FINANCIAL MODELING AND VALUATION; UNLOCKING THE TRUE WORTH OF BSE INDICES SENSEX

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Abstract

This report analyzes financial modeling techniques to evaluate the valuation of the BSE Sensex, India's benchmark stock market index. The study aims to determine whether the Sensex is overvalued or undervalued using methods like Discounted Cash Flow (DCF), dividend discount models, and relative valuation. Inspired by experts like Aswath Damodaran, these techniques are tailored to India's equity market. The DCF approach estimates the intrinsic value of the Sensex by projecting future cash flows (dividends and buybacks) and discounting them using a risk-adjusted rate. It also considers factors like earnings growth, equity risk premiums, and the 10-year Indian government bond yield. Both short-term (3 years) and long-term (15 years) perspectives are analyzed for a complete view. Findings reveal varied results depending on time horizons and growth assumptions. The report also examines sector indices and relative valuation metrics, offering insights into India's stock market dynamics. These insights aim to guide investment strategies with a data-driven perspective on market trends and opportunities.

Keywords: *Financial Modeling, Valuation, Sensex, Discounted Cash Flow (DCF), Equity Risk Premium (ERP), Macroeconomic Analysis, Stock Market, Investment Strategies, Market Trends*

INTRODUCTION

Financial modeling is one of the most important tools in the field of finance that includes various models to demonstrate real life finance scenarios. This type of model is used by the analyst to forecast the future outcomes of stock prices or business performance of a company, project or any financial instrument using historical data and assumptions. It has therefore become crucial to employ a finance model in decision making especially on investment, valuation, mergers and acquisitions since it helps in estimating the future prices of stocks in any part of the financial system all across the world. When employing such approaches, one is able to assess trends in the market, value companies and quantitatively evaluate investment opportunities.

Several techniques of financial modeling will aid in our attempts to predict the Indian stock prices. One of such very famous techniques is the Discounted Cash Flow analysis. The technique allows for time value of money by adjusting the present value of a company's future cash flows. This means forecasting the future revenues, expenses, and capital expenditures and then discounting those cash flows back to their present value using a discount rate, typically the weighted average cost of capital for the company. By doing so, analysts can establish an internal value for the company stock. When comparing the internal value of the company with the current market price, an indication of whether the stock is undervalued or overvalued is shown. In India, Discounting Cash Flow models are used by equity research analysts and institutional investors to analyze investment opportunities in sectors that include the burgeoning pharmaceutical industry.

There's the relative valuation of stocks-a more common financial modeling technique where an analogy, also called comparable company analysis or comps, relates how valuable your subject firm is relative to those it can be compared to; namely, firms similar in size and scope, presumably operating in the same type of business. Actually, through the creation of such models, we could, to a great extent, understand how the value of a particular company relates to its peers within the same industry, at least from the perspective of certain key financial indicators. Suppose that the P/E ratio of an Indian pharmaceutical company is less than the industry average; in that case, the same company might be undervalued, presuming that it has the same kind of fundamentals as the companies of its peers. Relative valuation models are perfectly applicable in markets like India, where different sectors have different risk profiles and growth profiles. The technical analysis of the Indian stock market forms one of the significant elements of financial modeling which allows forecasting about the prices of stocks.

In contradistinction to fundamental analysis, which takes into consideration the company's financial statements and economic indicators, technical analysis refers to past data, mostly price and volume, in an effort to forecast future price movements. There is a significant reliance of Indian traders and investors on such technical indicators like moving averages, the Relative Strength Index, the Bollinger Bands and MACD to calculate the moves, turnarounds and some trading signals. For instance, a 50-day moving average crossing with a 200-day moving average can be interpreted as an event that is believed to signal the bull market, or a

market where the stock prices are expected to increase. Technical analysis tools are an integral part of the trading platforms like Zerodha, Upstox, and Share khan used in the country, thus making them easily accessible to a large group of investors in India. Furthermore, the traditional stock price prediction in the Indian stock market is generally based on statistical and econometric models.

Among them, a model named ARIMA-Generalized Autoregressive Conditional Heteroskedasticity and Vector Autoregression, the tool used for analyzing time series and producing future trends of price, based on past ones. For example, the ARIMA models have been used to predict the short-term stock price from the autocorrelation in the data, and GARCH models assist in understanding and predicting the volatility of returns. These models are flexible tools and therefore market-specific instruments, providing value not only in India's vast economy but also in places where volatility in the economy is particularly caused by political, economical, and global issues. Indian finance firms and hedge funds use such models in order to develop trading tactics and control portfolio risks. It also sees a further transformation of financial modeling from the Indian stock market to machine learning and artificial intelligence.

This would make tremendous amounts of data inputs identify complex patterns, and consequently yield highly accurate predictions if the algorithms were in the form of neural networks, decision trees, or support vector machines. The machine learning algorithms thus are trained using historical stock prices, trading volumes, macroeconomic indicators, and even news sentiment for making predictions about future price movements. For example, a neural network can be trained to predict the price of a particular stock with regard to its past performance and other input features like company earnings, interest rates, and market sentiment. In India, fintech and investment companies are making more frequent use of machine learning techniques to get an edge over the competition in the market. Other platforms such as QuantInsti offer courses and resources to arm traders and analysts with the knowledge of executing machine learning in financial modeling. Another innovative method which is being applied to financial modeling so as to predict the future stock prices in the Indian market is through sentiment analysis.

This process studies textual data, whether news articles, social media posts, or financial reports to evaluate the market sentiment. In a way, these NLP algorithms will assist analysts to quantify the sentiment of the texts and associate it with movements in the prices of stock. In case it happens to be positive, like a new product launch or positive earnings report, then the stock value of the company rises; in case of a negative story, the reverse happens. In India, the market sentiment analysis tools enable the participants to make better informed decisions while trading, to catch the prevailing mood of the market. The Indian stock market is diversified and dynamic, which makes it one of the best places to use techniques in financial modeling.

Huge cap, mid-cap, and small-cap companies and its presence across sectors of the industries with a strong growth of economy of the country create immense scope for the investors and analyst to apply the model, hence financial modeling will break down the intrinsic value of stocks, understand market trend, and manages the investment risks. Also, it becomes easy for the investor to take some data-driven decisions that will maximize the market efficiency. Regulatory bodies like the Securities and Exchange Board of India (SEBI) are playing a very important role in making financial reporting more transparent and standardized; otherwise, it would not have been possible to develop proper financial modeling.

SEBI regulations ensure standardized accounting practices with relevant disclosure of financial information by companies. Thus, it becomes easy for the analysts to develop good models. Also, the same kind of data from any part of the world through the CMIE Prowess, Bloomberg, and Thomson Reuters Eikon can easily be fetched so that the whole lot of comprehensive data shall be in place that can make all the difference to form and validate financial models. Institutions for learning and professional groups are from India. University and business school offer programs like financial modeling and analytics courses; then there is the Institute of Chartered Accountants of India, ICAI and the CFA Institute providing the training and certifications. These efforts equip the financial analyst with knowledge and the requisite tools to work within financial modeling. Good Predictor for the Movement of the Prices of Stocks and Rational Investing Decision in the Indian Stock Market: Financial Modeling. It uses a methodical approach with the help of different modeling techniques, ranging from the most conventional techniques such as DCF and relative valuation to the most complex ones such as machine learning and sentiment analysis. As time progresses, the Indian stock market will only expand further; financial modeling in predicting the prices of stocks and influencing the investment strategies will gain more importance.

Major stock market in India:
- **Bombay Stock Exchange**
- **National Stock Exchange**

Bombay Stock Exchange

The Bombay Stock Exchange, established in 1875, is the oldest stock exchange in Asia and the critical part of the financial markets of India. It is a location that is still standing and a place of historical significance in Mumbai city, and by affecting Indian capital market development, it has made a significant contribution to the history. Sensex is the benchmark index of this exchange, consisting of 30 stocks, which are the biggest and most actively traded, and serve as an important indicator of the overall performance of the Indian equity market. The BSE contains a wide array of financial instruments, such as equities, derivatives, bonds, and mutual funds. BOLT is an umbrella platform of BSE which is a technology solution in the trading arena. BOLT is a seamless way to experience a transaction where trading and transparency issues both get resolved in the course of trading. The BSE is among the leading indices that capture a wide range of sectors and market segments, covering valuable insight and diverse investment opportunities.

One of the movements of the BSE's that have been noticed and are unique is giving a helping hand to small and medium enterprises which are aiming to capture market opportunities, spark growth and employment. Also, the risk management practices within the BSE are very robust, and so are the regulatory standards as it supplies a secure trading environment.

Within the area of continued innovation and educating the investing community, BSE assumes a core role within an informed investor society that is driving economic growth. Due to its importance in historical terms and far-reaching benefits, along with its merit, BSE has, for a considerable period been the most dominant entity within the Indian financial sector.

National Stock Exchange

It is known as the National Stock Exchange of India, founded in 1992 and fully functional since 1994. It is the country's largest stock exchange, as it is ranked first based on market capitalization and trading volume. This is also the first exchange that allowed a fully automated electronic trading platform, thus significantly enhancing the Indian capital markets with respect to transparency and efficiency. Nifty 50 includes the top 50 most liquid and biggest stocks; it is actually one of the best performers' indicators that gives a result of Indian equity.

NSE has transformed the India's trading scenario with high-end modern and sophisticated infrastructure capable of handling high frequency trading combined with robust risk management. This technological sophistication has made the place attractive to a diverse cross-section of investors encompassing domestic and international institutional as well as retail players. The exchange encourages trading of equities, derivatives, commodities, and debt instruments.

In keeping Indian financial markets deepened through it, innovative product introductions of index derivatives, currency futures, interest rate futures, and suchlike items only shows their continuous work. Its focus on educating and enlightening investors through the provision of various programs and initiatives also speaks to its objective in striving to build a well-informed investor community.

It adopted the NSE, a very tight regulatory framework with best international practices while ensuring the secure and reliable trading environment which in itself has further strengthened investor confidence. As this continued to be done through innovation and dedication towards excellence, it became one of the building blocks towards India's future in the country's financial markets and quickened economic growth.

- **Purpose: Committed to improve the financial well-being of people.**
- **Vision: To continue to be a leader, facilitates the financial well-being of people.**
- **Values: NSE is committed to core values - Integrity, Customer Focused Culture, Trust,**

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Respectand Care for the Individual, Passion for Excellence, Teamwork.

Reason for selecting Bombay stock exchange Indices:

Some reasons a value investor would be inclined towards using the indices from BSE are that they have greater value in understanding the Indian market, especially its dynamics, over those in the National Stock Exchange. One of the oldest and established ones is the BSE Sensex, which accounts for the performance of 30 large-cap companies that have leaders in their respective industries. This historical significance provides a more meaningful context for the analysis of market trends and investor behavior over time.

More about, BSE has other stocks too which would be very difficult to be acquired in the case of NSE, giving an investor an exposure and access to a much wider portfolio of sectors and industries, thus providing more diversified portfolios to investors if an investor bases information strictly on the availability that one can find in NSE. Besides, the methodology of the BSE in calculating its indices, which includes market capitalization and trading volumes, provides a comprehensive view of how these companies are performing within the broader economic landscape. Another reason for valuing BSE indices is that they can be used as a benchmark for evaluating investment performance.

Investors can compare their portfolios against the BSE Sensex to determine whether they are outperforming or underperforming relative to this established index. This comparison can help in making informed decisions about asset allocation and investment strategies. Moreover, understanding BSE indices aids in risk management; by tracking these indices, investors can gauge market volatility and adjust their investment approaches accordingly. Lastly, giving importance to BSE indices aids in better comprehension of economic indicators in India.

General or broad movements in these indices tend to mirror the broader economic climate, such as shifts in consumer confidence or industrial performance. An understanding of BSE indices goes a long way in developing critical information about the larger health of the Indian economy as well as guide investors' more informed decisions about their investment choices. It depicts the general valuation indices of BSE, and hence market dynamics would be understood better, along with strategic advantage in terms of decision making in India's financial arena.

Overview of Discounted Cash Flow (DCF):

Surely enough, among probably the most simplistic approaches to any firm's valuation is a DCF, quite remarkably when specific business applications- such as in the pharma-biotech industry- may be considered, where their future capacity would be a matter of extreme importance. The DCF approach goes on the basis that the money value changes with time-that is, a dollar today is more valuable than a dollar in the future due to its capacity to earn. It is very essential to any pharma company as quite many times companies will have spent hundreds of thousands of dollars just to cover for the R&D and finally be able to come up with the newer drugs. It is an investment, hence, vital importance for the investor in trying to establish which of those entities would generate appropriate cash flows in the future.

A DCF essentially talks about an estimate of the cash flows a pharmaceutical company will likely create in the future and discounting those cash flows backward to their present value on a specific discount rate. In most cases, the discount rate reflects the inherent risk involved with the investment, even more so in the pharmaceutical business due to high uncertainty levels and competition. Potential product recalls, regulatory barriers, and patent expirations could also dramatically impact the company's future cash flows and hence it is essential to get it right. As far as the DCF is concerned, making projections about revenues of the company will come first, as first comes first and most prominent in such projections.

Probable timelines for a drug launch, pipelines in the pharmaceutical companies, probable market sizes would be the things to consider while forecasting the future revenues in this industry of pharmaceuticals. The various possibilities, such as best case and worst case, are to be considered so that the inherent uncertainties of drug development are considered. Once the revenue projections have been done, analysts estimate operating expenses, taxes, and change in working capital to ascertain the expected free cash flow. Once the future cash flows have been estimated then the appropriate discount rate is to be ascertained. This rate is a function of the risk of an investment and typically comes from WACC of the company.

WACC is the cost of equity plus the cost of debt, adjusted by the capital structure of the company. Where investments are more risky especially in pharmaceutical drugs a discount rate is increased. Predicting the success of drugs is not an easy call. Once the cash flows that are projected into the future are discounted their present value is added up to give the total value of the company. From there, the value can be compared to the market capitalization of the company in the current market to show whether the stock was undervalued or overvalued. If this were to be the case and the DCF had resulted in a higher intrinsic value than the market price, then this would indicate an investment opportunity for investors. However, DCF analysis has its own set of difficulties. Projections would solely depend upon the assumptions that are considered relating to future growth rates, profit margins, and discount rate. Changes at small levels in such assumptions make a very large difference to the calculated value.

So, usually, sensitivity analysis is performed for understanding how key changes in inputs may affect the overall valuation. This would also make investors understand the probable risk and range of outcomes from

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the decisions that have been made for their investments. The DCF model is best used for firms that may have the ability to undertake mergers and acquisitions. Normally, the acquiring firm will use DCF analysis to estimate the fair value of the target firm based on the cash flows that it will have in the future. This becomes important during negotiations as each party would try to justify their assumptions. DCF analysis is a very powerful tool for valuing Indices as it provides a structured approach to evaluate the future potential of these businesses. It helps the investors make decisions regarding the intrinsic value of a company, by estimating future cash flows and discounting them to their present value. This method, however, requires extremely cautious consideration of various assumptions and is best utilized in combination with other valuation techniques to ultimately reach a final, overall analysis.

As the pharmaceutical industry continues to evolve, it would remain important for doing well in DCF analysis for investors wanting to gain a good grasp of the intricacies involved in such a dynamic industry.

Overview of Indices

BSE SENSEX: BSE Sensex is simply known as the Sensex among the people. BSE, or Bombay Stock Exchange, represents one of India's leading stock market indices. As indicated in its full term form-the "Bombay Stock Exchange Sensitive Index"-it works mostly like a barometer when evaluating the health of Indian's stock market and general overall economy in the country. The Sensex is an index of the performance of the best 30 companies listed on the Bombay Stock Exchange in terms of their market capitalization and it originated in 1986. These companies are also leading in their respective industries; for example, in banking, IT, energy, and consumer goods. Thus, in a nutshell, it gives the performance of the Indian economy in general. This gives a benchmark index to analyze the general direction of stock markets by investors.

On the Sensex rise, it portrays that the markets have performed well and most of them feel upbeat about the economic indicators vice versa. Because of the fact that Sensex is the oldest and encompasses a wide cross-section of industries, this index is also considered to be the pulse of the Indian financial markets. The calculation method of the index is known as "free-float market capitalization," which considers only shares available for public trading and excludes those shares held by promoters or by the government. This is more correct in giving the impression of the market value of a company and the implications that this has on the index. The base year of Sensex is 1978-79 and it has been taken to a base of 100 points. Since its very inception, the figure has gone up manifold and in consonance with the growth of the Indian economy over the decades. In fact, investors, analysts, and economists often look at Sensex to gauge the direction of market movement and make their investments. It reacts to various factors such as corporate earnings, government policies, global economic conditions, and even political events.

For example, any change in interest rates by the Reserve Bank of India, or a new regulation from the government, or global event such as policy change from the US Federal Reserve causes Sensex to fluctuate. All this has given wide publicity to the Sensex in the media and also made it popular because of the media for a finance professional as well as for any lay man to have a sense of market performance in those stocks. The Sensex, over the years, has seen many historical highs and lows in recording all major economic events, be it the liberalization of the economy in the 1990s, the 2008 global financial crisis, or the market upsurge following reforms and policies by successive governments.

BSE 100: The BSE 100, which is more commonly known as the BSE 100 Index, is another important index for the Indian stock market, giving a broad view of the country's equity market as compared to Sensex. The BSE 100 Index tracks the performance of the top companies listed on the exchange. The BSE 100 was first launched by the Bombay Stock Exchange in 1989. This will spread to various sectors, including finance, technology, healthcare, consumer goods, and more. This will make BSE 100 a proper indicator of the overall market sentiment and health. BSE 100 is created with an aim to providing an investor's view of the entire market instead of focusing solely on top 30. Therefore, there is an integration of the most diverse group of companies when comparing with Sensex, thereby bringing into account 100 companies whose performances are tracked along with capturing that of not just big-sized companies but also those which can influence the Indian economy mid-size firms. This makes the BSE 100 a more representative benchmark of reflecting the trends and shifts in the stock market with greater detail. Like the Sensex, the BSE 100 is calculated using the "free-float market capitalization" method, which considers only the shares available for public trading.

This will ensure that the index accurately represents the market value of the companies incorporated into it, based on the shares that investors could actually buy and sell. Base year for BSE 100 is 1983-84 with a base value of 100 points. The index has grown by leaps and bounds over the years and thereby reflected India's economic prosperity and the growing value of its stock market. The BSE 100 is a valuable resource used by investors and analysts to review the performance of a larger number of companies, making it a very good resource for people who wish to diversify their investments outside the largest blue-chip firms. It is useful in explaining the performance of different sectors within the market since it has companies from different industries. Movements in the BSE 100 are influenced by a combination of factors including company earning announcements, government policy changes, global economic conditions, and other major geopolitical events. The BSE 100 is widely followed by both institutional and retail investors. It gives an idea of how the Indian economy is doing rather than the largest companies. It gives a better perspective of market movement in the

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market and is said to reflect dynamics otherwise dormant in the narrower indices, such as the Sensex. For example, the BSE 100 may indicate what is happening in newer industries or mid-cap companies gaining popularity, which information will be useful to investors who would want to invest in emerging opportunities.

BSE HEALTHCARE: BSE Healthcare is one of the special stock market indexes from India, which only deals with health care companies. It caters to a diversified range of companies involved in pharmaceutical, biotechnology, hospitals, diagnostics, medical devices, and other healthcare-related services. This index was launched by the Bombay Stock Exchange and works as a benchmark index of the industry, giving the investors a clear idea about the performance of this sector in the stock markets. The BSE Healthcare Index monitors the growth and market trend of the healthcare sector, which has lately seen a sharp rise in demand for medical services, technology advancements, and health awareness. This is an index focused solely on healthcare-related companies, making it clear to investors whether or not the sector offers healthy financial health and good growth prospects. It is useful for health-care investors who are offered the possibility to pursue sectoral health care trends and take adequate investment decisions. This almost like "free-float market capitalization" is calculated method. Similar to the Sensex it thus provides regard only to available shares to the public. More appropriately and actually correct reflections of market values, these are seen in actively traded shares of the companies. Companies that comprise the BSE Healthcare Index are typically leaders in their space, ranging from giant pharmaceutical majors to innovative biotech firms and healthcare service providers. Such diversity is bound to ensure that the index captures the entire range of the healthcare sector by incorporating both well-established and emerging players.

Investors and analysts track the BSE Healthcare Index to measure how the health care sector reacts to a given set of factors, whether it be government policies, changes in regulations, or global health trends and scientific discoveries. It can also be used as an indicator of what is happening because of new drug approvals, health care reforms, and medical breakthroughs. The same is also influenced by macro factors prevalent in the economy in general, such as expenditure of health, consumer demand for healthcare, and the country's international trade policy related to drugs and other medical equipment. Institutional investors, mutual funds, and retail investors, who look for investment exposure in the health care sector, are a large number of followers of the BSE Healthcare Index. It serves as a benchmark for investment products so that investors could assess their performance vis-à-vis the rest of the industry. With the recent global events in the form of the COVID-19 pandemic, during which healthcare has emerged as an essential focus area, the BSE Healthcare Index has gained all the more relevance in measuring the resilience and growth potential of the sector.

BSE ENERGY: BSE Power Index is a sector-specific stock market index in India, tracking the performance of companies that fall under the power and energy sector. The Bombay Stock Exchange launched this index, focusing on a wide range of companies involved in generating, transmitting, distributing, and infrastructure for electricity generation and renewable sources of energy like solar, wind, and hydroelectric power. BSE Power Index is a sector power indicator; it gives a clear outlook of the health and current market trends concerning the company's financial matters, critical to India's energy supplies. It shall reflect well on the outlook of performances of the sector of powers in the Indian Stock market with both growth and setbacks into the list of companies of vital import for the present growing requirement of energy supplies within its boundaries. The BSE Power Index covers the old giants of the traditional energy sector and new entrants in the renewable energy space, which makes it an all-inclusive index for measuring the established companies and innovative players in the industry. The BSE Power Index is calculated on the "free-float market capitalization" basis, which means that it takes into account only those shares available for public trading and not held by the promoters or the government. This is done to represent the companies within the index more precisely in terms of market value. The index tracks a range of companies spread across the entire power sector, including state-run utilities and private power infrastructure firms besides large electricity producers, into green energy startups.

Investors and market analysts closely watch the BSE Power Index to understand how these influences such as government policies, regulatory changes, changes in technology, and a shift in energy demand might affect the sector. Such factors as changes in the price of fuel, strict environmental regulations, infrastructure projects, or investments in renewable energy influence the power industry and are reflected in the index. For instance, a policy that seeks to increase the share of renewable energy or restructuring to improve the efficiency of power distribution can directly impact these companies. The BSE Power Index is very popular with institutional and retail investors looking for exposure to the power sector and provides them with a focused tool for tracking the performance of the sector. It is a benchmark for investment products like mutual funds and exchange-traded funds designed to be focused on the energy sector. This index proves to be very useful to the investors looking to gain exposure to India's increased focus on energy security, sustainability, and the trend towards renewable sources.

LITERATURE REVIEW

According to Md Shabbir Alam a, Muntasir Murshed b,c,*, Palanisamy Manigandan d,**, Duraisamy Pachiyappan d, Shamansurova Zilola Abduvaxitovna e- the main idea of the article is to predict the future

prices of oil, coal, natural gas in India. During the covid 19 period and post covid 19 period what is the performance of different kind of time series forecasting models like ARIMA, single exponential smoothing and k-nearest neighbor. In this article historical data has been collected for the commodities from the period January 2020 to May 2022 which cover both during and the after the covid 19 periods. the unit root test has been done by the researcher on time series data to seek its stability in the concerned period. They have also calculated basic statistics in addition to the correlation coefficient of the variables for the commodities. The model result demonstrates that ARIMA performs well by surpassing single exponential smoothing as well as k-nearest neighbor models when it comes to the commodity price prediction. Result shows that the price of oil, coal, and natural gas prices in India will increase after the covid 19 period, it is expected that there will be increases of 33% in oil, 31% in coal and 25% for natural gas by 2025 in comparison with the level of 2022. The model showcased the effectiveness, but the problem is that it did not consider other models like SARIMA or GARCH. this model is used in forecasting the price of commodities on Indian market thus it has not been tested into other market also economic factors like demand and supply of the commodities has not been considered briefly in the model which makes which represent a major gap in the study which can be discovered soon by the researchers.

In this paper, Mulukalapally Susruth explained various methods and approaches focusing on the forecasting of stock market trends and other financial data. In 2010, Abdulsalam Sulaiman Olaniyi et al. used regression analysis and data mining techniques so that the market trends can be predicted while evaluating the methods' effectiveness with the historical prices data of stock. In 2011, M. Suresh Babu and coauthors used data mining and artificial neural networks to forecast the price of the Indian stock market index such as NSE and BSE which is totally based on historical data, but surprisingly this method has not been compared with other techniques of forecasting to ensure effectiveness compared to other methods. Ching-Hsue Cheng and co-authors in 2010 mixed two models, rough set theory and genetic algorithm. It shows more effectiveness in predicting stock prices where it proves to be as effective as individual models; however, the only drawback is it utilizes a single type of hybrid approach. In the year 2010, Hsien-Lun Wong and its team have applied fuzzy time series to predict Taiwan's export money, proving the viability of the given model by not using hybrid methods. In 2011, Assaleh ET AL also used polynomial classifiers which predict the stock market of Dubai. In 2010, Merh ET AL. compared ANN and ARIMA approaches to find the effectiveness of the model in the Indian stock market. Results show that the model has outperformed various single individual models. Again, in 2016, Rene D. Estember and Michael John R. Maraña compared Brownian motion and Monte Carlo simulation to forecast stock prices to find the effectiveness of the model. Ayodele Ariyo Adebiyi ET AL., in 2017, compared ARIMA and ANN models to forecast the stock prices which show that the ANN model has a slight advantage over the ARIMA model while predicting prices of stocks.

Sanjay Sehgal & Kumar Bijoy The paper "Modeling and Forecasting Debt Market Yields: Evidence from India" uses various models and forecasting techniques to forecast debt market yields in India. In this article, two kinds of models are used: first is ARIMA and second is exponential smoothing models for forecasting the short-term and long-term yields of the debt market in different periods of the market (from 14 days to 25 years). These two models will be compared based on performance evaluation like RMSE and Theil's U coefficient. Analysis based on factor structure identifies essential macroeconomic and financial factors to determine debt yields at all maturities. Key variables are identified as follows: bank rate, inflation, liquidity, and forward rates. Using the multivariate VAR model, incorporating several of these vital factors, yield forecasts for which this study provides is found to significantly outperform both the ARIMA and exponential smoothing models. The analysis shows that the Ohlson model and P/B model have a higher explanatory power compared to other valuation models like CAPM, DDM, P/E, and Excess Return Model for Indian bank stocks. Similarly, various models like the EBO model, Price to equity model, and price-to-book value model have given better forecasting as compared to the CAPM model in bank stocks in the Indian stock market. This research can be extended to consider a larger sample of bank stocks/debt instruments and a longer period. The effect of changes in accounting standards and regulations on the value relevance of financial statements could also be explored.

The article "Financial forecasting using stochastic models for the multi-commodity exchange of India" by Paarth Thadani compared different types of models such as ARMA, ARMAX, SARMA, and SARMAX in order to predict commodity prices in India, specifically the oil and gas prices at India's multi-commodity exchange. The author's aim is to use simple models in order to predict the prices while ensuring the effectiveness of the model by creating dynamic models which can be updated from time to time. These models will be compared with various performance models like MAE, MSE, MAPE, AIC, BIC, and HQIC. The result shows that seasonal ARMA models with the duration of 40-60 days were the most promising model among all while predicting the price of the commodity, but as per Paarth Thadani, this model needs to be tested on other commodities and exchanges to find the true capability of the models. It further demonstrates how to use a simple model very effectively to predict the price of commodities through minimum use of computers in regard to complex machine learning techniques. The author has explained how to reduce the model by common data in the market. This research provides a simple model for creating the forecasting model of commodities.

T Bharat Kumar Meher, Manohar Singh, Ramona Birau, and Abhishek Anand carry out this research to predict the stock prices of the top three fintech companies in India with the help of the random forest algorithm using

data collected at very short intervals. This research is carried out solely for Indian fintech companies, which reflects the massive gap identified in previous research, which has not been explored till now. The outcome of the study shows that the random forest model displayed its efficacy in predicting stock prices, which can be an ideal tool for investors, analysts, and policymakers for better decision-making and a better understanding of the scenario to encourage innovation in the fintech sector. Some key insights of the study are the higher rate of accuracy in predicting stock prices and the importance of using data collected in very short durations, also known as high-frequency data, which has the ability to capture price movement in the market. However, this study is not free of limitations, which include the reliability of data, generalization of the model in different geographical regions, difficulty in interpreting the model, and inability to consider the macroeconomic condition of a country. To address this issue in the research, future directions could include incorporating macroeconomic factors and then analyzing the effects of financial inclusion in the stock market. This could upgrade the model by covering its gaps, making it more robust and applicable, so that it can become an important tool to forecast stock prices in India's fintech sector.

Mohammad Irfan & Asif Akhtar has conducted this research in order to evaluate the worth of shariah compliant stocks in India on the basis of Discounted Cash Flow (DCF) method, in particular the Free Cash Flow to Equity (FCFE) model. This research includes ten Shariah-compliant firms included in the S &P BSE 500 Shariah Index, an average of one in each sector classified by market capitalization. The estimation of the intrinsic value of stock in this research was undertaken by projecting the future FCFE, and discounting this using the cost of equity determined using the CAPM model. The researcher then estimates the intrinsic values which are so obtained with the help of the DCF method of valuation and compares it with the actual market prices of each of these stocks. The research results highlight the fact that the intrinsic values derived from the log linear regression model are always lower as compared to the market prices, implying that the chosen Shariah compliant stocks are perhaps more expensive than their fundamental values. The issues that the investigators consider further include the effects of selected accounting variables such as book value, earnings per share, dividend per share, dividend payout ratio and the growth rate on the prices of the stock. This study has thus shed light on the valuation of Shariah-compliant stocks in India whilst employing the DCF methodology and adds knowledge on the efficiency of pricing of the Shariah index. The results may be useful for investors.

The literature review on stock valuation models for Indian bank stocks emphasizes that the methods used in arriving at the value of the Indian bank stocks and the ways through which they have tried to predict the prices at which the stocks will reach are discussed. The review aims to determine the intrinsic value of the bank stock to make an investment in it. The review involves several key models such as the Ohlson Model, Price-to-Earnings (P/E) Model, Price-to-Book (P/B) Model, CAPM, DDM, and Excess Return Model. The Ohlson Model is also referred to as the Earnings-Based Ohlson or EBO Model. According to this model, the stock price is determined by book value and the present value of expected future profits. According to research, it is very effective in explaining the variations in stock price. The P/E Model is one where stock price is related to earnings. Such studies reveal that a company with lower P/E ratios brings in more returns to its investors. Likewise, P/B Models relate stock prices to book value and indicate their dependability under different market conditions. The CAPM looks at the relationship between the expected return on a stock and risk, but others have found it to not be as effective in returning predictions. The DDM values stocks based on future expected dividends, but again, its reliability can differ, especially for companies whose dividend payments are not very consistent. The Excess Return Model focuses on the returns a company generates above its cost of equity and has shown promise in valuing bank stocks. Overall, the literature indicates that though there are many models to value bank stocks, the Ohlson Model is unique in its ability to predict. Every model has its strengths and weaknesses, and their applicability depends on the market conditions and the characteristics of the banks being analyzed. Thus, the findings indicate that the appropriate models need to be chosen based on the context and the financial data available.

The analysis of different valuation models for Indian bank stocks highlights the need to choose the most suitable model for the estimation of stock prices, thus making the investment decision better. Some of the prominent models are the Ohlson model, Price-to-Earnings (P/E), Price-to-Book (P/B), Capital Asset Pricing Model (CAPM), Dividend Discount Model (DDM), and Excess Return Model. The Ohlson Model, or Earnings-Based Ohlson (EBO) Model, posits that stock price is influenced by book value and the present value of future earnings, demonstrating significant effectiveness in capturing share price volatility. Research suggests that the P/E Model, which correlates stock price with earnings, offers substantial returns when P/E ratios are low. The P/B Model, a reliable indicator under specific market conditions, compares stock price to book value. Even though CAPM is a widely used method to measure the relationship between the expected return and risk, the ability of CAPM in predicting bank stocks might not be very strong. In DDM, a company's stock value is based on the expected future dividend; however, if dividend policies are not smooth over time, then this technique is not reliable. Excess Return Model, in which the excess returns from cost of equity have proven promising in the banking sector. The literature emphasizes the need to align model selection with context and bank-specific data. The Ohlson Model appears as a strong predictor, and others offer strengths under different conditions.

As evident in the literature, the relevance of interest rate forecasting has guided financial decisions at a sector level. The article indicates efforts by the Reserve Bank of India to improve its models after the introduction of

the 1990s liberalization of Indian financial reforms. The forecasting for call money and other short- and longterm government securities uses models of univariate analysis like ARIMA, while multivariate analysis relies on VAR and BVAR. These models consider several factors that would make the prediction more accurate, such as liquidity, inflation, and foreign interest rates. From empirical evidence, the multivariate models are shown to be better than single variable models, especially at long horizons of forecasts. This is because such models take into account interactions between variables. Although BVAR has performed satisfactorily in forecasting various rates, specialized models like VECM perform better at certain times. To create monetary policy properly, it is very essential to understand the linkage between interest rates and economic indicators. Thus, it reflects that Indian interest rate dynamics have a dynamic nature and in an unregulated financial world requires advanced forecasting techniques.

Predictive Modeling for Sustainable Investments: ARIMA, GARCH, ARCH Analysis In terms of forecasting volatility in returns, this study uses three ARIMA, GARCH, and ARCH techniques on the basis of historical stock price data for HDFC Ltd., Reliance Industries Ltd, and ICICI Bank Ltd from August 2012 to July 2022. These companies are a few key constituents of leading sustainability indices. ARIMA models are used for the stock price prediction. For HDFC Ltd, the best model found is ARIMA(9,1,9), for Reliance Industries Ltd it is ARIMA(10,1,7), and for ICICI Bank Ltd, it is ARIMA(2,1,2). The predicted prices for July 2023 are ₹2,613.78 for HDFC Ltd, ₹3,073.75 for Reliance Industries Ltd, and ₹857.73 for ICICI Bank Ltd. GARCH models have shown that Reliance Industries Ltd has the least volatility followed by ICICI Bank Ltd, and HDFC Ltd is the most volatile in terms of volatility analysis. This study is a typical example of how advanced statistical methods can be applied for forecasting stock prices and volatility analysis for sustainable investments that help investors make better-informed decisions regarding socially responsible stocks.

Interest rate modeling and forecasting literature in India puts interest rates as an important financial variable influencing decisions in various sectors of the economy, such as consumers, businesses, and policymakers. With the liberalization of financial markets that began in the early 1990s, the Reserve Bank of India has been focused on the development of effective models for short-term and long-term interest rates, including call money rates and government securities. Models include ARIMA as a univariate model and VAR, BVAR models as multivariate models. Such models are based on the assumption that there are several factors including liquidity, inflation, and foreign interest rates which could improve the accuracy of predictions. The findings of the research show that multivariate models perform better than naive and univariate models, particularly at longer horizons of forecasting because they consider the interactions among different economic variables. For instance, the BVAR model has done fairly well in forecasting a variety of rates, though some specific models like VECM have been better suited for certain time horizons. The literature reveals that the relationship between interest rates and economic indicators such as credit supply and inflation is extremely important for effective monetary policy formulation. Overall, the studies point out the changing nature of interest rate dynamics in India and the requirement for strong forecasting methods to handle the intricacies of a deregulated financial system.

Predictive modeling of return volatility in sustainable investments: An in-depth analysis of ARIMA, An in-depth analysis of ARIMA, GARCH, and ARCH techniques. It predicts stock prices and examines the volatility of returns of India's three leading socially responsible companies with the help of sophisticated statistical models. The authors of the paper used the HDFC Ltd, Reliance Industries Ltd, and ICICI Bank Ltd's data for stock prices, and HDFC Ltd's, in particular, from August 2012 to July 2022-the time during which it formed part of major sustainability indices in India. The study has made use of ARIMA models for predicting the stock prices. These are a class of statistical models used in the analysis and forecasting of time series data. The best model for HDFC Ltd is ARIMA(9,1,9), for Reliance Industries Ltd is ARIMA(10,1,7), and for ICICI Bank Ltd is ARIMA(2,1,2). With the use of these models, it projected the stock price predictions for these companies in between August 2022 to July 2023 with ₹2,613.78 for HDFC Ltd, ₹3,073.75 for Reliance Industries Ltd, and ₹857.73 for ICICI Bank Ltd for July 2023. The researchers used GARCH models to analyze return volatility, which is yet another class of statistical models that capture time-varying volatility in financial time series. The study indicates that Reliance Industries Ltd is the least volatile of the three companies, while ICICI Bank Ltd ranked next to it, followed by HDFC Ltd. This study illustrates how advanced statistical techniques, such as ARIMA and GARCH, can be applied in the forecasting of stock prices and return volatility analysis of socially responsible companies in India. The results will, therefore, be helpful for investors in making decisions in the investment of sustainable stocks.

Article "Predictive Modelling for Non-Performing Assets in Indian Banking Sector" by Dr. Suresh Pathare and Mohneet Sandhu analyses one very critical issue concerning the Indian banking sector, viz NPAs or non-performing assets. NPAs refer to loans that the customers cannot repay. It, in turn, deters banks' profitability and potentially could be hazardous for the whole economy. The authors try to find the causes for NPAs, their financial impact, and suggest predictive models to help banks tackle this risk. The article begins by explaining what NPAs are and why they matter. When banks give out loans that are not being repaid, it creates a financial burden for them. Higher NPAs have a direct correlation with decreased profit margins, increased bank costs, and higher interest rates for the consumer. The authors also point out that NPAs had begun to become an increasing problem in India, especially since the global financial crisis in 2008, when several firms could not

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service their loans. The researchers used statistical methods like regression analysis and time series analysis to ascertain the most significant factors behind NPAs. They established that poor credit assessment, lenient lending practices, and economic downturns are among the most significant factors in the increase of NPAs. The study calls upon banks to improve their credit evaluation processes so that they do not lend to potential defaulters. the authors give a predictive model that is to be used by the banks in assessing the credibility of potential borrowers. In this model, the bottom line is to enable banks to make more informed credit decisions and reduce the threat of future NPAs. A study based on data analysis provided by public, private and foreign banks gives vital understanding about how different types of banks are affected by NPA. the article gives a comprehensive view of the challenges NPAs pose to the Indian banking sector and provides practical solutions for improvement. It is a useful source of information for policymakers, bank managers, and all those interested in understanding the complexities of banking risks in India. The findings, therefore, emphasize the need for proper risk management practices to ensure the stability of the banking system and the economy.

In the article "Modeling and Forecasting Inflation in India," Tim Callen and Dongkoo Chang discuss inflation in India for many years. The writers explained that inflation is one of the most important problems since it affects everyone, particularly the poor, as they are the ones mostly hurt when prices go up. It is therefore critical to understand and control inflation in order to maintain the stability and growth of economies. The paper starts from the introduction of how the RBI has shifted its approach in managing inflation. At first, the RBI dealt with money supply to control its amount in circulation, whereas now, it has transformed into a "multiple indicators" approach. That means they have to consider and look at several economic factors to determine a clearer vision of the inflation trend in comparison with the figures produced by money supply. They describe several inflation measures: WPI and CPI. Though WPI is used more often in India as it has more extensive coverage and updates are made frequently, CPI has significance because of the relevance it carries with regards to measuring average households' cost of living. Both indexes have strengths and weaknesses and choice can considerably impact the policy economics. The article also discusses historical inflation trends in India. It points out that the inflation rates have fluctuated greatly over the decades. For instance, inflation was relatively stable in the 1980s but sharply increased in the early 1990s due to economic crises and market changes. The authors emphasize that different factors such as agricultural production and global market conditions influence inflation rates.

They use statistical models to determine the best economic indicators that could be used to predict future inflation. They found out that money supply is indeed essential, but other variables like exchange rates and import prices are also crucial for the forecasting of inflation. The goal of their analysis is to equip policymakers with better tools for anticipating inflationary trends and making informed decisions. the article stresses the intricacies of inflation management in India and the need for a plethora of indicators for effective forecasting. Understanding the factors that determine inflation can help policymakers to better protect the economy and the well-being of its citizens, especially those who are most vulnerable to changes in prices. Overall, this research contributes valuable insights into the ongoing efforts toward maintaining price stability in India.

APPROACH AND RESEARCH METHODOLOGY

Employed a systematic and methodical approach to value Sensex by using a combination of quantitative analysis and financial modeling. The heart of my methodology is the application of an adapted Discounted Cash Flow (DCF) model, based on Professor Aswath Damodaran's framework, specifically customized for the Indian stock market. This approach incorporates all the important financial factors, which are comprised of expected dividends, buybacks, sector-specific earnings growth rates, the risk-free rate calculated from the 10-year Indian government bond yield, and the implied equity risk premium. Each step in this methodology attempts to assess the factors affecting the valuation of the Sensex as an entity. Research Method:

A quantitative research methodology to conduct this study. This would entail using numerical data to measure, analyze, and interpret the financial factors that would influence the valuation of the Sensex. My major aim was to provide an objective, data-driven appraisal of the Sensex by the use of widely accepted techniques in financial modeling.

- **Top-Down Approach**: The method requires one to study the macro variables, such as risk-free rate (10-year government bond yield) and the general market risk premium.

- **Bottom-Up Approach**: In the bottom-up approach, I studied the individual constituents of Sensex, namely, its dividend yield, its earnings growth, and how its 30 constituents performed so that insights could be drawn at the grass-root level.

Both these approaches have helped in understanding how the valuation of the Sensex is influenced through a combination of external and company-specific factors.

- **Data Collection:** Data collection formed an integral part of the research process. I relied on secondary data sources for gathering relevant and reliable information. These sources included the following:

- **Historical Financial Data**: Historical data regarding the payment of dividends has been fetched from the official BSE website. This is an efficient source with detailed and accurate information pertaining to the declaration of dividends made by Sensex companies. However, historical data in respect of buybacks are less as buybacks are not very common in the case of Sensex companies.

- **Sensex Earnings**: The earnings of Sensex were calculated through a simple application of the given PE

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ratio that was directly available on the websites for Bloomberg and the BSE.

Macroeconomic Data:
▪ **Risk-Free Rate:** The latest available 10-year Indian government bond yield is used as the risk-free rate. This data is taken from official government publications and real-time financial websites tracking the yields of bonds.
▪ **Equity Risk Premium (ERP):** ERP is found by reverse engineering the valuation of Sensex from the expected free cash flows to equity.
▪ **Sector-Specific Growth Rates:** Data for sector-wise earnings growth was sourced from BSE reports and other financial publications that analyze the performance of various sectors within the Sensex.
▪ **Expert Insights and Models:** Methodologies adapted from financial research, particularly from Professor Aswath Damodaran's valuation techniques, to suit the specific characteristics of the Indian market.
▪ **Analytical Tools:** To ensure the accuracy and reliability of my analysis, I used several analytical tools and techniques. These include:
▪ **Discounted Cash Flow (DCF) Model:** The DCF model served as the basis for this study. However, rather than calculating FCFE for each Sensex company, I relied on expected dividends and buybacks as surrogates. This simplification was required because the FCFE calculations for all 30 Sensex companies were complex and resource intensive.

The DCF model required inputs such as:
• **Expected dividends and buybacks**
• **Risk-free rate (10-year bond yield)**
• **Implied equity risk premium (ERP)**
• **Expected growth rates for Sensex earnings**

By discounting the future cash flows (dividends and buybacks) to their present value using the risk-free rate and ERP, I estimated the intrinsic value of the Sensex.
▪ **PE Ratio Analysis: To get to the earnings of Sensex, I used the PE ratio. Dividing the current value of Sensex by its PE ratio gave me the average earnings for the index as a whole. The other benefit of this was how much the index is priced over or under relative to their historical PE levels.**
▪ **CAGR: CAGR stands for Compounded Annual Growth Rate, to calculate the 3-year CAGR on the Sensex earnings, which can be used as smooth measure of fluctuations and helps to give more reliable estimations of the long-run growth trend.**
▪ **Reverse-Engineering the Equity Risk Premium (ERP): The ERP was calculated by reversing the current Sensex value using expected Free Cash Flows to Equity (FCFE). This approach ensured that the ERP reflected real-time market conditions and investor sentiment.**
Why These Methods and Tools Were Chosen:
The choice of methods and tools was guided by the unique characteristics of the Indian stock market and the specific objectives of this research.
▪ **DCF Model:** The DCF model is the most robust and reliable valuation tool, as it gives a detailed and structured analysis of the factors driving the value of the Sensex. By using dividends and buybacks as proxies to adapt this model, I could overcome the challenges of calculating FCFE for all 30 Sensex companies.
▪ **PE Ratio Analysis:** The PE ratio is a simple yet powerful tool for assessing market valuation. Using this ratio to derive Sensex earnings provided a straightforward way to measure the index's performance.
▪ **CAGR for Earnings Growth Analysis:** A three-year Compounded Annual Growth Rate (CAGR) for earnings serves as a balanced metric, effectively mitigating the impact of short-term volatility that can obscure underlying growth trends. This approach was deemed particularly pertinent when examining the Sensex, an index where individual company performance can precipitate substantial earnings fluctuations.
▪ **Reliance on Secondary Data:** Secondary data sources, such as the BSE website and financial databases, ensured the accuracy and reliability of the inputs used in the analysis. These sources are recognized for their credibility and are commonly used in financial research.

Step-by-Step Explanation
To ensure clarity, I'll break down my research methodology into distinct steps:

Step 1: Identify Key Variables
The first step was to identify the key variables influencing the Sensex's valuation. These included:
▪ Dividends and buybacks
▪ Earnings growth rates
▪ Risk-free rate (10-year bond yield)
▪ Equity risk premium (ERP)

Step 2: Collect Data

I gathered data from secondary sources, focusing on the variables identified in Step 1. For example, historical dividend data was obtained from the BSE website, while the risk-free rate was derived from 10-year government bond yields.

Step 3: Apply the DCF Model

▪ Using the DCF model, I estimated the intrinsic value of the Sensex. This involved:

▪ Projecting future cash flows (dividends and buybacks) for the Sensex.

▪ Discounting the cash flows to their present value by using risk-free rate and ERP.

Step 4: Analysis of Earnings Growth

To calculate CAGR for the Sensex. This step required dividing the index level by its PE ratio to derive total earnings. The growth rate provided a forward-looking perspective on the Sensex's performance.

Step 5: Calculate the Implied ERP

By reverse-engineering the current Sensex value using expected FCFE, I derived the implied ERP. This metric reflects the additional return investors expect over the risk-free rate.

Step 6: Interpretation of Results:

After conducting the analysis interpreted the results to determine whether the Sensex was overvalued or undervalued in comparison to its intrinsic value. This was done by integrating the earnings growth of the Sensex with its current ERP.

Limitations Acknowledged:

• **Despite the robustness of our research methodology, we recognize the presence of certain limitations that could potentially influence the accuracy of our conclusions:**

• **FCFE Simplification: The utilization of dividends and buybacks as substitutes for Free Cash Flow to Equity (FCFE) might not fully encapsulate the financial robustness of all constituent companies.**

• **Assumptions' Sensitivity: The DCF model is notoriously sensitive to key input variables such as growth rates and the risk-free rate. Changes in these factors can result in significant differences in the valuation results.**

• **Representativeness of Sensex: As it has a representation of just 30 companies, Sensex is not an ideal proxy to represent the whole Indian Stock Market.**

• **In summary, bearing in mind the limitations highlighted above, the methodological approach adopted by our paper helps to throw insight into the valuation landscape of the Sensex and sets an appropriate ground for further extensive research activities.**


Figure 1
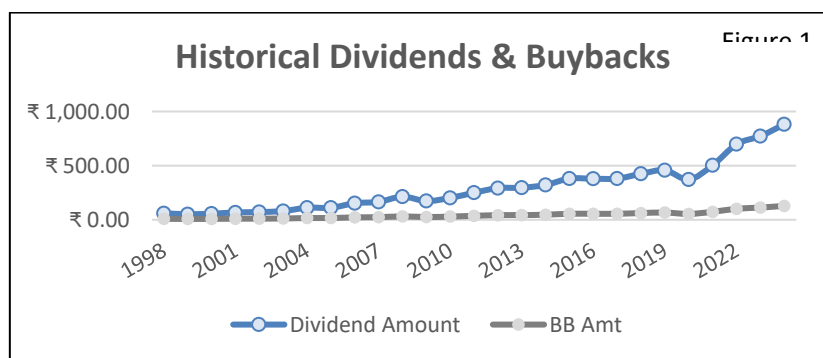
Expected Dividends & Buybacks

In DCF valuation, estimating Free Cash Flows to Equity (FCFE) for each Sensex company is complex. Instead, expected dividends and buybacks are used as proxies. While historical dividend data is available on the BSE website, buybacks are rare among Sensex companies and have minimal impact on valuation.


Figure 2
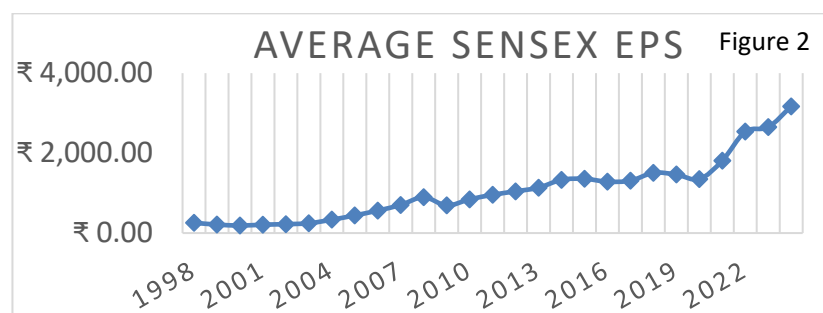
Expected Growth in Sensex Earnings.

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Sensex earnings are calculated by dividing the index level by its PE ratio, with earnings growth measured using a 3-year compounded growth rate for better forward-looking insights.

INDIA BOND RETURN Figure 3
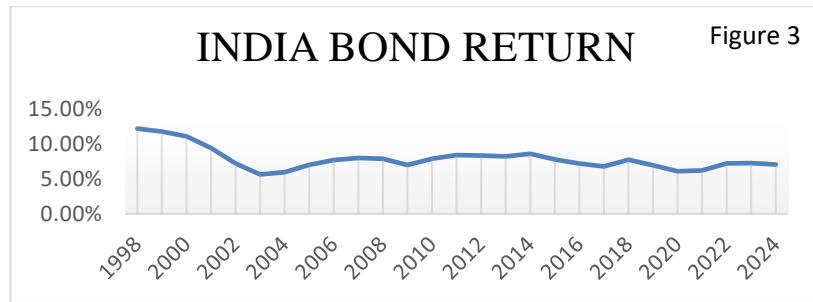
Risk Free Rate – 10 Years Indian Govt Bond Yield.

The risk-free rate, based on the 10-year government bond yield, represents opportunity cost and is crucial for valuation. This report uses the latest yield (July 2024) for accuracy.

HISTORICAL IMPLIED ERP IN INDIA Figure 4
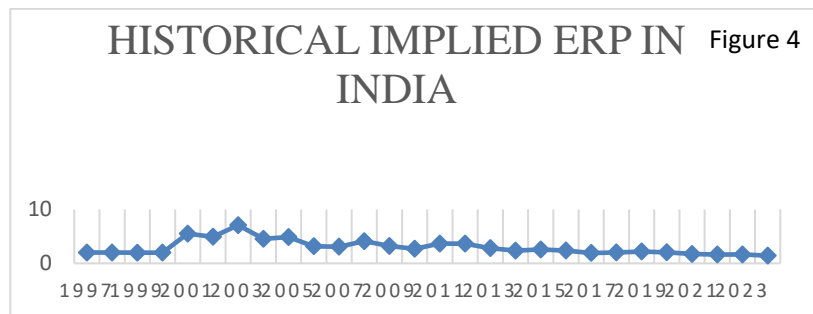
Implied Market Risk Premium

The market risk premium (MRP) reflects the extra return expected over the risk-free rate. A higher MRP suggests cautious investor sentiment. It is calculated by reversing the current index value with expected FCFEs to derive implied MRP.

4.5 Valuation of BSE Sensex in short Period

valuation of sensex			Figure 5
key inputs		**assumption**	123102.8066
dates	11/14/2024		UNDERVALUED
current sensex	77690	77690	
total yield	3 years	1.36%	
expected growth	3 years	11.66%	
riskfree rate	latest	7.03%	
equity risk premium	latest	1.43%	
cost of equity		8.46%	

year	expected Dividend & Buybacks	cumalative PV factor (risk free rate +equity risk premium)	present value of expected rate and dividend
2024	1182.745314	0.9220	1090.479816
2025	1320.676637	0.8501	1122.662682
2026	1474.69346	0.7838	1155.795346
2027	1646.671669	0.7226	1189.905841
2028	1838.705914	0.6662	1225.023025
2029	2053.135121	0.6143	1261.176607
2030	2292.570983	0.5663	1298.397174
2031	2559.929768	0.5222	1336.716215
2032	2858.467836	0.4814	1376.166151
2033	3191.821303	0.4439	1416.780355
terminal value	249234.2888	0.4439	110629.7034

In this section, I have discussed the valuation analysis of BSE Sensex over a short time horizon. I intended to check whether the index is overvalued or undervalued, keeping in mind its intrinsic value as compared to the

current market level. For this, I analyzed key financial data incorporated specific assumptions and applied systematic valuation techniques. Let me explain the process step-by-step in a clear and detailed manner.

Interpretation of Data

I used specific financial assumptions and projections in analyzing the Sensex. I used the following: earnings growth rate, risk-free rate, and equity risk premium (ERP). Using all these as inputs, I estimated the intrinsic value of the Sensex by computing the present value of future dividends and buybacks. Simply, it says that the intrinsic value of the Sensex is its "real" value as a company that is expected to produce, according to its companies, dividends and buybacks. Then, I compared this intrinsic value with the current market level of the Sensex in order to determine whether the company was priced correctly or not. I was calculating the intrinsic value of Sensex that turned out to be as high as 123,102.8066. With the current market level that stands at 77,690 (at the time of analysis), this gap just indicates that the Sensex has been undervalued at present. In short, the Sensex can still increase in value if its market price is relatively smaller compared with its intrinsic worth.

Analysis of Data

The whole procedure in valuing demanded very few critical assumptions as is necessary for all calculations done.

Key Assumptions

The valuation process required making a few critical assumptions, which serve as the foundation for all calculations:

1. **Expected Growth Rate:** Based on the 3-year compounded annual growth rate (CAGR) of the index, the growth rate of Sensex earnings is estimated to be 11.66%. This number provides a forward-looking estimate of how much the earnings of the Sensex companies will grow in the near term.
2. **Risk-Free Rate:** It was assumed at this date of analysis that the yield of 10-year Indian government bond was 7.03%. It is a return anticipated from risk-free investment like government bonds.
3. **Equity Risk Premium (ERP):** ERP is assumed at 1.43%. It is extra return the investors require while taking risk to invest in the stock market compared to in risk-free assets.

These assumptions are crucial because they directly impact the valuation. Small changes in any of these inputs can result in considerable variations in the calculated intrinsic value.

Dividend and Buyback Projections:

To calculate the intrinsic value of the Sensex, I projected its future cash flows as dividends and buybacks. These cash flows represent the financial returns that investors in the Sensex companies can expect over time. I took advantage of not estimating Free Cash Flows to Equity for each firm instead I employed proxies consisting of the anticipated dividends and buybacks as these cash flows. Dividends are parts of profits distributed by the companies to their shareholders. Buybacks occur when a company repurchases its outstanding shares from the market reducing its number of outstanding shares. It increases value for other remaining shareholders.

Since buybacks are relatively rare among Sensex companies, dividends played a more prominent role in my calculations. Historical data on dividends was obtained from the BSE website, ensuring accuracy and reliability.

Discounting to Present Value

discounted the projected dividends and buybacks to their present value. This is because the time value of money changes with the inflation factor and others. Simply put, a rupee received today is worth more than a rupee received in the future. In order to account for that, I have utilized discounting with a cost of equity, which I calculated to be 8.46%. Cost of Equity is the anticipated return through investing in Sensex. The discounting process adjusts each year's expected returns for risk and sums the results to calculate the present value factor. This cumulative factor is then applied to the projected cash flows to calculate their present worth.

How it works: Let's say you would receive ₹100 in the form of dividends sometime next year. Using 8.46% being the discount rate, value that ₹100, then, is approximately ₹92 in today's money. That was done for all the expected returns for all the years, and what was left was the adding up of all those discounted figures to get an approximate figure that represented the total value of those future cash flows.

Computing Terminal Value: The final step in the valuation process was to calculate the terminal value of the Sensex. The terminal value represents the value of all future cash flows beyond a certain point in time, assuming a constant growth rate. I have assumed the long-term growth rate of 11.66% and projected the long-term growth of the Sensex's earnings and included it in the terminal value calculation. This value was then discounted to its present worth, just like the projected dividends and buybacks. The terminal value is important because it constitutes the largest portion of the intrinsic value of Sensex. It represents the long-term potential of the index and its ability to generate returns for investors over a long period.

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Summary of the Results: By taking the present value of projected dividends and buybacks and the terminal value, I added all together to give the sum of the total intrinsic value of Sensex. I got 123,102.8066, which was substantially higher than its market price of 77,690. This creates an anomaly that the Sensex has been undervalued. Otherwise, the price given to Sensex by the market, based on all financial information and assumptions provided, it is lower than the worth of the intrinsic value of Sensex.

Understanding the Implications: The undervalued position of the Sensex brings forth several implications
1. **Market Potential:** There is scope for further appreciation in the Sensex because its intrinsic value places a higher price level to play than its existing market price level.
2. **Investor Sentiment:** A relatively low equity risk premium at 1.43% could mean that the investors are not over cautious; confidence in the long-term prospect of the market is an indication.
3. **Assumptions:** Though the Sensex is undervalued as indicated by the valuation, it has to be accepted that results are highly sensitive to assumptions used. For example, even a small change in the growth rate, risk-free rate, or ERP may lead to a huge deviation in the intrinsic value calculated.

Obstacles in Valuation: Valuing the Sensex over a short time frame also poses its challenges as stated below:
- **Sensitivity to Inputs:** The valuation is fairly sensitive to assumptions like growth rate and discount rate. Changes of this nature in input can bring about huge variation in results.
- **Market Volatility:** The Indian stock market is pretty volatile, which makes short-term projections pretty unreliable.
- **Data on Buybacks:** Not much data is available pertaining to buybacks by companies that are part of Sensex. Hence, they act as a poor proxy to cash flows.

Despite all these difficulties, this methodology gives a well-equipped framework for analyzing the Sensex's valuation and provides very relevant insight to investors and researchers.

4.6 Valuation of BSE Sensex in Long Period

Figure 6

key inputs	valuation of sensex	assumption	71299.18929
dates	11/14/2024		OVERVALUED
current sensex	77690	77690	
total yield	15 years	1.44%	
expected growth	10 years	10.89%	
risk free rate	15 years	7.42%	
equity risk premium	15 years	2.32%	
cost of equity		9.73%	

year	expected Dividend & Buybacks	cumalative PV factor (risk free rate +equity risk premium)	present value of expected rate and dividend
2024	1240.389043	0.9113	1130.350376
2025	1375.487766	0.8304	1142.265489
2026	1525.300956	0.7568	1154.306199
2027	1691.431262	0.6896	1166.473832
2028	1875.655884	0.6285	1178.769724
2029	2079.94559	0.5727	1191.195229
2030	2306.485799	0.5219	1203.751712
2031	2557.699953	0.4756	1216.440553
2032	2836.275452	0.4334	1229.263149
2033	3145.192394	0.3950	1242.220909
terminal value	150507.284	0.3950	59444.15212

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This section has long-term valuation of BSE Sensex, and this research will expand the horizon of the analysis for 15 years. With that in view, this gives an outlook to a broader perspective concerning how the index may be moved around based on growth rates, risk-free rates, and the equity risk premium for an extended period. In fact, my aim was to understand whether the Sensex was overvalued or undervalued in terms of a long-term perspective. Let me explain the interpretation and analysis of the data in a clear and detailed manner so that complex financial concepts can be easily understood.

Interpretation of Data: Using various financial inputs and assumptions, I worked out the long-term valuation of the Sensex. For this, I considered the anticipated earnings growth rate, the risk-free rate over 15 years, and the equity premium, or ERP. From here, I estimated the intrinsic value of the Sensex through computing the present value of dividends and buybacks from its future periods for a total of 15 years.

This means I tried to find out what this "real" value of the Sensex would be based on the cash flows expected from its constituent companies over the next 15 years. Then, by comparing the intrinsic value with the current market level of the Sensex, I could find out if the index is priced right or not.

My calculation shows that the long-term intrinsic value of the Sensex is 71,299.18929, which means that it is slightly low from the current market price of 77,690. This would mean the Sensex is overpriced from a long-run perspective. In other words, assuming the same assumptions applied, the market price of the Sensex seems high from its intrinsic value viewed over a 15-year period.

Analysis of Data: long term valuation process in stepwise and structured way. Now I wish to bring you to grasp through how I ended up by reaching these conclusions and understand why Sensex might eventually have a long run over-valued.

Key Assumptions: The long term valuation were based on certain of the critical assumptions that shape a kind of underlying backbone or structure of the computation processes:

1. **Growth rate:** Assumed Growth Rate I assumed 10.89 percent for the period of 15 years. It is slightly below the short-term growth rate of 11.66 percent as it considers long-term growth to be not as strong as the near-term one. This would reflect a moderate optimism with the long-term performance of Sensex.

2. **Risk Free Rate:** I have used a 15-year Indian government bond yield, which at the time of writing was 7.42%, as the risk-free rate. It is what an investor can expect return when they invest their money for a 15-year time period in a risk free investment like government bonds.

3. **ERP:** The ERP used in this calculation is 2.32%. This indicates the surplus return demanded by the investors because of the risk associated with long term investments in the equity market. The long-term ERP is, therefore higher than the short term one being 1.43%, which signifies a greater uncertainty of the long term investment.

These are very sensitive assumptions since they have a direct bearing on the valuation. Small variations in these inputs can cause massive variations in the calculated intrinsic value of the Sensex.

Projection of Dividends and Buybacks: The valuation process began by projecting the cash flow coming from Sensex in the future and in the form of dividends or buybacks. The majority of such cash flows would be monetary returns investors would like to get out of their companies listed on Sensex over the next 15 years.

For ease of simplicity, I have used dividends and buyback as surrogates of FCFE because while every company pays some sort of dividend, its incidence among Sensex firms is less frequent with both representing direct returns to owners so valued.

Because buybacks were not so frequent, my estimates made dividends occupy much more percentage share. Details on historical dividend pay outs are taken from BSE website.

Present Value Discounting

The next step is discounting the projected cash flows to their present value. This is essential because any money received in the future is worth less than money received today, partly due to inflation and the value of money over time. I used a discount rate based on the cost of equity, which I calculated at 9.73%. The cost of equity reflects the return that investors expect from investing in the Sensex over the long term.

The discounting process was as follows:

- Each year's projected cash flow was adjusted for risk and discounted back to its present value using the discount rate.
- The sum of the present value factors, for each year, was computed that signifies the rate at which the cash flows worth diminishes with the passage of time.
- These factors were then applied in computing the sum of the present value of the expected dividends and buybacks.

In simpler words, this step allowed me to come up with the sum of the present value of future cash flows, which would be required to compute the intrinsic value of Sensex.

Calculation of the Terminal Value

The terminal value is the last element of valuation, representing the sum of all future cash flows after the 15-year projection period. I have made use of an assumed growth rate of 10.89% presuming the long-term earnings of the Sensex and putting it into the determination of the terminal value. Similarly, the determined value was put to discount to the present worth like the projection cash flows for the first 15 years. This value is important because it forms a considerable part of the intrinsic value of Sensex. It is a representation of the long-term returns generating potential of the index to the investors.

Summary of Results: By calculating the present value of projected dividends and buybacks along with the terminal value, I put these components together to find the total intrinsic value of the Sensex in the long term. It came out to be 71,299.18929, which is below the market level of 77,690 currently.

This indicates that the Sensex is overvalued from the long-term point of view. In other words, the market price of the Sensex is higher compared to its actual value when one considers a 15-year horizon.

Interpretation of Implications: Overvaluation of the Sensex in the long term brings forth the following implications:

- Moderate Growth Expectations: The growth rate of 10.89% is relatively modest, which may indicate that the index's long-term performance will not match its short-term potential.
- Dependence on Price Gains: The total yield of 1.44% over 15 years means that most of the expected returns are based on price appreciation rather than dividends or buybacks. This means that the company's returns are more dependent on market-driven growth rather than company-generated returns.
- Effects of Discounting: The entire discounting process highly discounts the value of cash flows that are to come later, which makes the cost of equity a very significant ingredient in long-term valuations.

Problems with Long-Term Valuation: Valuing Sensex for a long period has posed some unique problems:

- **Uncertainty of Projections:** There are uncertainties in long-term projections about changes in market conditions, policies, and global events.
- **Sensitivity towards Assumptions:** If the growth rate, or the risk-free rate, and the ERP are altered moderately, then the difference in the sensex value calculated would tend to be huge.
- **Market Volatility:** Indian stock market generally is highly volatile, reducing the reliability of long-term predictions.

Long term valuation provides valuable insights towards the potential trajectory of Sensex and offers a useful perspective for investor and researchers. In doing so, I was able to present a comprehensive long-term valuation of the Sensex. This analysis throws light on the factors that determine the intrinsic value of the index and gives a clearer view of its current market position.

Findings and Conclusion:

I embarked on this research in order to learn the worth of Sensex, India's premier stock market index, and to see if it is justly priced relative to its fundamentals. Well, for one who has always been curious about the workings of financial markets, it was a journey that brought me deeper into the nitty-gritty factors influencing market movement. Well here's it simply enough- Even without knowledge of financial markets- a clear picture of how the results will be described.

Methodology and Timelines:

Used a method called DCF, to estimate in the first place what actually the Sensex is really worth. Simply put DCF is a way one would figure out how much returns from an investment today are worth in the present moment. Since money depreciates because of inflation and other effects, you have to "discount" future cash flows to get their present values. For this research, I selected two periods: short-term, three years; and long-term, fifteen years. Let me present some key findings from each of those analyses.

Key Findings from Short-Term Analysis:

For the short-term, the calculation shows that Sensex is undervalued. Its intrinsic value, as calculated by me, is around 123,102, which is much higher than its current market level of 77,690. It makes me believe that the index has not yet tapped the true and full potential of the market. An undervalued asset is a hidden gem undiscovered. It might mean an opportunity to benefit from future price growth if the market adjusts to a more accurate value of Sensex.

This translates to an 11.66% short-term growth rate, showing how fast the earnings of Sensex companies are likely to rise. That's a pretty good growth rate and a healthy sign for the market prospects in the near term, as it would indicate a lot of positivity on the prospects of companies constituting Sensex, hence the index as well.

However, when I looked at who the returns came from, it is pretty clear to me that for the most part, those returns come through dividends—the part of company profits shared with investors are a small amount. The yield from dividends has been pretty low, being only a 1.36 percent return over the last three years. Which

means that most the returns in short term probably come from a growth in price rather than those regular payouts.

One thing that appeared to be striking in the short-term analysis was the effect of discounting. As I calculate the present value of the cash flows by discounting the future cash flows, I noticed how quickly the values went down as time passed. It has highlighted the need to know how time and risk factors influence the value of money. The cost of equity simply speaks of the returns which investors expect as a mitigation of the risk associated with them while investing in the market. In the scenario described here, discounting worked towards showing just how careful a move it was towards return when it came to finding out how much future returns actually look for the present value of returns.

On overall short-term analysis, still all good for the Sensex. Undervaluation combined with promising growth rate along with market majorly on price appreciation; much has to feel good about that. To an investor also, this could mean some opportunities in the market offered by undervaluation today.

Long-term Analysis findings:
Long-term analysis will present a contrasting picture for you. The intrinsic value of the Sensex decreases to 71,299 over a fifteen-year horizon. This is below the current market level of 77,690, meaning that the Sensex could be overvalued in the long run. Although short-term prospects appear to be bright for growth, the long term is more conservative. The growth rate over fifteen years is expected to be 10.89%, which is just a little lower than that in the short term. This slower growth reflects the reality that economies and markets often expand at a steadier pace over longer periods.

Similar to the short term, returns in the long term are driven primarily by price appreciation. The total yield over fifteen years stands at 1.44%, once again reflecting that dividends account for only a small proportion of the expected returns. That is a common trend in the Indian stock market where companies tend to reinvest their profits to fuel growth rather than distributing it as dividends. Although this type of strategy favors long-term growth, investors will rely more on market-related returns rather than on consistent income from their investments.

Discounting has an even more significant impact in the long-term analysis. Since the time horizon is stretched, much more value is lost for the future cash flows while discounting to the present. This brings out that the discount rate is a critical consideration, since it reflects the expense of equity and market-related risks. For instance, the long-term cost of equity was almost 9.73% that was higher than the equivalent short-term of 8.46%. A discount rate would mean a diminished present value for future returns, accounting for why the intrinsic Sensex is lower in the long-term scenario, partially.

The long-term study brings in some red flags for the investor. While the Sensex's long-term growth remains optimistic, overvaluation seems to indicate a warning. Major dependence on price appreciation and coupled with the slowdown of growth and discounting effect necessitates careful planning in terms of long-term investment.

Sensitivity to Assumptions:
Going through all the analysis one thing comes to mind- that whatever assumptions you take has significant implications on the outcome. Small changes in factors like growth rate, risk-free rate (the return on risk-free investments like government bonds), or the equity risk premium (the extra return investors demand for taking on stock market risks) may result in big differences in the valuation. For instance, an increased growth rate would enhance the intrinsic value, and an increased discount rate would reduce it. This sensitivity towards assumptions reminds us of the essence of realism and thoroughness of financial analysis.

The results from both timeframes, the short term and the long term, would give valuable insights into the state of Sensex and its future prospect. The short-term scenario would present an undervalued aspect that might be optimistic for the growth of the market so that the investor could enjoy the benefits out of the same. However, the long-term overvaluation would suggest that the market may be overestimating the growth prospects in the future. In this dualism, there is an important indication that financial markets are dynamic in nature where short-term trends and long-term fundamentals would often say different stories.

CONCLUSION

Short term analysis of Sensex shows the former seems to be undervalued. It offers investment opportunities through taking advantage of the probable growth in the market. This is evident from the optimistic growth rate 11.66% along with reliance on price appreciation, which speaks of confidence in the market's short-term prospects.

However, analysis in the long run requires caution. Slight overvaluation, a lower growth rate, and a significant influence of discounting call for careful planning. Investors need to be cautious about their portfolios and seek fundamental factors rather than fixating on short-term trends.

This research has not only provided me with insights into the Sensex but also taught me the value of understanding the broader factors driving market valuations. By examining both the short-term optimism and

long-term challenges, I've gained a clearer perspective on how to approach investment decisions in a dynamic financial landscape.

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