Significance of GDP and Population Growth in Shaping the Indian Stock Market: A Case Study of BSE Index

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Abstract

Various factors impact the stock market. Among them, gross domestic product and population growth are the significant variables. This research paper focuses on how GDP and population growth affect the Indian stock market. This study aims to examine the association between real GDP, population growth, and the performance of the Indian stock market. This research's findings, which explore the impact of GDP and population growth on volatility between the Bombay Stock Exchange (BSE) and macroeconomic variables, are crucial for shaping investment plans. The analysis utilizes a multiple regression equation model to examine how these factors interact. The data collected consists of annual records of Real GDP and the population growth rate from 1996 to 2023. The result shows a strong positive correlation between GDP and the BSE index.

Similarly, population growth and the BSE index have a strong negative correlation. The regression model provides a significant impact of independent variables on the BSE index, where the independent variables explain a 96.62% variation in the BSE Index. Also, BSE increases by 84.49% with a one percentage point GDP growth, whereas a one percentage increase in population growth results in a 102.04% decrease in BSE. The study found that the macroeconomic variables GDP and population growth used in regression analysis are suitable explanatory variables. The regression model constructed in this study is essential in explaining the relationship between the dependent and independent variables. However, the current research employs only two explanatory variables to analyze stock prices. Therefore, there is an opportunity for further examination to elucidate how these additional explanatory variables impact stock prices. This study opens the door for future research to explore the influence of other macroeconomic variables on the Indian stock market. The research findings help the concerned stakeholders make policy aware of them in the investment plans, providing a solid bedrock for decision-making in the volatile stock market.

Introduction

In the initial stages of human history and pre-history, the population proliferated until the 17th century (i.e., .002% per year). Population growth began accelerating with advancements in science, agriculture, and industry. It took humanity over a million years to reach the first billion around 1800. By 1900, a second billion was added, and another 3.7 billion was adjoined in the twentieth century. The present world population is estimated at 6.8 billion. Every four days, the world's population increases by one million. India, the largest democratic country in the world, covers 2.4% of the world's total land, and 16% of the world's population inhabits it. Every year, about 1.6 crore persons are incorporated into its population. According to the United Nations Fund on Population Activities (UNFPA), the world population increases by about 78 crores yearly, and India contributes about one-fifth of this growth. As per the 2011

census, India now has a population of 1.2 billion, comprising 624 million males and 587 million females. It denotes an increase of 181 million people since the census in 2001, which is nearly equivalent to Brazil's population.

Population research has become increasingly significant as the world's population continues to extend at an unprecedented rate. As the population increases, so do several economic indicators, including the Sensex index in India. Understanding the potential impact of demographic trends on the stock market is critical for investors and policymakers. Population research involves the study of demographic trends such as fertility rates, mortality rates, migration patterns, and aging populations. The demographic data obtained from this research imparts vital insights into economic and social development trends. Understanding a particular country or region's current and future population growth is essential. The data obtained from population research also helps governments and non-governmental organizations generate policies that cater to the evolving needs of the country's population. Sensex is the two primary stock market indexes that reflect the investment performance of India's Bombay Stock Exchange (BSE), respectively. These indexes represent the overall direction of the stock market in India and are used as a barometer to measure the country's economic performance. As population research affects demographic trends, it is unsurprising that demographic changes also impact these indexes. One significant demographic trend that affects the stock market is the aging population. As the population ages, the demand for specific goods and services grows while the demand for others declines. For instance, healthcare demands tend to increase while the demand for durable goods like automobiles decreases. Companies that cater to the aged or healthcare service providers, thus, experience an increase in demand, which ultimately impacts the stock market positively. Likewise, an increase or decrease in the youth population can also affect the stock market. The youth are often heralded as drivers of the economy due to their high consumption patterns. However, they are also more volatile in their investments than older investors. This sentiment plays a crucial role in stock market performance and changes in the Sensex index. On the other hand, an aging population may negatively affect the stock market, as older individuals are inclined to save more and spend less, leading to reduced demand for specific services and goods. However, this trend could also be reversed, with the growing demand for healthcare services specifically targeted at the senior, leading to increased investment in healthcare-related companies and, consequently, the stock market. Migration patterns also play a pivotal role in determining the Sensex value, with growth in urban areas leading to increased demand for housing and infrastructure, offering investment opportunities in real estate and construction industries. Subsequently, the stock market performance is positively affected.

Economic growth rate (EGR) is vital to a country's financial health and accomplishments. It measures the change in the total value of merchandise and services caused in a country between two periods. The distinguishing growth rate changes established the change in result over a period - higher EGR displays faster economic growth while lower or negative progress results in a slower or declining output. EGR characterizes a country's economic progress by comparing its total result and earnings growth between various periods. It determines a primary metric of a nation's economic advancement. GDP growth rates shall be used to measure the comparative condition of an economy over time. These numbers are collected and reported quarterly or annually (Fernando, 2023). India's GDP growth reached 7.2 percent in 2023, making it the world's largest economy. Strong service sector performance and strong consumption growth, in addition to a recovery from the COVID-19 virus that impacted the economy throughout 2020 and 2021, have contributed to India's GDP growth rate. In 2023, India's nominal GDP was estimated to reach $3.75 trillion, making it the fifth-biggest economy in the world. (World Bank, 2023) Gross Domestic Product per capita is obtained by separating a country's GDP by its total population. In the following table, nations general are ordered to establish their GDP per person at Purchasing Power Parity, and it further contains the Nominal GDP per capita.

GDP is the total profit of all merchandise and duties caused in a given country over a likely period, ordinarily a period or a quarter. Due to the offering of earnings and money built apiece saving, GDP per capita is frequently believed to be evidence of a country's level of material comfort (Worldometer, 2023). The stock exchange is where people can

trade shares of publicly traded companies. In a company, shares are ownership units that give shareholders the right to claim their assets and profits. The market allows investors to play a part in the growth and development of various sectors or industries, diversify their portfolios, and reduce risk. In addition, companies have access to capital and liquidity, which may help them expand their activities and create more excellent value for stakeholders on the stock market. (Stock Market Library, 2020)

Statement of the problem

The stock market is one of the most significant issues for the 21st-century generation as it reflects a country's financial health (Academies Press, 2023). The connection between India's stock exchange performance GDP and population growth must be clarified. The stock markets in India are experiencing extreme volatility, which is a matter of great worry for both financiers and procedure makers. The research aims to define the primary determinants moving the stock exchange, focusing on GDP and population growth rate effects. It is critical to understand how investors behave in the stock exchange. Because they rely so heavily on news from brokers and important investors, many investors need more understanding of the stock exchange. Making wiser investing determinations can benefit financiers, policymakers, and investigators by giving a better understanding of the variables behind stock exchange evaporation. The extending significance of capital markets everywhere supports the idea that "finance" is essential to economic progress. Stock market growth relates to economic growth and population growth. The performance of the stock exchange is a significant indicator of a country's stability and happenings, and this correlation is still relevant to examine.

Objectives of the study

This study's empirical analysis clarified how GDP and population growth influence India's Bombay Stock Exchange performance. The study mainly checked the connection between GDP, population growth, and the Indian stock market to measure how these key macroeconomic determinants relate to and impact the country's primary stock index.

Limitations of the study

This research focuses explicitly on how GDP and population Growth rate impact the stock market in India. As we concentrated only on India, the results of this study might only be relevant in some nations. For this study, we have used the most recent data gathered, and its accuracy depends on the credibility of these data sources. This study focuses solely on India's Bombay Stock Exchange (BSE). It does not consider other macroeconomic factors like unemployment, inflation, foreign direct investment, remittances, dividends, exchange rates, political events, or natural disasters, even though they can also influence the stock market. Additionally, India has multiple stock exchanges, but this research concentrates exclusively on BSE.

Literature Review

Modigliani and Brumberg (1954) furnished one of the first studies that revealed a link between asset prices and different phases of the life cycle model. They developed the life cycle hypothesis, which states that consumers' consumption and saving decisions aim to level consumption during their lifespan. The varying developments in asset accrual and portfolio choices over different stages of a person's life cycle alter demand-supply patterns for assets, leading to fluctuations in asset prices. They provide a theory explaining investors' saving and investment behavior

during their life span. According to their theory, the productively employed younger individuals tend to save and subsequently invest in tangible and financial assets over their period of employment. At the early stage of employment, most of the savings would be directed towards housing, leading to a rise in real estate prices. At a later stage, during the mid-40s and above, substantial excess savings would be invested in the stock markets. On the contrary, the old age group, as non-savers and sellers of common stock, tends to impact its return negatively.

Morin and Suarez (1983) provide additional empirical evidence to the studies on the effect of wealth and investors' life cycle on risk aversion. Their study reveals that the phase of the investor's life cycle plays a vital role in portfolio selection behavior. Also, risk aversion increases uniformly with age. Their study investigates Canadian households' demand for risky assets. For this, they used the analysis of covariance techniques. When the sample and wealth parameters were revised according to previous empirical studies, their result on relative risk aversion was upheld, and their results supported the existing empirical studies.

Bakshi and Chen (1994) explored the associations between demographic transition and asset prices. The population under study was the US population from 1900 to 1990. They have tested the life cycle investment hypothesis and later tested that as the investor's age increases, they become more risk averse. Their results show that earning people in their 20s and 30s first invest in housing facilities, and after that, as savings accumulate, they invest in financial assets. They used average age and consumption growth data to explain stock and T-bill returns and found that average age had a significant effect. Their research revealed that the risk-taking behavior of financial investors changes with age, and they become more risk-averse and prefer less risky assets as they approach retirement. For their statistical testing, they used Euler equations and a two-factor model based on consumption growth and percentage change in average age. They thus found robust provisions for their lifecycle risk aversion hypothesis and a statistically strong positive relationship between the stock excess returns and growth in the population's average age.

Chaves D.B. (2012) studies the influence of demographic transition on the economy and financial markets of 30 countries: the U.S., Japan, Denmark, Spain, Ireland, and China. He has considered the difference between the share of workers in the population and the share of retirees. Further, the influence of the change in this difference on the GDP per capita growth is studied. He has also studied the impact of the difference in the share of the population between the potential buyers and sellers on the stock and bond excess returns. In the article, he reveals that developing countries are experiencing a significant change in their demographic structure, which will impact economic growth and capital markets, which is not very encouraging if past trends are considered.

Vithalbhai (2020) evaluates the effect of GDP on stock market development. Secondary data collected from the Indian stock market were used for the study. Statistical tools for testing hypotheses, which are Descriptive statistics, Co-relation, and simple Regression analysis, were used for the study. Findings from the study revealed a strong relationship between GDP growth and stock market movement in India. The study further revealed that GDP significantly affects stock market development in India. The study's outcome reflects the regulation and market structure of the Indian capital market. The findings from the study may have been different if it was to be conducted in Nigeria. A deeper investigation into the relative importance of various channels, especially under alternate market structures, may change the outcome of the findings. The previous study also focuses on GDP and capital market growth, while the current research focuses on GDP and stock returns.

Tripathi and Kumar (2015) analyzed whether macroeconomic factors sway aggregate stock returns in BRICS (Brazil, Russia, India, China, and South Africa) markets. They find evidence that GDP significantly impacts stock returns only in Russia and India. In Russia, there is a weighty negative relationship between aggregate stock returns and past GDP values. At the same time, in India, they institute the idea that Indian stock returns are positively linked to contemporaneous GDP values. The study attributed the insignificant influence of GDP shocks on stock returns in South Africa and Brazil to the notion that stock returns tend to lead rather than follow GDP. Consequently, South African and Brazilian stock markets have already discounted for GDP; hence, stock prices reflect future GDP expectations. The current study employs panel data analysis to investigate the relationship between the chosen macroeconomic determinants and the stock returns in Nigeria, compared to the purely time-series data sets the previous study used.

Olubiyi, Babalola, and Ayemidotun (2017) examine the effect of the Gross Domestic Product on the Stock Exchange in Nigeria from 1996 to 2015. The study uses secondary data procured from the annual stock market report of the Nigerian Exchange and the yearly statistical bulletin of the Central Bank of Nigeria. The variables adopted for the study include Gross Domestic Product (GDP), Federal Government/State Bonds (FGS), Corporate Bonds (CB), Alternative Securities Market (ASeM), Exchange Traded Fund (ETFs), Main Board (MB) and Premium Board (PB). Findings from the study show that Exchange-traded funds and the Main Board positively impact the GDP. The current study departs from the previous study because it examines GDP and stock returns, not GDP and stock exchange.

Limitations of the study

This research focuses explicitly on how GDP and Population Growth rate impact the stock market in India. As we concentrated only on India, the results of this study might not be relevant in every nation. For this study, we have used the most recent data gathered; its accuracy depends on the credibility of these data sources. This study focuses solely on India's Bombay Stock Exchange (BSE). It does not consider other macroeconomic factors like unemployment, inflation, foreign direct investment, remittances, dividends, exchange rates, political events, or natural disasters, even though they can also influence the stock market. Additionally, India has multiple stock exchanges, but this research concentrates exclusively on BSE.

Research Objectives

1) To study the linear relationship between BSE Sensex and population growth rate and GDP.
2) To study the correlation among BSE Sensex, population growth rate, and GDP.

Data Collection

The Sensex data was collected from the BSE website annually, and macroeconomic variables data was gathered from the World Bank database as per the research objective of this paper. Here, two macroeconomic variables have been finalized: GDP (current US$) and Population growth (annual %). In GDP (current US$), GDP has been considered at purchaser's prices, which is the aggregation of gross value added (GVA) by all resident producers in the economy by adding any product taxes and subtracting any subsidies not appended to the value of the products. It is premeditated without making deductions for the depreciation of fabricated assets or for the degradation and depletion of natural resources. Data are in current U.S. dollars. GDP dollar figures are converted from domestic currencies using single-year official exchange rates. A substitute conversion factor is used for a handful of countries where the official

exchange rate does not reveal the rate effectively applied to actual foreign exchange transactions. In the Population growth (annual %), the annual growth rate of the population for year t is the exponential growth rate of the midyear population from year t-1 to t, demonstrated in percentage form. The population depends on the de facto definition of population, which counts all residents irrespective of citizenship or legal status. The data ranges from 1996 to 2023. The reason for choosing the dataset from 1996 to the recent year, i.e., 2023, are: -

- India's GDP growth rate was 6.8% in 1996-97, higher than the 1980s average of 5%.

- The manufacturing sector grew by 10.6%.

- Foreign currency reserves increased from $17 billion to $19.5 billion by February 27, 1997

- Mutual funds raised Rs. 2167 crore from different schemes between April and December 1996.

- By the end of December 1996, 427 Foreign Institutional Investors (FIIs) were registered with SEBI and had invested around $2032 million in the securities market.

- Indian issuers made Euro-issues (GDRs and FCCBs) of $1304 million during the same period, which was higher than in 1995-96.

Methodology

The analysis is based on correlation analysis, multinomial linear regression, and descriptive statistics. Data was collected from the BSE website and the World Bank database from 1996 to 2023. Correlation Analysis is a statistical methodology used to discover if there is a relationship between two variables or datasets and how strong that relationship may be. It is also used to spot patterns within datasets. A positive correlation result means that both variables increase about each other. In contrast, a negative correlation means that as one variable decreases, the other increases. The P-value of the correlation coefficient evaluates how well your data rejects the null hypothesis, which states that there is no relationship between the two compared groups. Successfully rejecting this hypothesis tells you that your results may be statistically significant. Multiple linear regression (MLE) is a statistical methodology that uses some explanatory variables to forecast the outcome of a response variable. Multiple regression is an appendage of linear (OLS) regression that uses just one explanatory variable. While constructing the linear model, we have made a natural log transformation of GDP and SENSEX to reduce the magnitude of the data and make it comparable with other data. The model was constructed as Ln (BSE Index) = Ln (GDP (current US$)) +population growth rate. Descriptive statistics involves a set of methods used to summarize and narrate a dataset's main features, such as its variability, central tendency, and distribution. These methods furnish an overview of the data and help identify patterns and relationships. We have calculated descriptive statistics for all the variables considered in the analysis.

Model of The Research Paper

Ln (Bse Sensex) = α + β*P + β*Ln(G)

Where:
'P': Population growth rate
'G': GDP at current US$
'α': representing the coefficient intercept term as constant
'β': representing the slope intercept as vibrant due to the multiplier value of Population growth rate and GDP in Time.

The analysis was done using R software, with the regression analysis.

Analysis and Interpretation

1. Descriptive statistics

Descriptive statistics points out a set of methods utilized to summarize and describe the main features of a dataset. The foremost objective of descriptive statistics is to effectively summarize and delineate the main features of a dataset, rendering an overview of the data and helping to identify patterns and relationships within it.

Features	*LN_BSE SENSEX_Close*	*Ln_GDP (current US$)*	*Population growth (annual %)*
Mean	9.5639	27.8532	1.4039
Median	9.8212	28.0362	1.3844
Standard Deviation	1.0172	0.7512	0.3655
Kurtosis	-1.2458	-1.4615	-0.8560
Skewness	-0.1861	-0.2656	-0.2278

Table 1

Table 1 depicts the descriptive statistics of the variable used in this paper's analysis.

Standard deviation is widely used to measure dispersion or variability. A low or slight standard deviation indicates data are clustered tightly around the mean, and a high or significant standard deviation suggests data are more spread out. Higher standard deviation implies higher uncertainty, and vice versa. As per Table 1, Sensex has the highest Standard deviation, and population growth has the lowest. However, all three standard deviations do not differ much.

Kurtosis is a statistical estimate describing observed data distribution around the mean. A positive kurtosis indicates that the data is more concentrated around the mean than a normal distribution, while a negative kurtosis indicates that the data is more spread out. Table 1 shows that the Kurtosis of all three variables has negative values, suggesting fewer extreme values in the data.

Skewness is a statistical measure that depicts the asymmetry of the distribution of values in a dataset. For a negatively skewed distribution, the tail on the left side (smaller values) is longer than the tail on the right (larger values). This implies that most data points are concentrated on the right side of the distribution, with a few extreme values on the left side, which are exceptionally lower than other values.

In addition, we observe that the means and medians of all three variables are pretty close, indicating that all the variables have symmetrical distributions.

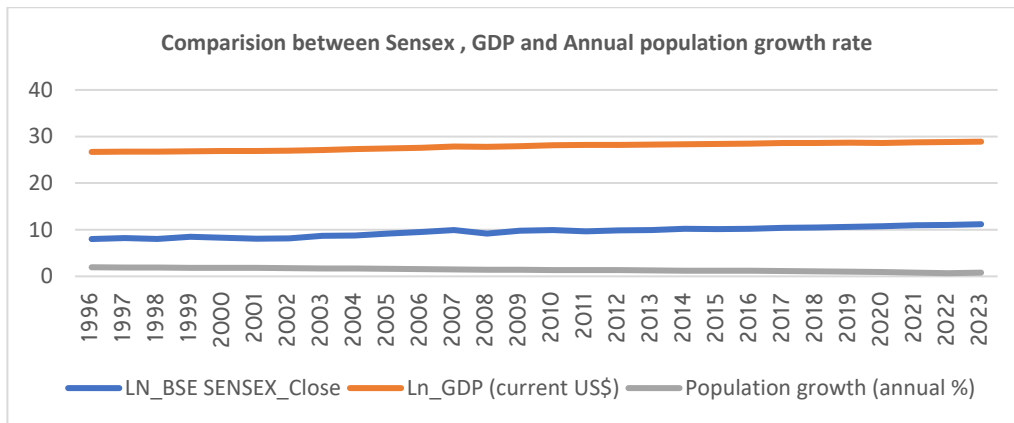Figure 1 also proves all these facts.

Figure 1: Data Plot

2. Correlation Testing

Correlation is used to denote the association between two quantitative variables. The correlation coefficient is calculated on a scale ranging from + 1 through 0 to – 1. The correlation between two variables is demonstrated by either + 1 or -1. When both variables increase together, it is positive. When the variables change in the opposite direction, it is negative. The complete absence of correlation is represented by 0. Here, Pearson's product-moment correlation coefficient has been calculated, which measures the linear relationship linking two variables measured on interval or ratio scales. It can only be used to estimate the relationship between two variables, which are also normally distributed. It is usually denoted by r and can only take values between −1 and 1. Along with the test statistic, the p-value is also calculated to check the significance level and accept or not accept the null hypothesis. The null hypothesis presumes no correlation, and the alternative hypothesis states a significant correlation.

Pearson's product-moment correlation	Pearson's product-moment correlation	Pearson's product-moment correlation
data: Population_Annual_Growth_rate and Ln_GDP_at_current_USD	data: LN_BSE.SENSEX_Close and Ln_GDP_at_current_USD	data: LN_BSE.SENSEX_Close and Population_Annual_Growth_rate
t = -21.172, df = 26, p-value **< 2.2e-16**	t = 25.418, df = 26, p-value **< 2.2e-16**	t = -21.626, df = 26, p-value **< 2.2e-16**
alternative hypothesis: true correlation is not equal to 0	alternative hypothesis: true correlation is not equal to 0	alternative hypothesis: true correlation is not equal to 0
95 percent confidence interval: -0.9872113 -0.9401079	95 percent confidence interval: 0.9577076 0.9910333	95 percent confidence interval: -0.9877253 -0.9424600
sample estimates: cor	sample estimates: cor	sample estimates: cor
-0.9722019	**0.9804656**	**-0.973311**

Table 2

Table 2 exhibits Pearson's product-moment correlation of the variables. Only Sensex and GDP have significant positive collinearity, but the other two combinations have significant negative collinearity. Here, the notable point is that all collinearity coefficients are statistically significant.

3. Regression Analysis

Residuals:					
Min	1Q	Median	3Q	Max	
-0.33613	-0.09126	-0.01588	0.09912	0.43957	
Coefficients:					
	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	-12.5381	6.2768	-1.998	0.056762	.
Population_Annual_Growth_rate	-1.0204	0.4207	-2.425	0.022842	*
Ln_GDP_at_current_USD	0.8449	0.2047	4.128	0.000356	***
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1					
Residual standard error: 0.1871 on 25 degrees of freedom					
Multiple R-squared: 0.9687, Adjusted R-squared: 0.9662					
F-statistic: 386.6 on 2 and 25 DF, p-value: < 2.2e-16					

Table 3

Table 3 refers to the multinomial linear regression model mentioned in "Model of the Research Paper."

As observed, all independent variables are statistically significant, and Adjusted R^2 is satisfactory (96.62%). The F-test of overall significance concludes that the model lays out a better fit than the intercept-only model.

Findings and Conclusion of The Study

1) The annual population growth rate and the change in GDP significantly impact the BSE Sensex.
2) Control of population growth needs the utmost attention for India's financial upliftment.
3) For India's financial progress, fiscal policy for positive GDP growth needs attention.
4) Uncontrolled population growth impairs the consistent economic growth of India.
5) This paper has analyzed 28 years of data as a whole. Still, we can break the study period into relevant years. In that case, it will depict the impact of GDP and population growth in different time phases.

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