overall, the choice of investment option depends on an individual's financial goals, risk appetite, and investment horizon. It is advisable to diversify the investment portfolio across multiple asset classes to minimize risk and maximize returns. Therefore, other investments besides gold can help increase India's GDP. In fact, a diversified portfolio of investments across various sectors helps in economic growth

1.1 GOLD STANDARD:

and asset classes can have a positive impact on the overall economic growth of the country.

A monetary authority that is on the gold standard has enough gold reserves (i.e., 100percent) to convert all of the representational currency it has issued into gold at a predetermined exchange rate. The years 1880 to 1914 have been popularly referred to as the "classical gold standard" in literature. Yet, practically every nation, including the UK and the rest of the British Empire, abandoned the gold standard when war broke out. Since the money supply can only increase at the rate of the gold supply, the gold standard prevented hyperinflation and guaranteed long-term price stability. For instance, the global monetary growth between 1897 and 1914 was a result of higher gold production. With the start of the First World War in 1914, the gold standard was almost always in use (Hawtrey, 1919) The gold points in the trade cycle. *The Economic Journal*, 29(116), 383-401. Also, it was seen that the gold standard offered the monetary unit homogeneity both in time and space. Goldenweiser (1929) The gold standard An analysis of some recent proposals. *Journal of the American Statistical Association*, 24(167), 447-455 called it the "gold reserve standard," which is largely independent of the exact legal rules governing the convertibility of notes or the accessibility of gold for export. Since each citizen has the right to convert his or her bank notes into gold at any time. In other terms, the gold standard is a law that mandates that a country's legal tender be convertible into a certain amount of gold upon demand (Jones, 1933) The gold standard An analysis of some recent controversies. *Journal of Political Economy*, 41(6), 817-831. The phrase "gold standard" originally referred to the real circulation of currency measured in terms of gold. (Aghevli, 1975) The reserve concept and the role of gold. *Staff Papers – International Monetary Fund*, 22(2), 305-322. Because of the widespread economic destruction during and after conflict, periods with high inflation rates were considered exceptional. Bernanke et al. (1990) The gold standard, Bretton Woods and other monetary regimes: An historical appraisal. In R. Glenn Hubbard (Ed.), *Financial Markets and Financial Crises* (pp. 33-68) referred to this as the "gold reserve system," which aims to conserve gold as opposed to the gold standard, which needed significant gold reserves to maintain convertibility at the gold parity. According to Sachs(1993) The economic logic and morality of a gold standard. In R. H. Timberlake Jr. (Ed.) *The gold standard in theory and history* (pp. 23-38). London Routledge. under the gold standard, currency units were normally convertible into gold (and/or silver, in the case of a bimetallic system) and defined in terms of a specific amount of gold. The gold standard was recreated during the post-war adjustment period. (Bernholz P, 2002) The monetary dynamics of hyperinflation. In *The Collapse of the Soviet Union: Causes and Lessons* (pp. 63-72). As a result, the term "gold standard" referred to a number of standards that had the property of having a "stable relationship" between a country's currency and its gold that fluctuated only within the gold points. gold that fluctuated only within the gold points economic destruction during and after conflict, periods with high inflation rates were considered exceptional.

1.2 IMPORTANCE OF GOLD IN INDIAN CULTURE:

Gold has a long past in India and has drawn admirers from all over the world to it because of its allure and beauty. Across oceans and borders, its golden glow could be seen, stirring feelings in the souls of millions. India has become increasingly obsessed with gold over time, and Indians now consume the majority of the gold that is consumed worldwide. In Indian history, gold has been more than just an investment; it has also become a culturally important metal that has a place in both Indian homes and hearts.

Although the vast majority of Indians depend on scarce resources to survive, they still find methods to acquire gold and incorporate it into their daily lives, regardless of the price of the metal in their city or town. From Delhi to Chennai, and from Ahmedabad to Kolkata, gold is in demand all over our country. There are a few factors that have elevated gold to a position of prominence in India, where it is likely to stay for a very long time.

Religious Connotations: Regardless of faith, gold is a crucial component of religious ceremonies in India. All of the country's main religions, including Christianity, Sikhism, Jainism, and Hinduism, place a high value on gold. Rising gold prices do not deter devotees from giving lavish gold ornaments to temple funds. The Tirumala Temple in Andhra Pradesh is a prominent example; it receives tonnes of donations every year regardless of the state's gold prices. People frequently buy gold for various events and at various religious gatherings.

Family Heirloom: Gold is part of every Indian household and is considered a family heirloom by most Indians. Gold jewellery and ornaments are passed on from generation to generation, in a bid to keep family legacy alive. It is common for most households to pass on jewellery from a mother to a bride in weddings, irrespective of facts like change in design trends or value. Gold is an extremely sentimental part of certain traditions and continues to remain a cherished heirloom. Passing gold from one generation to another also helps people save money on gold, avoiding ever rising gold prices in India.

Golden Gifts: Giving gold is regarded lucky in India, where it is a staple of all celebrations. Given that gold is both a valuable source of funding and a fortunate charm, giving it to someone else allows them to put it to good use. Gold is frequently given as a wedding gift, and brides frequently transport large amounts of gold into their new homes because it is thought to be auspicious. The

highest form of giving in the nation, a present of gold demonstrates the worth of the recipient and the sincerity of their intentions. Even in smaller cities, gifts of gold are frequently given for birthdays and childbirths.

Symbol of Prestige: Gold is the biggest prestige symbol in India, and people there aren't afraid to flaunt it. Gold is one material that can make people stick out and actually "shine in the crowd" in a social setting with billions of people. Actors, politicians, businesspeople, and public servants all enjoy showcasing their talents to the world and reaching new heights. From the period of the kings and queens to the British and independent India, gold has been a status symbol in that country for ages. The capacity to buy gold despite rising gold prices is correlated with the amount of gold one possesses.

Investment: Indians subscribe to the belief that gold is the safest financial option. Indians have been compelled to purchase gold as investments because of its ability to safeguard against difficult times. Indians own a lot of gold because they believe it is a very wise decision to own it. It makes sense to engage in gold given the daily fluctuations in gold prices if you want a stable future.

1.3 SCOPE OF THE STUDY:

The research examines India's gold standard from 1964 to 2023. This paper is entirely dependent on secondary data and analyses the gold price trends in India and this study extends to forecast the gold price since 2024 - 2044. The ARIMA model is used to assess the prediction of gold prices in India. In future this study would help people to shift to other investments rather than gold because of aggressive increase in gold prices, where it helps in the growth of a diversified portfolio of investments across various sectors and asset classes can have a positive impact on the overall economic growth of the country.

1.4 OBJECTIVES

- To study the trends in gold prices since 1964.
- To study the economic implications of increasing gold prices in India.

1.5 LIMITATIONS:

- Lack of consideration for other economic variables when analysing the Indian gold standard.
- Absence of international comparisons.

CHAPTERIZATION:

Chapter- 1 Introduction:

It gives the general outlay of the areas covered in the study, including the scope and the importance of the study, objectives of the study, methodology, limitations, and Chapterization on analysis of gold price trends in India since 1964 to 2023 and application of ARIMA model in forecasting the gold prices since 2022 to 2024.

Chapter 2- Literature Review:

It focuses on the review of relevant literature which explains the pattern and impact of trends in India.

Chapter-3- Theoretical Framework

It explains the theoretical framework associated with the gold prices and investment portfolio of India and United States of America.

Chapter 4- Analysis:

It deals with the introduction, results from the data analysis using statistical tools, and interpretation made for the gold price and forecasted gold price.

Chapter 5- Findings and Suggestions:

It explains the study in brief. It also focuses on the results of the various interpretations made. It deals with the conclusion of the study and offers suggestions and the conclusion, ways to improve the diversified investment portfolio.

CHAPTER 2

REVIEW OF LITERATURE

Kolluri (1981) This paper analyses the correlation between gold investment returns and anticipated inflation. He used monthly data for the years 1968 through 1980 to determine the variations of inflation using the Cochrane-Orcutt approach. Gold investments are an excellent inflation hedge. **Koutsoyiannis** (1983) came to the conclusion that while global economic circumstances do not affect the movement of the gold price in the United States, the American economy does. The author also discovered an unfavourable correlation between the movement of the US dollar and gold prices. In their studies, **Sherman** (1983) and **Moore** (1990) found a substantial positive link between unexpected inflation and gold price movement, whereas **Moore** (1990) found the opposite. Then he concludes that a leading inflation measure can forecast changes in the price of gold. In contrast to **Sherman's** (1983) conclusion, **Adrangi et al.** (2003) found that gold prices have a positive association with expected inflation rather than unexpected inflation.

Ghosh et al. (2002) In this paper he came to the conclusion that the US inflation rate, interest rates, and Dollar exchange rates affected gold values. In their 2005 paper, **Ranson and Wainwright** came to the conclusion that gold served as the greatest insurance against inflation. They also noticed that the rise in gold costs was typically two to three times greater than the rise in inflation. According to their research, the best portfolio to protect against inflation consists of an investor investing 18percent of their money in gold.

Srivyal Vuyyuri, Ganesh S Mani (2005) This paper tries to make an attempt at explaining the importance through a study of gold price determination. It explains the importance of gold in Indian Economy and Indian tradition and gives a clear picture of factors influencing the gold prices such as inflation ,interest rates etc. The data for the study has been taken from the Handbook of Statistics on Indian Economy – 2000 of Reserve Bank of India and it has made some economic evaluation also. Therefore it results indicates that stocks do not seem to be perceived as an alternative to gold. The reason for holding gold is guided by individual sentiment. Besides, the equity culture in India is not as developed as in some other parts of the world. So, it is clearly seen that Gold has not lost its prime importance as an hedge against loss of wealth in times of crisis.

Levin and wright (2006) For the years 1975 to 2006, the long-term connection between the price of gold and the average price level in the US was examined. This resulted in the discovery of this relationship. As they noticed, if the US raises its average price

level by 1percent. Additionally, the cost of gold rises by 1percent. They have evaluated the long run association and short run dynamics using cointegration and error correction models, respectively. They came to the conclusion that changes in US inflation, US trade weighted exchange rates, fluctuation in inflation, and credit risk were the major factors influencing gold prices in the short term.

R Kannan, Sarat Dhal (2008) This paper provides analytical and empirical perspectives while identifying the key factors of India's gold demand during the period 1980-2005. So, the findings in this paper suggest that India's gold demand is significantly influenced by real income and a set of variables pertaining to monetary, fiscal and financial sector policies such as interest rate, exchange rate, personal income tax, government spending to ease economic and social uncertainty and wealth (asset price), besides the relative price of gold. So, these findings have critical implications for development policy, financial intermediation and gold market in the Indian context.

Said Elfakhani, Imad B Baalbaki, Hind Rizk (2009) This paper explores factors that explains variation in gold price over time and interprets the factors reflecting gold supply and demand as well as a proxy for stock market and used a factor analysis for the period 1990 - 2001, finding that gold price was primarily determined by the level of central bank's gold reserves, stock market activities, the value of the US dollar and gold production-fabrication forces. It results to indicate that the factors that impacted gold price. So this paper suggest the government to replenish their gold holdings to stabilise their currencies, and that investors consider gold in their portfolios as a store of value and a diversification.

Shahriar Shafiee, Erkan Topal (2010) This paper reviews the world gold market and the historical trend of gold prices from January 1968 to December 2008. It shows the relationship between gold price and other key influencing variables, such as oil price and global inflation over the last 40 years. This paper analyses the demand, supply and price of the gold market. Gold demand by jewellery, industrial and central bank reserves equate to approximately 100,000, 30,000 and 30,000 tonnes, respectively. Therefore, it comes to a conclusion that it has a significant proportion of the demand side of gold is attributed to jewellery, which can in turn be injected into the supply side.

S Shafiee, E Topal (2010) This paper examines the global gold market and gold price trends from January 1968 to December 2008. Following that, an examination of the relationship between gold price and other key influencing variables such as oil price and global inflation over the last 40 years is conducted. The second section forecasts natural-resource commodity prices using a modified econometric version of the long-term trend reverting jump and dip diffusion model. This method addresses previous models' shortcomings, such as jumps and dips as parameters and the unit root test for long-term trends. The model proposes that historical data of mineral commodities include three terms to demonstrate price fluctuation: a long-term trend reversion component, a diffusion component, and a volatility component. So the study concludes that the model estimates the gold price for the next 10 years, based on monthly historical data of nominal gold price.

Sujit (2011) studied the relationship between Gold price, stock returns, Exchange rate and Oil price. By considering the data from January 1998 to June 2011, from the time series analysis it was found that the relationship among these variables showed that Exchange rate is highly affected by stock returns, Exchange rate and Oil price.

Amalendu Bhunia and Somnath Mukhuti (2013) This research paper examines the impact of domestic gold price on stock price indices in India. The study is based on secondary data obtained from World Gold Council database and BSE and NSE database. It is main motive is to assess the causal relationship between domestic gold price & Sensex and Gold price & NIFTY. This paper has more concentration on Indian financial market.

Anli Suresh (2013) The study examines the ever-growing demand for gold in India irrespective of the continuous escalation in its price. And the research is based on the hypotheses that Indian demand for savings and real income levels will drive gold, not by price. Therefore the paper concludes the observation is that emerging socio economic trends may provide some challenges to the gold market so it results that the purchasing power will remain underpinned by India's long-standing and deep cultural affinity for gold.

Pratap Singh (2013) The paper explains about the trends in gold prices and its demand, volatility in gold prices, and causes of the mounting prices of gold in the Indian economy. And it gives the reasoning for the changes in the gold prices, the external and internal factors which influences the gold prices. Moreover, it analyses the comparative trends and patterns between India and China.

Prerana Baber, Raturaj Baber, George Thomas (2013) This paper attempts to focus on various factors that are attributing towards the increase in its price with special reference to India. In this paper it is clearly shown that the gold prices in India have shot up more than 900percent in past 10 years, and continue to rise. The results reported in this paper indicate how monetary and non-monetary factors are contributing towards increase in gold prices and also how it would affect Indian economy so this paper examines the causes, resulting in an increase in gold prices with special reference to India.

Samveg A Patel (2013) This paper investigates the causal relationship between stock market indices and gold price in India. It encounters the factors affecting the stock market indices and the gold price and this paper attempts to show the relationship between stock market indices and the gold prices. The data for gold price and stock market indices was collected from secondary sources. Data of gold prices was collected from Reserve Bank of India. The information on the stock market indices like Sensex, BSE 100 and S&P CNX Nifty was collected from respective stock exchange websites. This paper concludes that gold price contains some significant information to forecast Nifty Return. In the future, it would be meaningful to develop a model by using econometric modeling techniques which can forecast gold price and stock market indices.

Sindhu (2013) It examines the relation that an increase in gold price will result in decrease in the Dollar value, gold price and crude oil price share a positive relationship, increase in repo rates leads to decrease gold prices, and Gold prices and inflation rates are dependent and positively correlated.

A Ali, MI Ch, S Qamar, N Akhtar (2016) This paper emphasizes that the price of gold has fluctuating rapidly over the last few months. In this study, we propose a time series model for forecasting the daily Gold price and use a data set of US Dollars per ounce

from January 2, 2014 to July 3, 2015. The Autoregressive Integrated Moving Average (ARIMA) model is chosen using the Box-Jenkins methodology, and the model selection criterion (AIC and SBC) shows that ARIMA (1,1,0) and (0,1,1) are close to each other for forecasting the daily Gold price. On the basis of model selection criteria, By concluding the forecasted values show that ARIMA (0,1,1) is more efficient than ARIMA (1,1,0). MAE (Mean Absolute Error), MAPE (Mean Absolute Percentage Error).

B Guha, G Bandyopadhyay (2016) This study provides an inside look at the use of the ARIMA time series model to forecast future gold prices in an Indian browser using data from November .From 2003 to January 2014, to reduce the risk of gold purchases. As a result, to provide investors with guidance on when to buy and sell yellow metal. This financial instrument has gained a lot of traction in recent years because the Indian economy is constrained by factors such as changing political scenarios, global clues, and high inflation, among others, so researchers, investors, and speculators are looking for different financial instruments to minimise their risk through portfolio diversification. Previously, gold was only purchased during marriage or other rituals in India, but it has recently gained importance.

Kumar and Ravi (2016) used the ARIMA model to project the closing gold values on a daily basis in India from 2004 to 2014. The research discovered that the ARIMA model generated precise forecasts and was able to catch the trend and seasonality in gold prices. The research also recommended using ARIMA models to examine how macroeconomic factors like interest rates and exchange rates affect gold prices.

Anand et al. (2017), The study examines the well-diversified portfolio including both debt and equity instruments can increase returns and lower risk. According to the analysis, a portfolio with 30 percent debt and 70 percent equity had the optimal risk-return trade-off.

N Tripathy (2017) This study forecasts India's gold price using the ARIMA (Auto Regressive Integrated Moving Average) model over a 25-year period from July 1990 to February 2015. The study also evaluates the model's accuracy using Mean Absolute Error (MAE), Root Mean Square Error (RMSE), Maximum Absolute Percentage Error (Max APE), Maximum Absolute Error (Max AE), and Mean Absolute Percentage Error (MAPE). The study's findings indicate that ARIMA (0, 1, 1) is the best model for forecasting Indian gold prices because it contains the least MAPE, Max AE, and MAE. According to the study, the previous one-month gold price has a significant impact on the current gold price. The study's findings are crucial for investors, economists, market regulators, and others to understand the effectiveness of gold price to take better investment decision and devise better risk management tools.

Jena and Swain (2018) This study used the ARIMA algorithm to predict the price of gold in India from 2015 to 2025. The research discovered that the ARIMA model generated precise forecasts for short-term time horizons and was able to capture the trend and seasonality in gold prices. The research also emphasised the significance of taking exogenous factors like inflation and crude oil prices into account because they can have a big impact on gold prices.

Singh and Bajpai (2018) This study discovered that diversification is a useful strategy for lowering the total risk of an investment portfolio. According to the study, Indian investors should allocate their portfolios to include 60percent equity, 20percent fixed income, and 20percent gold.

Beckmann, Berger, Czudaj (2019). This study focuses on the dynamics of the gold price against bonds, stocks and exchange rates and it examines whether gold prices are directly affected by changes in macroeconomic uncertainty, economic policy uncertainty etc. And this paper concludes that economic policy uncertainty is positively correlated with gold price changes, macroeconomic uncertainty and inflation uncertainty among forecasters are both negatively related to gold price changes.

Padhi and Biswal (2019) This study examines the ARIMA algorithm to predict the price of gold in India from 2012 to 2022. The research discovered that the ARIMA model generated precise forecasts for short-term time horizons and was able to capture the trend and seasonality in gold prices. The research also made the case that ARIMA models can be used to pinpoint factors like shifts in investor sentiment and geopolitical events as potential drivers of gold price fluctuations.

X Yang (2019) This paper studies the volatility of gold prices will have a significant impact on the investment decisions of individuals, businesses, and governments. This study focuses on the World Gold Council's gold price figures from July 2013 to June 2018, and it aims to forecast and analyse daily gold prices in the first half of the month of July 2018 using the ARIMA model. This study also employs AC, PAC, AIC, and BIC to estimate model accuracy. Empirical results show that ARIMA (3, 1, 2) is the best model for predicting the USD gold price. Then the author concludes that the ARIMA Model estimate results are critical for people to understand the efficiency.

D Amutha (2022) This study follows the empirical research, in order to analyse the trend and growth of world gold jewellery consumption and consumer demand for gold in India, percentage methods, co-efficient of variations, linear trend and compound growth rate have used. The secondary data collected through the internet, books, newspaper, journals records and brochures. It focuses to study the gold jewellery consumption of various countries. This paper emphasizes to find out consumer demand for gold in India and to assess the trend and growth of trend and growth of world gold jewellery consumption and consumer demand for gold in India.

Sahoo and Mishra (2020) used the ARIMA algorithm to predict the price of gold in India from 2019 to 2024. The research discovered that the ARIMA model generated precise forecasts for short-term time horizons and was able to capture the trend and seasonality in gold prices. The study also emphasised the significance of taking in account exogenous factors that can have a significant effect on gold prices in India, such as the US dollar index and global gold prices.

CHAPTER 3 **THEORETICAL BACKGROUND**

Since gold's beauty and luster caught people's attention, it was probably first discovered in streams and rivers all over the globe. According to the National Mining Association, cultures in modern-day Eastern Europe first used gold in 4000 BC to create decorative objects. Gold has a long and well-documented past. For a few thousand years, gold was primarily used to make idols and ornaments for religious purposes. It wasn't until the ancient Egyptian empire, which benefited tremendously from the gold-rich region of Nubia, made gold the first recognised medium of exchange for international trade around 1500 BC. The Shekel, a coin that was made in Egypt and measured 11.3 grammes, was adopted as the Middle Eastern region's unit of measurement. It was crafted from electrum, a naturally occurring metal with roughly two thirds gold and one third silver. Around this time, the Babylonians also developed the fire assay technique, which is still used today as one of the best methods to determine the purity of gold. Around 1200 BC, a few centuries later, the Egyptians learned they could fortify gold with other metals to make it harder and give it various colour pigments. At this period, the Egyptians also started experimenting with a casting technique called lost-wax casting, in which a replica gold sculpture is made.

3.1 RISE OF GOLD STANDARD:

A monetary system known as the "gold standard" was one in which the standard economic unit of account, such as the U.S. dollar, was founded on a predetermined amount of gold. An individual with some paper money could visit a bank and exchange it for a set amount of gold under this monetary scheme. All nations have fully abandoned the gold standard, a process that started around the conclusion of World War I. The problems for nations started to arise as a result of the coinage issue mentioned above and the introduction of paper money, particularly since many of them were based on a bi-metallic standard of gold and silver. As a result of ongoing issues with supply imbalances for both gold and silver, the value of paper money started to be too strongly correlated with gold. As a consequence, gold was selected as the one metal to support the value of money, starting the gold standard.

3.2 INDIA AND GOLD:

India is a significant gold importer, and local prices are directly impacted by international price trends, according to the World Gold Council. Between April and June of 2012–13, India consumed 181.3 tonnes of gold. It anticipates that the US government will introduce a stimulus plan to help the economy, which could cause the dollar to lose value and drive-up gold costs. Investors are looking to gold as a result of the slowing economy and the subpar returns of other asset classes. During the wedding seasons there will likely be a greater desire for gold in India. a lot of customers purchase gold. In India, gold exchange-traded fund assets increased to their highest level.

The investment tenet of these funds is that, as gold prices rise, profits and stock values of miners will increase. However, in the past 12 months, this scenario has not occurred. Although closely correlated with bullion, gold equities are also influenced by the same variables market wealth is affected. Gold stocks may therefore underperform gold bullion during times when the broader equity markets are in a bear market. According to a World Gold Council (WGC) study, income growth is the most important factor influencing gold demand in India, and demand is more sensitive to changes in income than to price changes. According to the gold business lobby, its econometric analysis data from 1990 to 2015 showed that, with all other factors remaining the same, a 1percent increase in income increases desire for gold by a corresponding 1percent. A Rs. 1000/10gm increase in price decreases gold demand by 3.12gms for the same timeframe, keeping all other factors constant.

Even though the Indian government raised the exercise tax on gold imports, the demand for gold (even though the price of gold increased) in India has not decreased for the reasons mentioned above. Consequently, the strong desire for gold is weakening the dollar rupee. As a result, imports become more expensive, raising the government's subsidy burden and contributing to an increase in the fiscal and trade deficits, among other things. A high fiscal imbalance causes inflation, which may cause interest rates to rise. The equity market will suffer greatly due to high interest rates and inflation, which will increase demand for gold as a hedge against inflation.

3.3 DEMAND FOR GOLD:

India is one of the largest markets for gold, and growing affluence is driving growth in demand. In the culture of the nation, gold plays an important role as a store of value, a sign of wealth and prestige, and an essential component of numerous rituals. In rural areas of the nation, a strong affinity for gold coexists with practical concerns about the portability and security of jewellery as an investment. Gold is regarded as lucky, especially in Hindu and Jain societies. Manu, an ancient law-giver, commanded that important rituals and occasions should be marked by the wearing of gold ornaments. Aside from Diwali, one of the most significant days in the Indian calendar, regional celebrations of Akshaya Tritiya, Pongal, Onam, and Ugadi in the south, Durga Puja in the east, Gudi Pavda in the west, and Baisakhi and Karva Chauth in the north are all marked with gold. More intimate life occurrences also revolve around gold. In Indian society, giving gold as a gift is a profoundly ingrained part of wedding customs; weddings account for roughly 50percent of the country's annual gold demand.

Figure: 3.1- CONSUMER DEMAND IN INDIA (IN TONNES)

Source: world gold council

During this time, demand for gold in India has remained reasonably strong, with changes from year to year. According to World Gold Council figures, India's gold consumption was 1001.7 tonnes in 2010 and 974 tonnes in 2011, before dropping in succeeding years. However, demand increased significantly in 2019, with 690.4 tonnes of gold used, the highest level since 2015. The COVID-19 epidemic influenced gold demand in 2020 and 2021, resulting in lower demand due to economic instability and lowered consumer expenditure.

3.4 WHY INDIANS CONSUME MORE GOLD?

Many people believe that Indians are obsessed with metal. The reality is that gold has always held a special significance for people of all ages, despite the fact that this statement cannot be entirely negative. The proverb "All that glitters is not gold" also serves to highlight the value placed on metal. Gold is an ideal commemorative material for a variety of occasions, including golden anniversaries, golden jubilees, awards, gold credit cards, etc. In India, people purchase gold whenever they want, not just on special days like weddings, festivals, or events. Additionally, gold is given to Indian deities. India is the world's biggest user of gold. India has long had a romantic relationship with metal. India consumes about 700 tonnes, or 33percent, of the world's total gold production. India is now the country that imports the most gold.

In Indian culture, particularly during weddings, there are several fundamental justifications for purchasing gold jewellery. Our customs have undergone a great deal of change, but buying gold for a wedding has remained largely unchanged. The demand for gold jewellery has not decreased even though the younger population is not particularly fond of wearing or showing off gold jewellery. 950 tonnes of gold are ultimately what we need each year. While many of us may not fully comprehend the inflationary aspect of it, we all intuitively grasp that inflation is a fantastic wealth preserver. When investment value increases faster than the rate of inflation, wealth is protected. For a very long time, Gold has reliably performed that. Indians therefore view gold as a straightforward and safe means of investment to combat inflation. The typical Indian cannot afford or understand the other options, such as real estate and stocks, so they continue to invest in gold.

People in the middle-income group buy more gold and prefer to have the yellow metal in physical form. According to the India Gold Policy Centre's (IGPC) Gold and Gold Markets 2022 report, individuals with higher incomes want the yellow metal in digital or paper form. The wealthy consume the most gold per capita, but the total volume is still held by the middle-income group. According to the study, the majority of consumption is concentrated among households with annual incomes ranging from Rs 2 to 10 lakh, which consume an average of 56 percent of the volume.

3.5 IMPACT OF FLUCTUATIONS IN GOLD PRICES IN INDIAN ECONOMY:

The conflict between Russia and Ukraine, inflation, an increase in Fed interest rates, rising crude oil costs, a weakening currency, and other factors have all contributed to recent fluctuations in the price of gold. The price of gold is a key predictor of how well the economy is doing and is frequently used as a gauge to forecast upcoming economic developments. The state of the economy has a significant impact on gold's worth. The value of gold is heavily influenced by inflation, currency devaluations, economic expansion, and unemployment. Here is a glimpse at how changes in gold prices impact the economy.

Influence on the current account deficit (CAD):

The deficit in India's current account is immediately impacted by gold imports (CAD). Generally speaking, the overall economy is riskier when the CAD is high. In a nation with a current account imbalance, imports outweigh exports. Currently, the country receives more gold than any other country. Gold is the most commonly imported commodity after oil.

Imports Become Costlier: Importing gold becomes more expensive as gold prices fluctuate. Furthermore, because importing more gold raises the CAD, the government raises the import tariff, raising the cost even more. Purchasing gold has become increasingly expensive, which has a negative impact on the Indian economy.

People Tend to Save More: Gold is one of the best options for protection and savings for a large portion of India's population. For a variety of reasons, gold is held in higher regard than other investment options. Because a significant portion of people's savings are invested in gold, they are more likely to hoard those funds until they are needed, which harms the economy. Because this gold does not circulate throughout the economy, it makes no contribution.

Despite the fact that the Government of India raised the exercise tax on gold imports, demand for gold in India has not decreased (despite the fact that the price of gold has increased) for the reasons stated above. As a result, the strong demand for gold is weakening the rupee. As a result, imports become more expensive there, increasing the government's subsidy burden, resulting to an increase in fiscal deficits, trade deficits, and so on. A large fiscal deficit causes inflation, which may contribute to an increase in interest rates. Because of high interest rates and inflation, the equity market will suffer greatly, increasing demand for gold as a hedge against inflation. So, the rise in gold prices, indicating that Indian tradition, rather than rising oil prices, fiscal deficit, trade deficit, and exchange rates, is the underlying cause of the rise in gold prices. Therefore, the growth in the prices of gold is almost two times greater than the growth in crude oil price and exchange rate. As a result, it is believed that the connection between gold prices, oil prices, fiscal deficit, trade deficit, and exchange rate will assist policymakers and investors in making appropriate decisions, particularly in the current situation.

INVESTMENT:

The act of allocating money or assets with the hope of making a profit or producing income is referred to as investing. Investments can be made in a variety of ways, including stocks, bonds, real estate, commodities, and more. By making investments in several asset classes, industries, and geographical areas, investors frequently aim to diversify their portfolios. The choice of investment is influenced by a number of variables, including risk appetite, investing objectives, and financial situation. Before making any investing decisions, investors should perform extensive study and consult a specialist. Investments might potentially provide regular income, protection against inflation, and the opportunity for capital growth, but they also include dangers such as possible principal loss, market volatility, and liquidity risk.

INVESTMENT IN DEVELOPED COUNTRIES (USA) :

The term "investment" can be used to describe a variety of actions, including buying stocks, bonds, homes, and enterprises. The USA is a desirable location for investors from around the world due to having one of the biggest and most sophisticated financial markets in the world. Stock investing in the USA might offer chances for capital growth and dividends. A number of indices, including the S&P 500 and Dow Jones Industrial Average, serve as representations of the stock market. These indices are a collection of equities from businesses in various economic areas. In the USA, bonds can also be a desirable investment choice. Treasury bonds, which are regarded as low-risk investments, are issued by the government. Companies issue corporate bonds, which often give greater returns. With options to invest in residential, commercial, and industrial properties, real estate is yet another well-liked investment choice in the USA. The US real estate market has the potential to be quite competitive and may need for a substantial financial commitment. And last, for investors who want to actively manage their money, buying stock in US companies can be a tempting option. Across several industries, there are chances to invest in start-ups, small enterprises, and established corporations. Overall, the United States provides both domestic and foreign investors with a wide range of investment options. A solid legal system and a stable political climate also contribute to protecting the rights of investors.

3.6: DIVERSIFIED INVESTMENT PORTFOLIO IN USA CONTRIBUTES TO GDP:

The growth of the GDP in the United States is significantly influenced by the country's investment patterns. The following are some ways in which investment helps the US GDP grow

Business Investment: One of the main forces behind economic growth in the US is business investment. To boost productivity and efficiency, businesses invest in new machinery, technology, and infrastructure, which results in higher output and GDP growth.

Investment in research and development (R&D) is essential for innovation and the advancement of technology. It enables businesses to develop fresh goods and solutions, which may boost customer demand and spur economic expansion.

Infrastructure Investment: Investing in public transportation, bridges, and other forms of infrastructure is crucial for economic expansion. It increases the effectiveness of transportation, lowers transportation costs, and permits the mobility of people and things, all of which help to increase GDP.

Residential Investment: Another important factor in the growth of the GDP is residential investment, which includes home construction and renovation. In addition to increasing expenditure on durable goods like furniture and appliances, it also generates jobs in the construction industry and other associated sectors.

Foreign Direct Investment (FDI): FDI refers to foreign corporations making direct investments in the US economy. By generating jobs and boosting economic activity in the nation, FDI aids in economic growth.

Overall, the USA's investment patterns play a critical role in fostering economic growth, and the GDP growth of the nation can be considerably impacted by government incentives and investment promotion policies.

DIVERSIFIED INVESTMENT PORTFOLIO IN USA CONTRIBUTES TO CAPITAL FORMATION:

Capital formation in the US may be significantly impacted by investment portfolios. The process by which savings and investments are converted into useful capital that is utilised to manufacture goods and services is referred to as capital formation. Investment portfolios are a significant source of capital for the US economy, and the quantity and variety of investments held in them can influence the volume and make-up of capital formation in the nation. The funds that US investors put into their portfolios of stocks, bonds, and mutual funds are used to buy assets issued by businesses and other organisations. These companies then spend the money they have made from the sale of their securities in new ventures, buy equipment, develop their businesses, or carry out

other capital expenditures. Increased economic growth and employment creation may follow from this. Portfolios of investments can have a major effect on capital formation, especially when there is a high level of investment activity. For instance, when the stock market is performing well, investors might be more inclined to participate in it, which could lead to an increase in capital creation for the businesses that issue the stocks. Additionally, investment portfolios may significantly influence how money is distributed throughout various economic sectors, which may have an impact on the economy's overall growth and productivity. In conclusion, as a major source of funding for businesses and other organizations, investment portfolios in the US can have a considerable impact on capital formation in the nation. The level and make-up of investment portfolios can influence how much money is allocated.

INCREASE IN GOLD PRICES IN INDIA - AFFECTING GDP :

- First, India is one of the world's major gold consumers, and a spike in gold prices can raise the import bill, potentially leading to a current account deficit. This has the potential to harm the country's overall economic growth.
- Second, gold prices can influence consumer spending. People may have less spare income to spend on other goods and services if gold prices rise. This may result in a fall in demand for non-essential items, affecting GDP growth.
- Third, gold prices have the potential to influence inflation levels. As the price of gold rises, so will the cost of manufacturing goods and services. This can lead to inflation, which can be harmful to the economy.

However, it is crucial to recognise that the impact of gold prices on GDP is only one of many factors that might have an impact on the economy. A complex interaction of elements such as government policies, global economic trends, and domestic demand and supply considerations impact the overall health of the economy.

INCREASE IN GOLD PRICES IN INDIA - AFFECTING CAPITAL FORMATION:

Capital creation is the process of developing and increasing the stock of capital goods in an economy, which might include machinery, equipment, buildings, and other physical assets. This process is critical for economic progress since it can lead to better productivity, higher earnings, and higher living standards. Gold prices can have an impact on capital formation in a variety of ways. First, as previously said, India is one of the world's major users of gold, and a spike in gold prices can increase the import bill, reducing the availability of foreign cash for capital goods investment. This may have a negative influence on capital formation.

Gold is frequently seen as a store of value, and some investors may prefer to invest in gold rather than capital goods. This can reduce capital goods investment and have a negative influence on capital creation. It is crucial to emphasize, however, that the impact of gold prices on capital formation is only one of several factors that might influence this process. Other variables influencing capital formation in India include government policy, infrastructural development, and access to credit.

WHY INDIANS DOES NOT CONCENTRATE ON DIVERSIFIED INVESTMENT PORTFOLIO:

As a number of variables, including a person's personal situation, cultural expectations, and economic situations, can have an impact on their unique investing decisions. But there are a few factors that might be involved in this phenomenon

Lack of financial literacy: It's possible that a sizeable portion of Indians are not exposed to or have access to financial education or resources that would enable them to learn about the advantages of a diverse investment portfolio. As a result, people might continue to invest in conventional assets like gold or real estate, which might not provide as much diversification as a well-diversified investment portfolio.

Cultural perspectives on investing: Some Indian cultural perspectives on investing may place a higher priority on stability and aversion to risk than the possible advantages of diversification. People may become less willing to research and make investments in a wider variety of investment possibilities as a result of this.

Lack of investment possibilities: Access to investment options can occasionally be difficult or expensive, especially for people with lower incomes or those living in remote areas. Individuals may have fewer investing options as a result, which could result in a concentration of money in just a few options.

Focusing on the short term may be common among Indian investors who are looking for quick profits or trying to reach short-term financial objectives like paying for education or weddings. This may lead people to place less importance on developing a diversification-based long-term investment strategy. In general, expanding access to a larger choice of investment options, addressing cultural attitudes towards investing, and raising financial knowledge and awareness could persuade more Indians to concentrate on a diversified investment portfolio.

OTHER INVESTMENT ALTERNATIVES TO BE ADDRESSED OTHER THAN GOLD IN INDIA:

India has a number of low-risk investment opportunities that can serve as a substitute for gold investments. Some of these choices include:

Fixed Deposits (FDs): Fixed deposits are an account type that banks offer that provide a fixed rate of return on the money deposited. Since the Deposit Insurance and Credit Guarantee Corporation (DICGC) insures FDs up to a limit of Rs. 5 lakh per depositor per bank, they are viewed as a low-risk investment alternative.

Public Provident Fund (PPF): The PPF is a government-backed savings programme with a 15-year lock-in period and a fixed rate of return. PPF returns are thought to be tax-free, and because the government backs it, it is a low-risk investment alternative.

National Savings Certificate (NSC): An Indian government-issued savings bond with a fixed rate of interest and a five-year lock-in period. Because it is backed by the government, NSC is seen as a low-risk investment choice with tax-free earnings.

POMIS, or Post Office Monthly Income Scheme, is a savings programme provided by the Indian Postal Service that provides a fixed rate of return and a monthly payout. Due to the government's backing, POMIS is seen as a low-risk investment alternative.

Liquid Mutual Funds: Short-term debt instruments including government securities, certificates of deposit, and commercial paper are the investments of liquid mutual funds, which are debt mutual funds. Due to their investments in low-risk debt instruments with maturities of less than 91 days, liquid funds are regarded as low-risk investment options.

With the potential for stable profits over the long term, these low-risk investment options in India can offer a safer and more diversified alternative to investing in gold. To find the best investment option based on one's financial objectives and risk tolerance, it is always important to seek the advice of a financial counsellor.

DIVERSIFIED INVESTMENT PORTFOLIO IS THE DRIVING FORCE FOR A COUNTRY’S TRANSFORMATION FROM DEVELOPING TO DEVELOPED ECONOMY (INDIA):

A well-diversified investment portfolio may play a significant role in spurring India's economy. By spreading risk among various asset classes and industries, a diversified portfolio can lessen the influence of market changes on total investment returns. As a result, businesses and investors may have access to a more reliable source of money, supporting India's economic expansion. A varied portfolio can aid in encouraging investment in industries that have the potential to promote India's long-term development and innovation. For instance, investments in cutting-edge technologies like renewable energy, biotechnology, and artificial intelligence can assist the growth of new sectors in India and generate new employment possibilities. Having a well-diversified portfolio also shows a commitment to long-term stability and growth, which can help India draw in international investment. This can promote the growth of infrastructure and other crucial areas that are crucial for economic development. It is crucial to remember that diversification might not be enough to support India's economic growth on its own. A trained staff, stable economic conditions, and other elements are also crucial for building a climate that encourages long-term investment and growth.

In conclusion, a diverse investment portfolio can play a significant role in spurring economic growth in India by spreading risk, encouraging investment in developing markets, and luring international capital. In order to create a setting that supports long-term economic growth, other conditions are equally crucial.

3.6 ARIMA MODEL:

An autoregressive integrated moving average, or ARIMA, is a statistical analysis model that uses time series data to either better understand the data set or to predict future trends. A statistical model is autoregressive if it predicts future values based on past values. For example, an ARIMA model might seek to predict a stock's future prices based on its past performance or forecast a company's earnings based on past periods. An autoregressive integrated moving average model is a form of regression analysis that gauges the strength of one dependent variable relative to other changing variables. The model's goal is to predict future securities or financial market moves by examining the differences between values in the series instead of through actual values.

Autoregression (AR): A model in which a changing measure regresses on its own lag, or prior, values Integrated (I): denotes the differencing of raw data in order for the time series to become stationary. (i.e., data values are replaced by the difference between the data values and the previous values).

Moving average (MA): Moving Average includes the dependency between an observation and a residual error from a lagged moving average model.

Autoregressive integrated moving average (ARIMA) algorithms forecast future values using historical data. ARIMA smooths time series data using delayed moving averages. They are frequently employed in technical analysis to predict future security prices Autoregressive models make the implied assumption that the future will be similar to the past. As a result, under certain market circumstances, such as financial crises or times of rapid technological change, they may prove inaccurate.

Given below is the regression model of the form:

$$Y = b_0 + b_1X_1 + b_2X_2 + \dots + b_pX_p + e \quad \text{----- 1}$$

Where,

- Y- forecast variable
- X1 through Xp = the explanatory variable
- b0 through bp = the linear regression coefficients
- e = the error term

3.7 AUTOREGRESSIVE (AR) MODEL:

Suppose, that these variables are defined as $X_1 = Y_{t-1}, X_2 = Y_{t-2}, \dots, X_p = Y_{t-p}$, then it becomes

$$Y_t = b_0 + b_1Y_{t-1} + b_2Y_{t-2} + \dots + b_pY_{t-p} + e_t \quad \text{----- 2}$$

Equation 2 is a regression model equation but the explanatory variables in the right-hand side as different from equation 1. In equation 2 the explanatory variables are simply time lagged values of the forecast variable and therefore it is called autoregressive (AR). An autoregressive model of order one is:

$$Y_t = e + \phi_1 Y_{t-1} + e_t$$

The above equation shows the basic form of an AR 1 model. Observation Y_t depends on Y_{t-1} . The value of the autoregressive coefficient ϕ_1 is restricted to lie between -1 and +1. The time plot of an AR 1 model varies with the parameter ϕ_1 . For example, When $\phi_1 = 0$, Y_t is equivalent to a white noise series.

When $\phi_1 = 1$, Y_t is equivalent to a random walk series.

Higher Order Autoregressive Model:

In general, a p^{th} AR model is defined as follows :

$$Y_t = C + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \dots + \phi_p Y_{t-p} + e_t \quad \text{-----AR(P)}$$

Where ,

- C = Constant term
- ϕ_p = p^{th} autoregressive parameter

e_t = the error term at time t

These are specific restrictions on the allowable values of the autoregressive parameters

For $p=1$, $-1 < \phi_1 < 1$

For $p=2$, the following three conditions must be met :

- $-1 < \phi_2 < 1$
- $\phi_2 + \phi_1 < 1$
- $\phi_2 - \phi_1 < 1$

And more complicated condition holds for $p \geq 3$.

3.8 MOVING AVERAGE (MA) MODEL:

$$Y_t = b_0 + b_1 e_{t-1} + b_2 e_{t-2} + \dots + b_q e_{t-q} + e_t \quad \text{-----1}$$

The above equation is a time series model which use past error or explanatory variables. It explicitly shows, a dependence relationship is set up among the successive error term and the equation is called moving average model . the above model is called a moving average because it is defined as a moving average of the error series (e_t). A Moving average model of order one is shown as:

$$Y_t = e + e_t - \phi_1 e_{t-1} \quad \text{----- 2}$$

Equation 2 gives an MA (1) model or ARIMA (0,0,1) to be general observation Y_t depends on the error term e_t and also the previous error term e_{t-1} , with coefficient $-\phi_1$. The value of the coefficients ϕ_1 is restricted to be between -1 and +1

Higher order moving average models:

The general MA model of order q can be written as follows:

$$Y_t = e + e_t - \phi_1 e_{t-1} - \phi_2 e_{t-2} - \dots - \phi_q e_{t-q}$$

Where ,

C = Constant term

ϕ_q = qth moving average parameter

e_{t-q} = the error term at time t-q

(In short , a moving average process is simply linear combination of white noise)

These are specific restrictions required for MA models which is the same restrictions that are required for AR models.

For $q=1$:

$$-1 < \phi_1 < 1$$

For $q=2$, the following three conditions must be met.

- $-1 < \phi_2 < 1$
- $\phi_2 + \phi_1 < 1$
- $\phi_2 - \phi_1 < 1$

More complicated conditions will prevail for $q \geq 3$.

Table 3.1: The ACF and PACF patterns for pure AR and pure MA Models

	ACF	PACF
AR (1)	Exponential decay on positive side if $\phi_1 > 0$ and alternating in sign starting on negative side if $\phi_1 < 0$	Spike at lag 1, then cuts off to zero spike positive if $\phi_1 > 0$, negative if $\phi_1 < 0$
AR (P)	Exponential decay on damped sine-wave. the exact pattern depends on the signs and sizes of ϕ_1, \dots, ϕ_p	Spikes at lags 1 to p, then cuts off to zero.

MA (1)	Spike at lag 1 then cuts off to zero spike positive if $\phi < 0$, negative if $\phi > 0$	Exponential delay on negative side if $\phi > 0$ and alternating in sign starting on positive side if $\phi < 0$.
MA (q)	Spikes at lags 1 to q, then cuts off to zero.	Exponential delay or damped sine wave. The exact pattern depends on the signs and sizes of ϕ_1, \dots, ϕ_q

3.9 ARIMA MODELS :

Autoregressive (AR) models can be effectively coupled with moving average (MA) models to form a general and useful class of time series model called Autoregressive Integrated Moving Average (ARIMA) models . it can be only used when the data are stationary

$$Y_t = \phi_1 Y_{t-1} + e_t - \phi_1 e_{t-1}$$

The above equation combines a first order AR model and first order MA model. this is called ARMA (1,1) OR ARIMA (1,0,1) model. here, Y_t depends on one previous Y_{t-1} value and one previous error term e_{t-1} . The series is assumed stationary in the mean and variance . An ARMA model with higher order term is written as:

$$Y_t = \phi_1 Y_{t-1} + \dots + \phi_p Y_{t-p} + e_t - \theta_1 e_{t-1} - \dots - \theta_q e_{t-q} \quad \text{-----ARMA (p,q) or ARIMA (p,0,q)}$$

The same parameter restrictions apply as for pure AR and pure MA models:

Pure AR

- For $p=1, -1 < \phi_1 < 1$
- $p=2, -1 < \phi_2 < 1$
- $\phi_2 + \phi_1 < 1$
- $\phi_2 - \phi_1 < 1$

$p=3$, More complicated condition.

Pure MA

- For $q=1, -1 < \theta_1 < 1$
- $q=2, \theta_2 + \theta_1 < 1$
- $-1 < \theta_2 < 1$
- $\theta_2 - \theta_1 < 1$

$q=3$, More complicated condition.

3.10 BOX JENKINS (BJ) METHODOLOGY (ARIMA APPROACH):

There are four phases of the box Jenkins ARIMA approach. They are as follows:

Identification: Using plots of the data, autocorrelation, partial correlation and other information, a class of simple ARIMA model is selected . The main objective of the model identification step is to determine what is the order of MA, AR and the difference that should be taken into account. (i.e) Identify the p,d,q .

- ❖ Due to a variety of ARIMA models, it can be difficult to decide which model is most appropriate for a given set of data. The following steps solves the above problem.
 - Plot the data. Identify any unusual observations decide if a transformation is necessary to stabilize the variance. If necessary, transform the data to achieve stationarity in the variance.
 - Consider if the possibility transformed data appear stationary from the time plot and the ACF and PACF.
- ❖ If the time plot shows the data scattered horizontally around a constant mean or equality, the ACF and PACF drop to near zero quickly, it indicates that the data are stationary.
- ❖ When the data appear non stationary, they can be made stationary by differencing. For non-seasonal data take the first differences of the data. For seasonal data, take seasonal differences of the data. Check if they appear stationary, if they are still non stationary, take the first differences of the differenced data.
- ❖ When stationarity is achieved, examine the autocorrelation and partial autocorrelation function to see if any pattern remains and to determine which model would be good starting point.

Estimation:

Having made a tentative model identification the AR, the MA parameters are seasonal and non-seasonal, have to be determined in the best possible manner

For example:

$$(1-b)Y_t = (1-\phi_1 b)e_t$$

This is a family of models depending on one MA coefficients ϕ_1 , we want the best estimate of ϕ_1 to fit the time series that is being modelled. The method of least squares can be used for ARIMA models just as with regression, however for models involving MA

model there is no simple formula and thereby a preliminary estimate is chosen and a computer programme refines the estimate until the sum of squared error is minimized. Another method that is frequently used is maximum likelihood. The likelihood of a set of data is denoted by L and is proportional to the probability of obtaining the data given in the model. The method of maximum likelihood finds the value of the parameters which maximize the likelihood L . Maximum likelihood estimation is usually desired by statisticians because it has some desirable statistical property.

Computer programs for fitting ARIMA models will automatically find appropriate initial estimates of the parameter and then successively refine them until the optimum values of the parameters are found using either the least squares or maximum likelihood criterion. Akaike's information criteria (AIC) is an estimation of the quality of statistical model of given set. It is the most common penalized likelihood procedure. Given a collection of models for the data, AIC the quality of each model, relative to each of the other models. Thus, AIC provides a means for model data. An AIC estimates the relative information lost by given model. The lesser the information a model loses the higher the quality of the model. Suppose that we have a statistical model of some data, Let K be the number of estimated parameters in the model. Let L be the maximum value of the likelihood function for the model, the AIC value of the model is,

$$AIC = 2K - 2\ln(L^{\wedge})$$

Diagnostic Checking:

Diagnostic checking is done by studying the residual to see if any pattern remains unaccounted for. For a good forecasting model, the residuals left over after fitting the model should be simply white noise. If the portmanteau test had been significant, then the model would have been inadequate and one need to go back and consider other ARIMA model. The pattern of significant spikes in the ACF and PACF of the residuals may suggest how the model can be improved.

For example:

- Significant spikes at the seasonal lags suggest adding a seasonal component to the chosen model.
- Significant spikes at small lags suggest increasing the non-seasonal AR and MA components of the model.

Forecasting:

- A Forecast of the time series is generated using the ARIMA model.
- After choosing a model and checking its fit and forecasting ability one can use the model to forecast over a future time horizon

In many cases the forecasts obtained by this method are more suitable than those obtains from the traditional econometric modelling, particularly for short term forecast.

Data Methodology:

This study involves secondary data which are collected from various sources like world gold council, Reserve bank of India, Research papers and journals etc.

Table 3.2: Data View

Variables	Acronyms	Years	Units	Data source	No of years
Gold price	Gold price	1964-2023	Rs	Reserve bank of India	59
Stocks USA	Stocks	2013-2020	Percentage	Federal reserve	8
Real estate USA	Real estate	2013-2013	Percentage	Federal reserve	8
Retirement accounts USA	RA	2013-2020	Percentage	Federal reserve	8
Fixed investment securities	FIS	2013-2020	Percentage	Federal reserve	8
Cash equivalence	Cash EQ	2013-2020	Percentage	Federal reserve	8
Bank deposits (India)	Bank deposits	2013-2020	Percentage	Reserve bank of India	8
Gold (India)	Gold	2013-2020	Percentage	Reserve bank of India	8
Life insurance corporation (India)	LIC	2013-2020	Percentage	Reserve bank of India	8
Provident fund (India)	PF	2013-2020	Percentage	Reserve bank of India	8
Mutual funds (India)	MF	2013-2020	Percentage	Reserve bank of India	8
Forecasted gold price	Goldpricef	2024-2044	Rs	ARIMA MODEL	20

Table 3.3: VARIABLE NAMING

RA	Retirement account
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FIS	Fixed investment securities
Cash EQ	Cash Equivalence
LIC	Life insurance corporation
PF	Provident fund
MF	Mutual funds
Goldpricef	Forecasted gold price
ARIMA	Autoregressive integrated moving average
ACF	Auto Correlation Function
PACF	Partial Auto Correlation Function
AR	Auto Regressive
MA	Moving Average

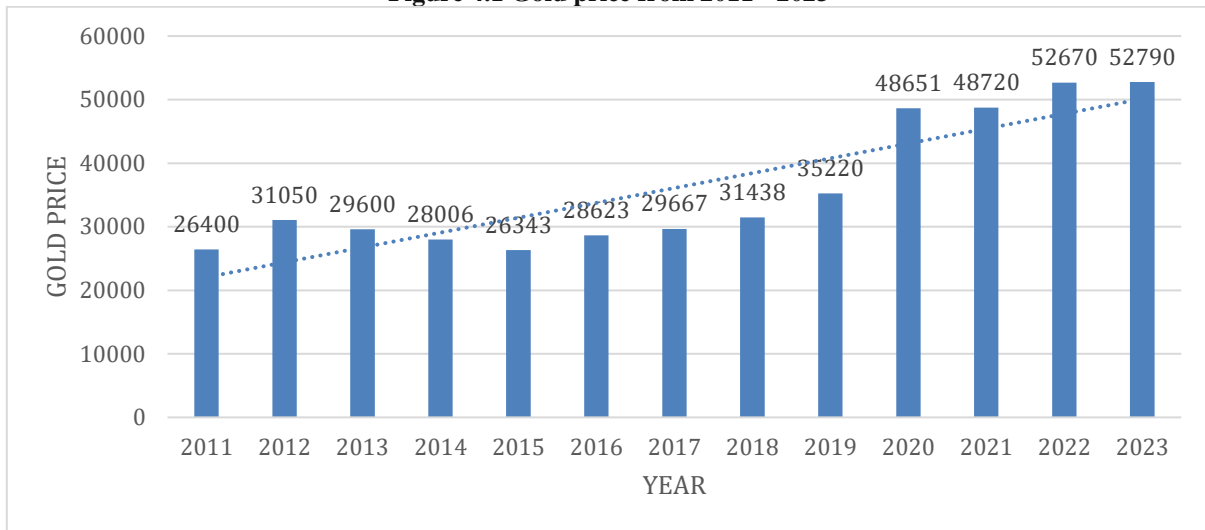
CHAPTER 4 **DATA ANALYSIS**

In this section, we will be analysing the trend in gold prices since 1964, as how it increased over the six decades, is it increased gradually or rapidly and analyse the fluctuations in the gold prices from 1964 to 2023. In this section it is discussed how the investment portfolio varies for developed and developing countries. And this section includes the prediction or forecasting the gold prices using ARIMA model (Autoregressive Integrated Moving Average) an econometric model since 2024 to 2044.

Gold prices since 1964 - 2023

From the table 4.1 it shows the historical data of gold prices from 1964 to 2023. The price of gold in 1964 was ₹63 it gradually increased till 1967, in the year 1968 the gold price took a hike of ₹60 suddenly, that was the first rapid increase in the gold price. And after 5 years there was a huge increase in the gold price in the year 1973 of ₹506. In 1973, India, along with many other countries around the world, experienced a significant increase in the price of gold. The United States had just come off the gold standard in 1971, which caused the value of the US dollar to decline. This led to a general increase in the price of gold around the world. Inflation was also a major factor in the increase in the price of gold in India in 1973. From then the gold prices started to increase rapidly, every year prices started to rise. Only in the year 1982 there was a drop in gold price of ₹155. In 1982, the gold price dropped in India due to a combination of factors such as government policies, global economic conditions, and changes in demand and supply. Prior to this, gold imports were restricted, and the government had a monopoly on gold imports. Another factor was the global economic situation at the time, as there was a recession in many countries, which reduced the demand for gold as an investment option. In the year 1991 the gold price was ₹3466 and in the year 1992 the price increased to ₹4334 literally the hike was ₹863. Then the rise was gradual from 1993 to 2004. There was rapid rise in the gold prices since 2005. In the year 2010-2011 there was a substantial increase of ₹7900 in the gold price. And in the year 2013 there was a sudden decline in the gold price from ₹31,050 to ₹29,600 and in the following three consequent years the gold prices were declining. After 2015 the gold prices started to increase from the year 2016. In the year 2019-2020 the gold price was aggravated to the extent of increase of ₹13,431. There were several factors that contributed to the increase in gold prices in India in 2019. The global economic uncertainty and the trade war between the US and China led to investors seeking out safe-haven assets such as gold, which led to an increase in demand and prices. The Indian Rupee depreciated against the US Dollar, which made gold imports more expensive, leading to a rise in gold prices in India. The Indian government increased the import duty on gold from 10percent to 12.5percent, which made gold more expensive for consumers, leading to a rise in prices. It was a huge hike in the gold price history of India. In 2019 the gold price was ₹35220 and in 2020 the gold price was ₹48651. After that there was no chance of decrease in gold price. At present in the year 2023 the price of gold is ₹52,790. Therefore, it clearly examines the historical evolution of gold prices and the dynamic change in the gold prices were very high since 1964-2023, Refer to the table 4.1 in the Annexure.

Figure 4.1 Gold price from 2011 - 2023

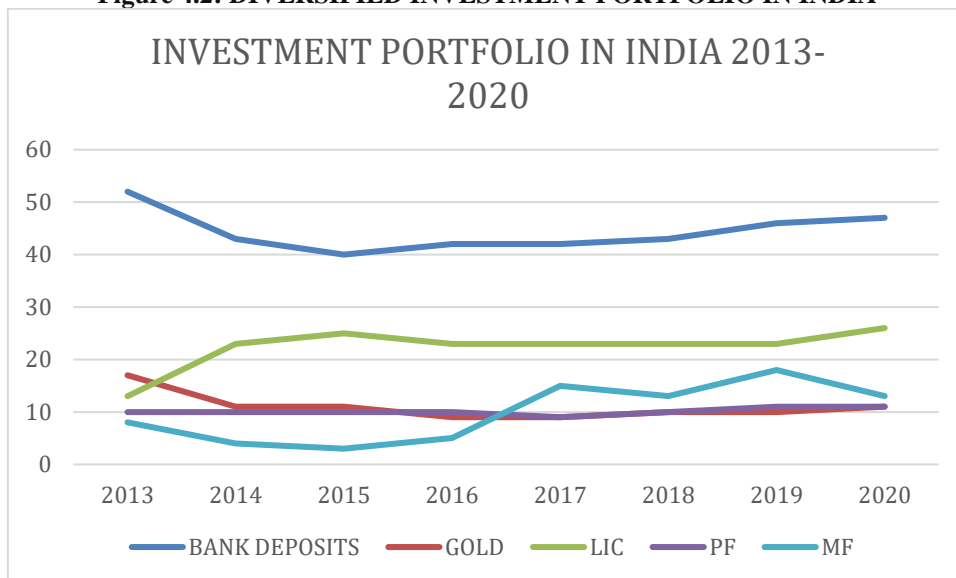


Source: Computed from Secondary data

Graph 1: Rapid Increase in the Gold Price 2011-2023

Gold price trends in India since 2011 to 2023 have been influenced by a variety of factors including global economic conditions, geopolitical tensions, and domestic factors such as inflation and currency movements. Here's an overview of the gold price trend in India during this period. From 2011 to 2013, the gold price in India increased, with prices hitting an all-time high of around Rs. 34,000 per 10 grams in September 2013. This was primarily due to the weakening of the Indian rupee and worldwide economic uncertainty. Between 2014 and 2015, the gold price in India fell as the Indian government put restrictions on gold imports to control the current account deficit. During this time, the price stabilised around Rs. 25,000 per 10 grams. From 2016 to 2018, the gold price in India began to recover, with prices gradually rising to around Rs. 32,000 per 10 grams in mid-2018. This was primarily due to worldwide economic uncertainty and the weakening of the Indian rupee. The Indian Rupee depreciated against the US Dollar, which made gold imports more expensive, leading to a rise in gold prices in India. The Indian government increased the import duty on gold from 10percent to 12.5percent, which made gold more expensive for consumers, leading to a rise in prices. In 2019 the gold price was ₹35220 and in 2020 the gold price was ₹48651. After that there was no chance of decrease in gold price. At present in the year 2023 the price of gold is ₹52790.

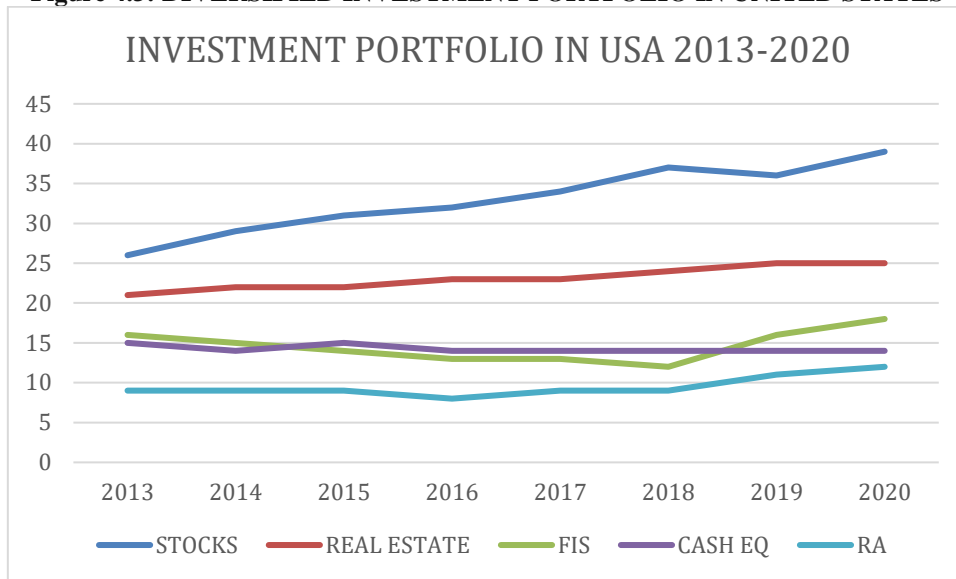
Figure 4.2: DIVERSIFIED INVESTMENT PORTFOLIO IN INDIA



Source: Reserve Bank of India

Bank deposits are regarded as low-risk investments. So more population is involved in bank deposits. Then investing in gold plays a major role in diversified investment. While stockpiling gold does not yields more returns but people prefer to invest in gold because they consider gold as a safe investment. Other options like LIC, PF, MF have a subsequent diversification of investment in India.

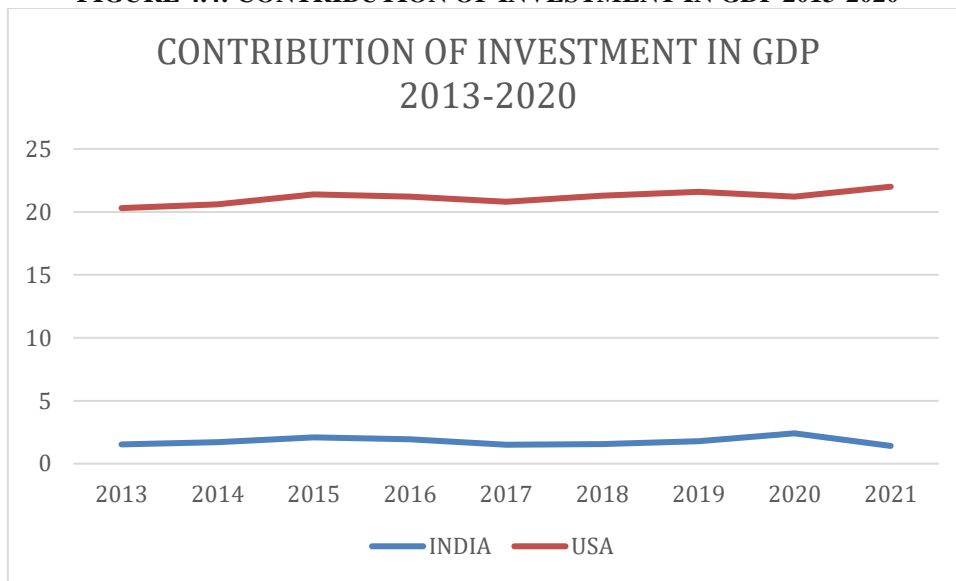
Figure 4.3: DIVERSIFIED INVESTMENT PORTFOLIO IN UNITED STATES



Source: Federal Reserve

When compared to India , the investment diversification portfolio in USA mostly concentrates on stocks with and real estate. In USA all the investments are with respect to returns and interest , they are more concentrated on earning profits with diversified investment portfolio which yields returns in the long run .

FIGURE 4.4: CONTRIBUTION OF INVESTMENT IN GDP 2013-2020



Source: World bank

By comparing the two countries investment portfolio , It is clear that USA concentrates more on return yielding investments such as bonds ,stocks, etc. But whereas in India Gold is given much importance as other investments , as investing in gold contributes to stockpiling as it does not yield more returns in the long run. Investment is a substantial component of Gross Domestic Product (GDP) and is critical to generating the US economic growth. Investment also generates job opportunities, which leads to higher consumer spending and additional economic growth. Furthermore, when organisations invest in R&D, they create new products and technology that can fuel innovation and economic growth.

Overall, investment is a significant driver of economic growth and a critical component in determining the level of GDP in the United States. A high amount of investment is necessary for a strong and developing economy .So therefore if India also adapts diversified investment portfolio patterns like USA , India can renew a path in growth and development .

By predicting the gold prices it will be helpful by giving awareness for the investors to switch over to other investment alternatives , If this is the situation in future then India’s GDP will increase and India will enter into a new phase of “DEVELOPED ECONOMY”.

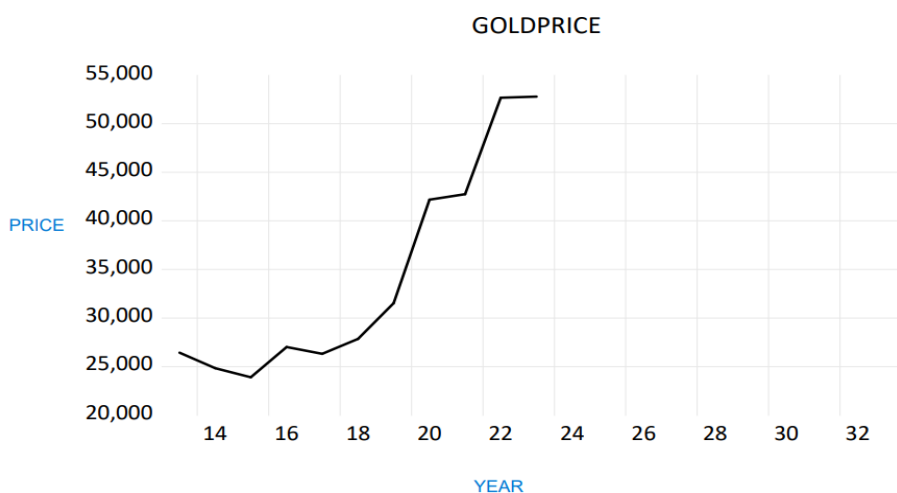
Table 4.2 Data used for ARIMA model

GOLDPRICE	
2013	26440.2
2014	24835.1
2015	23903.2
2016	27013.5
2017	26319.7
2018	27861.3
2019	31542.5
2020	42181.7
2021	42750.1
2022	52670
2023	52790
2024	NA
2025	NA
2026	NA
2027	NA
2028	NA
2029	NA
2030	NA
2031	NA
2032	NA
2033	NA

SOURCE: Computed from secondary data

The above data is the raw data set of gold prices since 2013 -2023 .The data is not available from the year 2024,that is the period where the prices are to be predicted or forecasted using (ARIMA) model Autoregressive Integrated Moving Average is a popular time series forecasting model used to forecast future values based on past data. It is a powerful model that combines autoregressive (AR) and moving average (MA) models with differencing to handle non-stationary data. The model is widely used in forecasting applications, such as sales forecasting, demand forecasting, and stock price forecasting.

Figure 4.5 Representation of the data – trend line



Source: Computed from secondary data

The first procedure that will be used in this study to determine that the time series is stationary or not is graphical analysis. If the graph of the data exhibits a certain trend, then the data is non stationary. As seen in Figure, there is an upward trend observed from the time series data This above graph depicts the graphical representation of the data in the year 2010-2011 there was a substantial increase of ₹7900 in the gold price. And in the year 2013 there was a sudden decline in the gold price from ₹31,050 to ₹29,600 and After 2015 the gold prices started to increase from the year 2016. In the year 2019-2020 the gold price was aggravated to the extent of increase of ₹13,431. So the data is available till 2023.From 2024 the prices are to be predicted or forecasted.

Table 4.3 Correlogram representation – level

Correlogram of GOLDPRICE

Date: 03/02/23 Time: 20:30		Sample (adjusted): 2013 2023		Included observations: 11 after adjustments			
Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob		
		1	0.740	0.740	7.8358	0.005	
		2	0.429	-0.263	10.761	0.005	
		3	0.161	-0.109	11.223	0.011	
		4	-0.113	-0.263	11.486	0.022	
		5	-0.268	0.008	13.199	0.022	
		6	-0.342	-0.104	16.534	0.011	
		7	-0.379	-0.113	21.671	0.003	
		8	-0.351	-0.064	27.531	0.001	
		9	-0.259	0.011	32.343	0.000	
		10	-0.118	0.065	34.339	0.000	

Source: Computed from secondary data

In table 3, the first column is a graphic representation of ACF statistics. Here it can be seen that even up to 2 LAGs correlation coefficient is high, about 0.429. Not only that, correlation coefficients decline slowly. This is in strong contrast to the white noise time series. Moreover, all correlation coefficient is significant at 95percent as they do not lie above of the interval 0.05. So, it can be concluded that GOLD prices are non -stationary

Table 4.4 Unit root – Level

Augmented Dickey-Fuller Unit Root Test on GOLDPRICE

Null Hypothesis: GOLDPRICE has a unit root Exogenous: Constant, Linear Trend Lag Length: 1 (Automatic - based on SIC, maxlag=1)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-1.357463	0.7997
Test critical values:	1% level		-5.521860	
	5% level		-4.107833	
	10% level		-3.515047	
*MacKinnon (1996) one-sided p-values. Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 9				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(GOLDPRICE) Method: Least Squares Date: 03/02/23 Time: 20:29 Sample (adjusted): 2015 2023 Included observations: 9 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
GOLDPRICE(-1)	-0.423183	0.311746	-1.357463	0.2327
D(GOLDPRICE(-1))	-0.599453	0.396108	-1.513357	0.1906
C	2482.626	5665.107	0.438231	0.6795
@TREND("2013")	2738.876	1023.563	2.675824	0.0440
R-squared	0.663162	Mean dependent var		3106.100
Adjusted R-squared	0.461060	S.D. dependent var		4359.692
S.E. of regression	3200.560	Akaike info criterion		19.28114
Sum squared resid	51217930	Schwarz criterion		19.36880
Log likelihood	-82.76514	Hannan-Quinn criter.		19.09198
F-statistic	3.281317	Durbin-Watson stat		1.876057
Prob(F-statistic)	0.116774			

Source: Computed from secondary data

The ADF statistics is estimated table value is less than even the 10percent critical t value and computed p value is 0.438 which is higher than 0.05 and insignificant. So, the null hypothesis of unit root is accepted and the series is non stationary.

Table 4.5 Correlogram representation – 1st difference

Correlogram of D(GOLDPRICE)

Date: 03/02/23 Time: 19:04 Sample (adjusted): 2014 2023 Included observations: 10 after adjustments						
Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob	
		1	-0.156	-0.156	0.3255	0.568
		2	0.308	0.291	1.7524	0.416
		3	-0.078	0.002	1.8569	0.603
		4	-0.010	-0.122	1.8591	0.762
		5	-0.295	-0.325	3.9438	0.558
		6	-0.095	-0.166	4.2121	0.648
		7	-0.108	0.046	4.6805	0.699
		8	-0.129	-0.080	5.6755	0.684
		9	0.063	0.010	6.1466	0.725

Source: Computed from secondary data

From the above Figure, we can conclude that the series become stationary after generation the new series by taking the logarithm of the original series and after that differentiating the new generated series at level 1. But from above graph we cannot clearly conclude the stationarity of the series as this is the informal way of checking the stationarity of the series.

Table 4.6 Unit root – 1st difference

Augmented Dickey-Fuller Unit Root Test on D(GOLDPRICE)

Null Hypothesis: D(GOLDPRICE) has a unit root Exogenous: Constant, Linear Trend Lag Length: 0 (Automatic - based on SIC, maxlag=1)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-4.936830	0.0191
Test critical values:	1% level		-5.521860	
	5% level		-4.107833	
	10% level		-3.515047	
*MacKinnon (1996) one-sided p-values. Warning: Probabilities and critical values calculated for 20 observations and may not be accurate for a sample size of 9				
Augmented Dickey-Fuller Test Equation Dependent Variable: D(GOLDPRICE,2) Method: Least Squares Date: 03/02/23 Time: 20:29 Sample (adjusted): 2015 2023 Included observations: 9 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GOLDPRICE(-1))	-1.849268	0.374586	-4.936830	0.0026
C	-3992.351	3263.956	-1.223163	0.2671
@TREND("2013")	1595.596	621.1867	2.568625	0.0424
R-squared	0.812499	Mean dependent var		191.6778
Adjusted R-squared	0.749998	S.D. dependent var		6835.855
S.E. of regression	3417.939	Akaike info criterion		19.37266
Sum squared resid	70093851	Schwarz criterion		19.43841
Log likelihood	-84.17699	Hannan-Quinn criter.		19.23079
F-statistic	12.99989	Durbin-Watson stat		1.753499
Prob(F-statistic)	0.006592			

The result in Figure is calculated on the new series generated by taking the logarithm of the original series and differentiating the new series at level 1. Since the absolute value of ADF test statistics p- value is 0.0191 which is less than 0.05 so we can reject the null hypothesis i.e. the series has unit root. It means that the gold price series has no unit root and hence the series is now stationary and is predictable

**Table 4.7 AR(1) MA(1) and AR(1) MA(3) model
(AR1 MA1) MODEL**

Dependent Variable: D(GOLDPRICE)				
Method: ARMA Maximum Likelihood (OPG - BHHH)				
Date: 03/02/23 Time: 20:40				
Sample: 2014 2023				
Included observations: 10				
Convergence achieved after 31 iterations				
Coefficient covariance computed using outer product of gradients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2736.638	2323.211	1.177955	0.2834
AR(1)	-0.877262	3.133027	-0.280005	0.7889
MA(1)	0.696506	3.943482	0.176622	0.8656
SIGMASQ	15071969	12347406	1.220659	0.2680
R-squared	0.123881	Mean dependent var		2634.980
Adjusted R-squared	-0.314178	S.D. dependent var		4372.021
S.E. of regression	5011.981	Akaike info criterion		20.19054
Sum squared resid	1.51E+08	Schwarz criterion		20.31157
Log likelihood	-96.95268	Hannan-Quinn criter.		20.05776
F-statistic	0.282796	Durbin-Watson stat		1.646455
Prob(F-statistic)	0.836343			
Inverted AR Roots	-.88			
Inverted MA Roots	-.70			

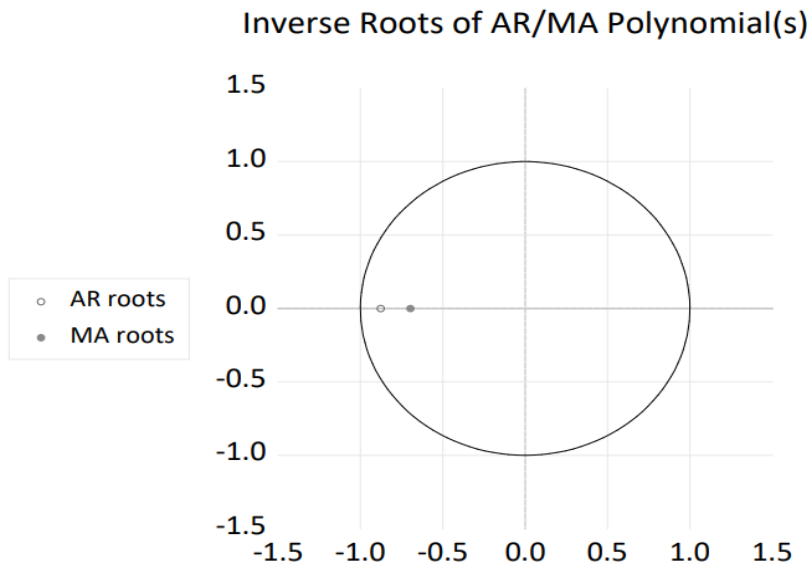
(AR1 MA3) MODEL

Dependent Variable: D(GOLDPRICE)				
Method: ARMA Maximum Likelihood (OPG - BHHH)				
Date: 03/02/23 Time: 20:41				
Sample: 2014 2023				
Included observations: 10				
Convergence achieved after 27 iterations				
Coefficient covariance computed using outer product of gradients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2770.883	2180.492	1.270761	0.2509
AR(1)	-0.128702	0.763379	-0.168596	0.8717
MA(3)	-0.162750	0.683099	-0.238253	0.8196
SIGMASQ	16421267	13920521	1.179645	0.2828
R-squared	0.045448	Mean dependent var		2634.980
Adjusted R-squared	-0.431828	S.D. dependent var		4372.021
S.E. of regression	5231.518	Akaike info criterion		20.26176
Sum squared resid	1.64E+08	Schwarz criterion		20.38279
Log likelihood	-97.30879	Hannan-Quinn criter.		20.12898
F-statistic	0.095224	Durbin-Watson stat		1.818738
Prob(F-statistic)	0.959886			
Inverted AR Roots	-.13			
Inverted MA Roots	.55	-.27+.47i	-.27-.47i	

Next step is to estimate the appropriate or potential model (i.e.) (AR1 MA)1 or (AR1 MA3). By resulting the coefficients are assessed, the result should showcase significant ARMA parameters, Here the two different models are compared on the basis of the Akaike information criterion, Schwarz criterion, and Hannan-Quinn criterion. The potential model should satisfy the volatility that attains the minimum by comparing the models. By analysing the two models (AR1 MA1) model is seen to be potential because the values of SIGMA, Akaike information criterion, Schwarz criterion, and Hannan-Quinn criterion are minimum when compared to (AR1 MA3).

	AR1 MA1		AR1MA3
• SIGMA	- 0.2680	<	0.2828
• AIC	- 20.19054	<	20.26176
• SC	- 20.31157	<	20.38279
• HQC	- 20.05776	<	20.12898

Table 4.8 Arima roots



As we have all the AR/MA roots inside the unit root circle, we can say that the ARIMA model (1,1,1) is appropriate to forecast the future gold prices in India.

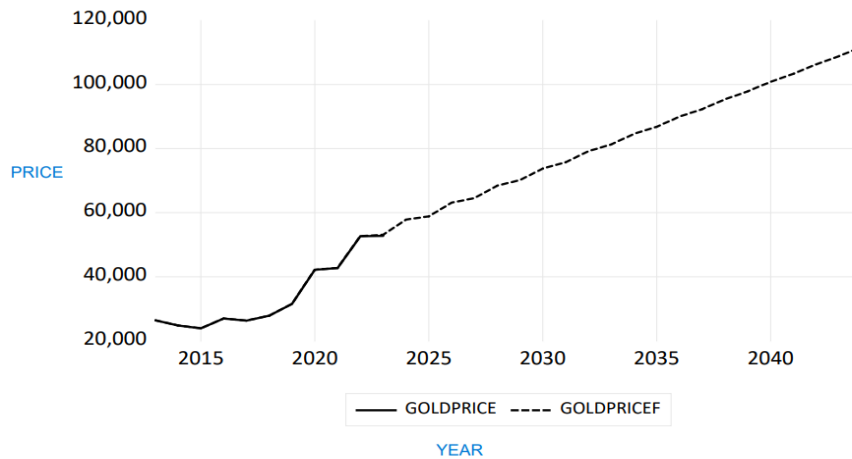
**Table 4.9 Forecasted prices 2024- 2044
FORECASTED PRICES 2024-2044**

	GOLDPRICE	GOLDPRICEF
2013	26440.2	26440.20
2014	24835.1	24835.10
2015	23903.2	23903.20
2016	27013.5	27013.50
2017	26319.7	26319.70
2018	27861.3	27861.30
2019	31542.5	31542.50
2020	42181.7	42181.70
2021	42750.1	42750.10
2022	52670	52670.00
2023	52790	53113.96
2024	NA	57861.88
2025	NA	58834.09
2026	NA	63118.59
2027	NA	64497.35
2028	NA	68425.20
2029	NA	70116.83
2030	NA	73770.21
2031	NA	75702.63
2032	NA	79144.78
2033	NA	81262.50
2034	NA	84542.09
2035	NA	86802.41
2036	NA	89956.90
2037	NA	92326.97
2038	NA	95385.19
2039	NA	97839.72
2040	NA	100823.8
2041	NA	103343.4
2042	NA	106270.5
2043	NA	108840.0
2044	NA	111723.2

The above figure is the result generated by using ARIMA model – Econometric model it shows the predicted gold price since 2024-2044. By analysing the predicted gold price, it tends to have a very aggressive increase in the future or in the coming years, there

may be several reasons. When the economy is uncertain, investors seek safe-haven investments such as gold. If global economies remain in turmoil or decline, demand for gold as a store of value may rise, causing its price to rise. Historically, gold has been regarded as an inflation safeguard. If inflation rates increase, the value of paper currency may fall, and investors may turn to gold to protect their wealth, driving up gold prices. Political unrest and conflict can also contribute to an increase in gold demand. If tensions between nations or regions rise, investors may seek refuge in gold, driving up its price. Finally, the price of gold, like any product, is determined by supply and demand. If the desire for gold exceeds the available supply, the price of gold may rise. Alternatively, if supply grows quicker than demand, gold's price may fall. By prediction of 20 years, in the year 2044 the price of gold will be ₹111723. In the year 1964 the price was ₹63/10grams and in the year 2044 it will be ₹111723/10 grams. Therefore, it is a huge historic transformation.

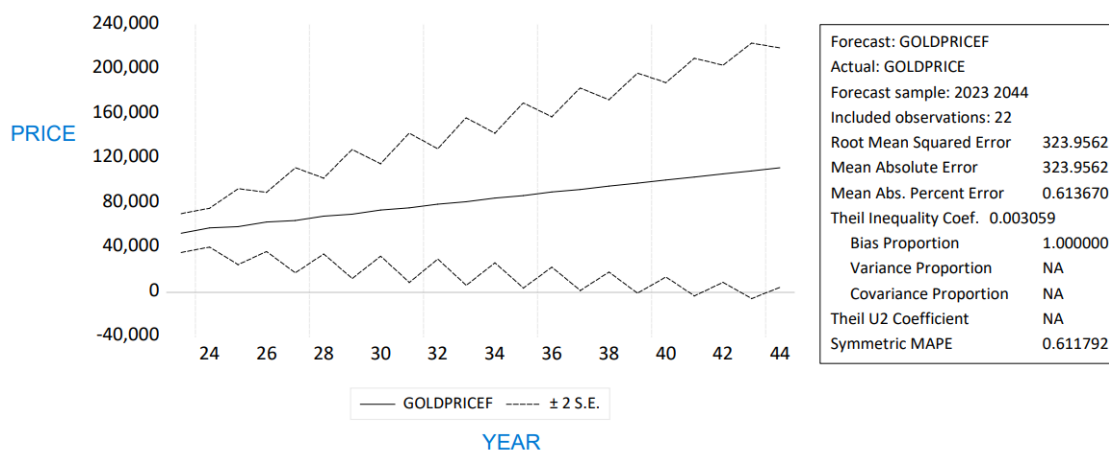
Figure 4.6 Graphical representation of the forecasted prices



Source: Computed from secondary data
 Graph: Representation of The Forecasted Prices

The above graph is the graphical representation of the predicted gold price from 2024-2044. The black trend line represents the gold price range from 2013 to 2023. And the black dotted line represents the predicted gold price range from 2024-2044.

Figure 4.7 Trend line of the predicted data 2024 - 2044



The GOLDPRICEF is the predicted gold price trend line ranging from the year 2024-2044. It includes the root mean squared error is 323.9562 and the mean absolute error is 323.9562 then it shows the mean absolute percent error is 0.6136 .

CHAPTER 5
FINDINGS, SUGGESTIONS, AND CONCLUSIONS

5.1 FINDINGS

- Gold prices in India have shown a consistent upward trend over the past few decades. In 1964, the price of gold per 10 grams was around Rs. 63. As of March 25, 2023, the price of gold per 10 grams is around Rs. 47,150.
- The price of gold in India is influenced by various factors such as global economic conditions, geopolitical events, demand and supply dynamics, inflation, and currency fluctuations.
- Over the years, there have been several examples of sharp fluctuations in gold prices in India. In the early 1990s, for example, the Indian government was forced to pledge its gold reserves to the International Monetary Fund (IMF) in order to obtain foreign currency. This led in a short-term decline in gold prices.
- The COVID-19 pandemic has affected the price of gold in India in recent years, causing a surge in demand for safe-haven assets such as gold.
- By comparing the two countries investment portfolio, it is clear that USA concentrates more on return yielding investments such as bonds, stocks, etc. But whereas in India Gold is given much importance as other investments, as investing in gold contributes to stockpiling as it does not yield more returns in the long run.
- By diversified investment portfolio in other developed countries like USA, India also can attain a new growth path by diversification.
- In ARIMA model first the graphical method is used, then correlogram was used to find whether the series was stationary or not. But we cannot clearly conclude the stationarity of the series as this is the informal way of checking the stationarity of the series. Yet we found that the series also shown stationarity only after calculating the first difference of gold price series.
- There was a straight trend observed from the time series data of the yearly average 1st difference Gold Prices in India starting from 2013 to 2023 which meant that the series of gold price got stationary after first difference.
- Since, after finding correlogram we use absolute value of ADF test statistics for which p-value was 0.0191 which is less than 0.05 so we can reject the null hypothesis i.e., the series has unit root. It means that the gold price series has no unit root and hence the series is now stationary and is predictable after the first difference of the series.
- After testing the selected ARIMA model, the AR/MA roots were inside the unit root circle, so we were able to say that the ARIMA model (1,1,1) was appropriate to forecast the future gold prices in India.
- After that our ARIMA was found, we at last concluded that the prices are likely to increase in 2024 and later than from 2024 to 2044 the prices are to increase rapidly till ₹111723.

5.2 SUGGESTIONS AND CONCLUSION

Historically, the price of gold in India has been influenced by a variety of variables including foreign market trends, currency fluctuations, geopolitical events, and domestic demand. The COVID-19 pandemic and its effect on the global economy have also played a major role in shaping trends in recent years. Gold prices in India have fluctuated significantly over the last decade, with both upward and downward patterns. However, the long-term tendency has been upward, with the price of gold steadily increasing over the years. Gold has traditionally been regarded as a safe haven asset and a hedge against inflation, making it a popular investment choice among many Indians. However, before investing in gold, as with any other investment, it is critical to thoroughly consider the risks and potential returns. By using the ARIMA model the gold price have been predicted for the next 20 years so the prices are likely to increase in 2024 and later than from 2024 to 2044 the prices are to increase rapidly till ₹111723.

People should change their mindset of only investing in gold. They should tend more of other investments which yields higher returns in the long run. Though gold is regarded as a secure investment choice there are more other investment options to invest that helps in individual growth as well as country's growth. Investment choices are highly personal and are influenced by a variety of factors such as financial objectives, risk tolerance, investment horizon, and market conditions. While gold has historically been a common investment option in India for cultural and historical reasons, it may not always be the best option for everyone.

Diversification: A well-diversified investment portfolio should include a blend of assets such as stocks, bonds, real estate, and commodities such as gold. This spreads the risk and lessens the effect of market volatility. While gold may provide a hedge against inflation and economic uncertainty, it may not always provide strong long-term returns. Other investments, such as stocks, mutual funds, and real estate, may provide greater returns over time. Gold is a highly liquid commodity that can be sold or traded in the market with ease. However, because prices can be volatile, it may not be the best choice for short-term investments. Gold investments are taxed on capital profits.

Stockpiling gold does not immediately reduce a country's GDP (Gross Domestic Product), but it may have an impact on other economic factors that influence GDP. GDP is a metric that measures the total value of goods and services created within a country's boundaries over a specific time period, usually a year. Gold, on the other hand, is a commodity that is frequently used as a store of wealth or as an inflation hedge. If a nation chooses to stockpile gold, it may divert resources away from other sectors of the economy, potentially reducing goods and services production in those sectors. This could slow GDP growth, though the magnitude of the effect would rely on the size and nature of the gold stockpile in relation to the overall economy.

Other assets than gold can help India's GDP grow. In fact, a well-diversified portfolio of investments across various sectors and asset classes can boost the country's overall economic development. Infrastructure, manufacturing, technology, and agriculture investments can generate jobs, improve productivity, and boost economic growth. Investment in infrastructure, for example, can improve the efficiency of transportation and communication, lowering transaction costs and improving market access, resulting in greater productivity and growth. Technology investments can boost a company's competitiveness and efficiency, resulting in increased output and exports. Similarly, agricultural investments can boost yields and reduce post-harvest losses, resulting in increased income for farmers and better food security. As a result, while gold can be a valuable investment, it is critical to diversify investments across sectors and asset classes in order to support overall economic growth and development. By diversified investment portfolio in other developed countries like USA, India also can attain a new growth path by diversification. Educating people on the advantages of investing in other asset classes and making them aware of the various investment possibilities available

can be a powerful method to encourage alternative investments. This can be accomplished through a variety of means, including seminars, workshops, webinars, social media campaigns, and books. The government can give tax breaks to investors that invest in alternative asset classes like real estate, private equity, venture capital, and commodities. This may entice investors to diversify their portfolios and invest in different asset groups.

The government can also regulate the investing business to safeguard investors and provide them with a broader selection of investment options. Regulation of the private equity and venture capital industries, as well as standards for investing in commodities and other alternative assets, are examples of this. Encourage innovation in the investment industry to promote new investment options. This can include the creation of new financial instruments such as exchange-traded funds (ETFs), which allow investors to invest in a diversified portfolio of assets, including those in alternative asset classes. To promote alternative investments, the government can collaborate with private sector enterprises. For example, the government can collaborate with private equity and venture capital firms to invest in startups and small enterprises, or with real estate developers to offer low-income families with affordable homes.

Overall, boosting alternative investment choices in India can help diversify the economy, minimise reliance on any single asset class, and give individuals with a broader range of investment options.

REFERENCES:

1. Aghevli, 1975 The reserve concept and the role of gold. Staff Papers – International Monetary Fund, 22(2), 305-322.
2. Ali, A., Ch, M. I., Qamar, S., Akhtar, N., Mahmood, T., Hyder, M., & Jamshed, M. T. (2016). Forecasting of daily gold price by using Box-Jenkins methodology. *International Journal of Asian Social Science*, 6(11)
3. Amutha, D. (2022). Economics of Consumption and Consumer Demand for Gold in India. *Asian Journal of Economics, Finance and Management*, 39-45.
4. Baber, P., Baber, R., & Thomas, G. (2013). Factors affecting Gold prices: a case study of India. In *National Conference on Evolving Paradigms in Manufacturing and Service Sectors*.
5. Beckmann, J., Berger, T., & Czudaj, R. (2019). Gold price dynamics and the role of uncertainty. *Quantitative Finance*, 19(4), 663-681.
6. Bernanke et al. (1990) The gold standard, Bretton Woods and other monetary regimes: An historical appraisal. In R. Glenn Hubbard (Ed.), *Financial Markets and Financial Crises* (pp. 33-68)
7. Bernholz P, (2002) The monetary dynamics of hyperinflation. In *The Collapse of the Soviet Union: Causes and Lessons* (pp. 63-72).
8. Bhunia, A., & Mukhuti, S. (2013). The impact of domestic gold price on stock price indices-An empirical study of Indian stock exchanges. *Universal Journal of Marketing and Business Research*, 2(2), 35-43.
9. Elfakhani, S., Baalbaki, I. B., & Rizk, H. (2009). Gold price determinants: empirical analysis and implications. *Journal for International Business and Entrepreneurship Development*, 4(3), 161-178.
10. Goldenweiser (1929) The gold standard An analysis of some recent proposals. *Journal of the American Statistical Association*, 24(167), 447-455
11. Guha, B., & Bandyopadhyay, G. (2016). Gold price forecasting using ARIMA model. *Journal of Advanced Management Science*, 4(2).
12. Hawtrey, 1919 The gold points in the trade cycle. *The Economic Journal*, 29(116), 383-401.
13. Jena, L., & Swain, R. K. (2018). Modeling and forecasting of rice production in India using ARIMA model. *Journal of Applied Statistics*, 45(14), 2617-2633.
14. Jones, 1933 The gold standard An analysis of some recent controversies. *Journal of Political Economy*, 41(6), 817-831.
15. Kannan, R., & Dhal, S. (2008). India's demand for gold: some issues for economic development and macroeconomic policy. *Indian Journal of Economics and Business*, 7(1), 107.
16. Kolluri, B. R. (1981). Gold as a hedge against inflation-an empirical-investigation. *Quarterly Review of Economics and Business*, 21(4), 13-24.
17. Kumar, S., & Ravi, V. (2016). Time series analysis using ARIMA models. *Journal of Data Science*, 14(2), 319-335.
18. Levin, E. J., Montagnoli, A., & Wright, R. E. (2006). Short-run and long-run determinants of the price of gold.
19. Padhi S., & Biswal, M. (2019). Time series analysis and forecasting of tourism demand using ARIMA models. *Journal of Hospitality and Tourism Management*, 38, 1-10.
20. Patel, S. A. (2013). Causal Relationship Between Stock Market Indices and Gold Price: Evidence from India. *IUP Journal of Applied Finance*, 19(1).
21. Sachs(1993) The economic logic and morality of a gold standard. In R. H. Timberlake Jr. (Ed.) *The gold standard in theory and history* (pp. 23-38).
22. Sahoo, S., & Mishra, S. (2020). Prediction of stock prices using ARIMA model. *International Journal of Recent Technology and Engineering*, 8(6), 3846-3849.
23. Shafiee, S., & Topal, E. (2010). An overview of global gold market and gold price forecasting. *Resources policy*, 35(3), 178-189.
24. Shafiee, S., & Topal, E. (2010). An overview of global gold market and gold price forecasting. *Resources policy*, 35(3), 178-189.
25. Sindhu (2013) A Study on Impact of Select Factors on the Price of Gold. *IOSR Journal of Business and Management*, 8, 84-93.
26. Singh, P. (2013). Gold Prices in India: Study of Trends and Patterns,“. *International Journal of Innovations in Engineering and Technology (IJJET)*, 2(4), 332.

27. Sujit, K.S. (2011) Study on Dynamic Relationship among Gold Price, Oil Price, Exchange Rate and Stock Market Returns. International Journal of Applied Business and Economic Research, 9, 145-165.
28. Suresh, A. (2013). A review on gold quest in the investment portfolio by Indian investors. Bloomberg: Gold climbs as Europe woes spur demand, Oct, 27, 2011.
29. Tripathy, N. (2017). Forecasting gold price with auto regressive integrated moving average model. International Journal of Economics and Financial Issues, 7(4), 324-329.
30. Vuyyuri, S., & Mani, G. S. (2005). Gold pricing in India: An econometric analysis. Journal of economic research, 16(1).
31. Yang, X. (2019, January). The prediction of gold price using ARIMA model. In 2nd International Conference on Social Science, Public Health and Education (SSPHE 2018) (pp. 273-276). Atlantis Press.
32. Anand V, (2017). Investment portfolios in India. In Handbook of Investments: Equity, Fixed Income and Alternative Asset Classes (pp. 221-244).
33. Singh, S., & Bajpai, R. (2018). Investor behavior and investment portfolio: An empirical study of Indian stock market. Journal of Advances in Management Research, 15(4), 346-362

ANNEXURE

Table 4.1 Gold prices since 1964-2023

Year	Price (24 karat per 10 grams)
1964	Rs.63.25
1965	Rs.71.75
1966	Rs.83.75
1967	Rs.102.50
1968	Rs.162.00
1969	Rs.176.00
1970	Rs.184.00
1971	Rs.193.00
1972	Rs.202.00
1973	Rs.278.50
1974	Rs.506.00
1975	Rs.540.00
1976	Rs.432.00
1977	Rs.486.00
1978	Rs.685.00
1979	Rs.937.00
1980	Rs.1,330.00
1981	Rs.1,800.00
1982	Rs.1,645.00
1983	Rs.1,800.00
1984	Rs.1,970.00
1985	Rs.2,130.00
1986	Rs.2,140.00
1987	Rs.2,570.00
1988	Rs.3,130.00
1989	Rs.3,140.00
1990	Rs.3,200.00
1991	Rs.3,466.00
1992	Rs.4,334.00
1993	Rs.4,140.00
1994	Rs.4,598.00
1995	Rs.4,680.00
1996	Rs.5,160.00
1997	Rs.4,725.00
1998	Rs.4,045.00
1999	Rs.4,234.00
2000	Rs.4,400.00
2001	Rs.4,300.00
2002	Rs.4,990.00
2003	Rs.5,600.00
2004	Rs.5,850.00
2005	Rs.7,000.00
2007	Rs.10,800.00
2008	Rs.12,500.00

2009	Rs.14,500.00
2010	Rs.18,500.00
2011	Rs.26,400.00
2012	Rs.31,050.00
2013	Rs.29,600.00
2014	Rs.28,006.50
2015	Rs.26,343.50
2016	Rs.28,623.50
2017	Rs.29,667.50
2018	Rs.31,438.00
2019	Rs.35,220.00
2020	Rs.48,651.00
2021	Rs.48,720.00
2022	Rs.52,670.00
2023 (Till Today)	Rs.52,790.00

SOURCE: Reserve Bank of India