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# Sectoral Beta Dynamics in India: A Decadal Analysis

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## Abstract

Beta coefficient is a measure of sensitivity of any stock or index with reference to the market index. The present study is an attempt to determine the beta of sectoral indices in India and their importance on investment decisions. The objectives of this study are to determine the relationship between sectoral indices and market index, and to compare the beta values of different sectors before and after the COVID pandemic. For fulfilling the first objective, values of 11 sectoral indices for 13 years, i.e. from 2012 to 2024, of BSE is considered and then the betas of each sector is calculated with reference to market index i.e. BSE Sensex. The result seems to be interesting as IT industry is having least beta of 0.21 and banking industry is having the highest beta of 1.25. For our second objective, we considered beta of the same sectors for three years pre-pandemic and three years post-pandemic. Our results indicate that realty sector has the highest deviation during the six years. Post-pandemic the sector with the highest beta (metal) hasn't changed but FMCG sector bears negative beta now.

**Keywords:** beta, COVID, sectoral indices, realty, FMCG.

JEL Classification: G11, G12, G15, C58

## Introduction

The field of asset pricing has been shaped by fundamental theories that help investors understand and predict the behavior of securities in financial markets. The Capital Asset Pricing Model (CAPM), developed by Sharpe (1964), Lintner (1965), and Mossin (1966), stands as a cornerstone theory linking risk and expected return through the concept of beta. Beta quantifies the sensitivity of a security or portfolio relative to market movements. Beta is a key measure of systematic risk. CAPM faced criticism and more sophisticated models like the Arbitrage Pricing Theory (APT) by Ross (1976) and the Fama-French Three-Factor Model (1993) were developed. However, the concept of beta remains central to understand market relationships.

Blume (1971) suggested that beta coefficients have significant predictive power. He also indicated that beta exhibits variation over

time. So, the temporal analysis of beta is important. Sectoral analysis through the lens of beta coefficients offers valuable perspectives for investors seeking to optimize their portfolios. As different sectors have varying degrees of sensitivity to the market, understanding these relationships becomes paramount. The COVID-19 pandemic was as an unprecedented global economic shock and it created a natural experiment to examine how these sectoral relationships may have evolved under extreme market conditions. Such analysis is particularly relevant in the Indian market, one of the world's largest and most dynamic emerging economies.

This research examines the beta coefficients of eleven sectoral indices on BSE[1] over a thirteen-year period from 2012 to 2024. The eleven sectoral indices represent the major industries in the Indian economy. Beta coefficients measure the systematic risk of an asset. The time period of the study also covers the COVID crisis. Thus, the study also conducts a comparative analysis of beta on these sectoral indices in the pre-COVID and post-COVID periods. This section is followed by literature review. After the literature review, methodology section is present, which is followed by the findings section. Then the study has the discussion section followed by conclusion and references.

**Literature Review**

The concept of beta was first introduced in the Capital Asset Pricing Model (CAPM) by Sharpe (1964), Lintner (1965), and Mossin (1966). Beta was proposed as a measure of systematic risk. Since then, it has undergone significant development. Systematic risk represents the sensitivity of an asset's returns to movements in the market portfolio. CAPM suggested beta as the only risk factor that could explain expected returns in excess of the risk-free rate. However, when empirical testing of CAPM was conducted, researchers identified limitations in beta's explanatory power.

Fama and MacBeth (1973) performed an extensive empirical analysis of the CAPM in their research. The study provided evidence in support of the risk-return association, yet it revealed inconsistencies which indicated beta as an insufficient factor to explain asset returns. This led to what Roll (1977) termed the "critique." According to Roll, CAPM remains untestable because researchers cannot observe the actual market portfolio. Black et al. (1972) found that stocks with high beta levels produced results below model predictions yet stocks with low beta levels exceeded predictions. This suggested a flatter security market line than CAPM proposed. The inconsistency catalyzed research into alternative asset pricing models. Ross (1976) introduced the Arbitrage Pricing Theory (APT), which expanded beyond beta to include multiple systematic risk factors. Similarly, Fama and French (1993) developed their three-factor model, incorporating size and value factors alongside market beta. This significantly improved the explanatory power of asset pricing models.

Despite these advancements, beta has remained relevant in financial analysis. Blume (1971, 1975) conducted pioneering work on the stability of beta. Blume found that individual security betas tend to regress toward the mean over time while portfolio betas exhibit greater stability. This research highlighted the temporal dynamics of beta that continue to interest researchers today.

**Cross-Sectional and Time-Series Variations in Beta**

The cross-sectional and temporal variation in beta across different sectors has been well-documented in financial literature. Hamada (1972) demonstrated that financial leverage significantly impacts beta. Higher leverage is typically associated with higher beta values. This finding helps explain the high betas observed in the banking sector across multiple markets. Fabozzi and Francis (1977) examined beta stability during bull and bear markets. They observed that betas tend to increase during bear markets for many securities. This asymmetric response highlighted the dynamic nature of systematic risk across different market conditions. This phenomenon is later termed as "conditional beta" by researchers such as Jagannathan and Wang (1996).

In the Indian context, Mohanty (2002) examined the stability of beta for BSE-listed companies, finding considerable variation across time periods and economic conditions. Singh and Singh (2016) specifically analyzed sectoral betas in the Indian market, documenting significant differences across sectors. They observed that technology and consumer goods typically exhibited lower betas than cyclical sectors like metals and realty. Choudhary and Choudhary (2010) found that beta values

for Indian sectoral indices exhibited substantial time-variation, especially around periods of market stress such as the 2008 financial crisis. Their study suggested that beta stability could not be assumed when making long-term investment decisions across sectors. Recently, Kumar et al. (2022) examined the evolution of sectoral betas in India over a 15-year period, finding that while sector rankings by beta remained relatively stable, the magnitude of betas changed significantly during crisis periods.

**Impact of Pandemics and Major Market Disruptions on Beta**

Researchers have examined the impact of previous health crises and major market disruptions on beta coefficients. Baker et al. (2020) documented that the stock market reaction to COVID-19 was unprecedented in its severity and speed compared to previous pandemics and health crises. Studies of previous health emergencies, such as SARS in 2003, provide limited but valuable insights. Chen et al. (2007) examined the impact of SARS on industry betas in Taiwan. They found significant increase in systematic risk for tourism and retail sectors but decrease in beta for healthcare-related industries. These findings suggest that health crises can alter the risk profiles of economic sectors based on their exposure to the crisis. The COVID-19 pandemic presents a harsh case study. Mazur et al. (2021) examined U.S. stock market reaction during the initial pandemic phase (January-March 2020) and detected dramatic shifts in sectoral betas. Natural gas, food, healthcare and software stocks displayed safe-haven properties with reduced beta while petroleum, real estate, entertainment and hospitality sectors faced substantial beta increase.

Harjoto et al. (2021) analyzed how systematic risk was affected by COVID-19 in the global markets. They suggested that beta volatility increased during the pandemic onset but displayed heterogeneous effects across countries and sectors. Their study documented that sectors with high physical proximity requirements and discretionary consumption characteristics suffered the largest increase in beta. Several studies show that the pandemic's impact on sectoral betas continued beyond the initial shock. Baek et al. (2022) found that many sectors continued to display modified beta profiles even after a year of the pandemic start. This suggests a potential structural change in market relationships. This finding is relevant for the comparison of pre- and post-pandemic beta values in this study.

**Beta and Negative Correlation Phenomena During Market Stress**

It is interesting to see negative beta values for certain sectors during and after the COVID-19 pandemic. Negative beta indicates countercyclical behavior. It means that the sector moves in the opposite direction to the broader market. Negative beta is rare in normal conditions but they can be seen during periods of market stress. Baur and Lucey (2010) introduced the concept of "flight-to-quality" during market crises. According to this concept, investors shift from higher-risk assets to perceived safe havens during crises. Their research focused on gold during financial turmoil and demonstrated how certain assets develop negative correlation with the broader market during crisis period. This explains how traditionally defensive sectors like FMCG might develop negative beta during and after the COVID-19 pandemic.

Similarly, Gulko (2002) examined how government bonds can shift from positive to negative correlation with equity market during crisis period. This is termed as “decoupling.” Woodward and Anderson (2009) examined how commodity markets, particularly gold and oil, can exhibit shift in beta relationships during market shocks. Their research suggested that these shifts could persist for extended periods after the initial shock.

**Implications for Investment Strategies and Portfolio Construction**

The temporal instability of beta has significant implication for investment strategy and portfolio construction. Ghysels (1998) argued that assuming beta to be constant can lead to substantial errors in asset pricing and risk management. Jagannathan and Wang (1996) proposed conditional CAPM framework that accounts for time-varying beta. Their work suggests that investors should consider how beta evolves under different market conditions rather than relying on historical averages.

In terms of sectoral investing, Faff et al. (2000) examined how industry rotation strategies can exploit the sensitivity

of sectors to market movements and macroeconomic factors. Their research hinted that understanding sectoral beta dynamics can enhance portfolio performance through tactical asset allocation. Recently, Narayan et al. (2022) examined how COVID-19 pandemic affected optimal portfolio weights across sectors. They found that traditional portfolio optimization methods required adjustment to account for the altered correlation structure between sectors. These studies suggest that investors need to reassess traditional assumptions about sectoral risk profiles in the post-pandemic environment.

### Research Gap and Objectives of the Study

Despite the rich literature on beta and growing body of research on COVID-19's impact on financial markets, the present study addresses several gaps. First, while numerous studies have examined the immediate market reaction to the pandemic, fewer have conducted a systematic comparison of pre- and post-pandemic sectoral betas over extended periods. This study examines the market reaction to pandemic by analyzing three-year windows on either side of the pandemic.

Second, existing research on COVID-19's impact on financial markets has focused on developed markets. Less attention is paid to emerging markets like India despite their increasing importance in the global economy. BSE's diverse sectoral composition offers a valuable context for understanding how different types of industries respond to and recover from such a shock.

Finally, existing literature does not talk about the impact of pandemic on cyclical and defensive sectors. This study adds to the understanding of how defensive sectors may fundamentally alter their relationship with the market following extreme shocks. This study contributes to the literature on safe-haven assets during crisis periods. By addressing these gaps, the present study contributes to both the theoretical understanding of beta dynamics during market disruptions and the practical application of this knowledge to investment decision-making in the post-pandemic environment.

Thus, the objectives of the study are:

- To study sectoral betas for investment decisions.
- To study sectoral betas pre- and post-COVID.

## Methodology

### Data and Sources

The data used in the study consists of index values of eleven sectoral indices and BSE SENSEX from 1st January 2012 to 31st December 2024. The time for the data is selected after 2012, as it is devoid of the effects of the US Financial crisis and the European Debt crisis. The eleven sectoral indices include BSE Consumer Durables Index, BSE Capital Goods Index, BSE Health Care Index, BSE Auto Index, BSE FMCG Index, BSE IT Index, BSE Metal Index, BSE Oil & Gas Index, BSE Realty Index, BSE Public Sector Index and BSE Bankex Index. BSE SENSEX is used as the proxy for the market return. The pre-COVID period is defined as 1st January 2016 to 31st December 2019 and the post-COVID period as 1st January 2022 to 31st December 2024. CMIE Prowess database was used to extract the indices values.

### Tools and Techniques

Beta of a security measures sensitivity of stock's return relative to the entire market. Moreover, it gives a sense of a stock's market risk compared to the market as a whole. Investment analysts uses Greek letter β to represent Beta. Beta can be calculated by regression analysis. Apart from using regression it can be used by applying one formula:

$$\beta = \frac{\text{Covariance}\,(R_i, R_m)}{\sigma_m^2} \qquad \text{Eq.(1)}$$

Where, $R_i$ = Return of sector indices

$R_m$ = Return of Market index i.e. BSE

$\sigma_m^2$ = Variance of $R_m$

Thus, to calculate relationship between industry index and market index we used the formula for calculating Beta. Beta can also be calculated by using CAPM. We are not using CAPM here because CAPM calculates the β for stocks not for industry indices. To calculate covariance, we have to calculate daily returns from the closing values of both the particular industry index and market index. To calculate covariance of returns we have used the formula:

Covariance $(R_m R_i)$ = Eq.(2)

$$\frac{1}{n-1}\sum_{i=0}^{n}(R_i - \overline{R_i})(R_m - \overline{R_m})$$

Where, $R_m$ = Return of Market index

$R_i$ = Return of sector indices

$\overline{R_i}$ = Average return of sector indices

$\overline{R_m}$ = Average return of market index

n = No. of days

To calculate variance of the market index the following formula has been used:

$$\sigma_m^2 = \frac{1}{n-1}\sum(R_m - \overline{R_m})^2 \quad \text{Eq.(3)}$$

Where, $\sigma_m^2$ = variance of market index

n = no. of days

$R_m$ = return of market index

$\overline{R_m}$ = average return of market index

**Results and Findings**

The beta of the indices indicates the sensitivity of the sector to the overall market. Higher beta value indicates a more sensitive or responsive sector. Table 1 indicates that the IT (Information Technology) sector is the least sensitive sector, whereas the banking sector is the most sensitive sector. FMCG and Realty also have beta. Metal and Capital goods have high beta. A risk-averse investor should not invest in banking, metal and capital goods sectors as a small fall in the market can cause similar losses in these sectors. However, sectors like IT, FMCG and realty will see less fall when the overall market becomes bearish.

Table 1 presents the beta values of 11 sectoral indices in BSE. The time period is from 1st January 2012 to 31st December 2024.

**Table 1: Beta values of sectors from 2012-24**

| Index | Beta |
|---|---|
| BSE Consumer Durables Index | 0.7885 |
| BSE Capital Goods Index | 1.0518 |
| BSE Health Care Index | 0.5732 |
| BSE Auto Index | 0.9983 |
| BSE FMCG Index | 0.2621 |
| BSE IT Index | 0.2049 |
| BSE Metal Index | 1.1501 |
| BSE Oil & Gas Index | 0.9558 |
| BSE Realty Index | 0.6077 |
| BSE Public Sector Index | 0.9966 |
| BSE Bankex Index | 1.2475 |

Table 2 shows the beta values of eleven sectors in the pre-COVID and post-COVID time periods. It also shows the deviation in the beta values. The metal sector has the highest beta in the pre and post COVID time periods. The FMCG sector had the lowest beta in the pre-COVID time period. In the post-COVID time period the beta of FMCG sector is almost 0, indicating disconnection from the overall economy. All sectors except consumer durables list a fall in beta. The highest fall is in the realty sector. In the post-COVID period the beta of realty sector is very low.

**Table 2: Beta values of sectors in pre- and post-COVID period**

| Index | Beta 2017-2019 | Beta 2022-2024 | Deviation |
|---|---|---|---|
| BSE Consumer Durables Index | 0.7833 | 0.8230 | 0.0398 |
| BSE Capital Goods Index | 1.1194 | 1.0203 | -0.0991 |
| BSE Health Care Index | 0.7163 | 0.5370 | -0.1793 |
| BSE Auto Index | 1.2117 | 0.9147 | -0.2971 |
| BSE FMCG Index | 0.5344 | -0.0072 | -0.5416 |
| BSE IT Index | 0.7163 | 0.5370 | -0.1793 |
| BSE Metal Index | 1.2772 | 1.1209 | -0.1562 |
| BSE Oil & Gas Index | 1.0203 | 0.9841 | -0.0363 |
| BSE Realty Index | 0.7624 | 0.0398 | -0.7227 |
| BSE Public Sector Index | 1.1031 | 1.0693 | -0.0338 |
| BSE Bankex Index | 1.2184 | 1.0758 | -0.1426 |

## Discussion

All sectors except Consumer Durables show a decrease in beta values from the pre-pandemic (2017-2019) to post-pandemic (2022-2024) period. This widespread reduction in systematic risk across sectors suggests a fundamental shift in market dynamics following the pandemic, consistent with findings by Harjoto et al. (2021) who documented heterogeneous impacts of COVID-19 on systematic risk across global markets.

The FMCG sector's transition from a positive beta (0.534) to a slightly negative beta (-0.007), represents the second-largest deviation (-0.542) in the dataset. This finding aligns with Baur and Lucey's (2010) "flight-to-quality" concept, where investors shift to perceived safe havens during market stress. The FMCG sector, providing essential consumer goods, appears to have developed countercyclical properties following the pandemic. This result is supported by Mazur et al. (2021), who found that food stocks displayed safe-haven properties during the initial pandemic phase. However, the persistence of this negative beta into 2022-2024 extends beyond their findings and suggests a more fundamental reassessment of the sector's market relationship.

The Realty sector experienced the most dramatic decrease in beta, from 0.762 to just 0.040, a deviation of -0.723. This substantial decline contradicts some findings by Baek et al. (2022), who observed increased volatility in real estate sectors globally post-pandemic. The Indian realty sector's sharp reduction in market sensitivity might reflect unique market conditions or policy interventions specific to India.

The IT sector's beta decreased significantly from 0.716 to 0.537 (-0.179), contradicting some expectations that technology would become more central to market movements following the pandemic's acceleration of digital transformation. This result diverges somewhat from Woodward and Anderson's (2009) findings on shifting beta relationships after market shocks but might reflect the sector's maturation and stability in the Indian context.

The Metal sector maintained the highest beta both pre-pandemic (1.277) and post-pandemic (1.121), despite experiencing some decline (-0.156). This persistence of high market sensitivity aligns with Singh and Singh's (2016) observation that cyclical sectors like metals typically exhibit higher betas in the Indian market.

## Conclusion

The widespread decrease in beta values across sectors challenges the assumption of beta stability that underlies traditional applications of the CAPM. This supports Ghysels' (1998) argument that incorrectly assuming constant betas when they are time-varying can lead to substantial errors in asset pricing and risk management. The emergence of a negative beta in the FMCG sector particularly supports Jagannathan and Wang's (1996) conditional CAPM framework that explicitly accounts for time-varying betas. The dramatic shifts observed in sectors like Realty and FMCG suggest that investors should consider how betas might evolve under different market

conditions rather than relying on historical averages.

These results have significant implications for portfolio construction in the post-pandemic environment. The reduced betas across most sectors suggest potentially lower market risk but also reduced diversification benefits as sectors become less responsive to market movements. The negative beta in FMCG offers new hedging opportunities, consistent with Narayan et al.'s (2022) observation that the COVID-19 pandemic affected optimal portfolio weights across sectors. The varying magnitudes of beta changes across sectors support Faff et al.'s (2000) research on industry rotation strategies that exploit differential sensitivity of sectors to market movements. Investors might now need to reconsider traditional sector allocations based on these new beta profiles.

While these results provide valuable insights into post-pandemic market dynamics, they should be interpreted with caution. As Blume (1971, 1975) noted, betas tend to regress toward the mean over time, suggesting that some of these changes might be temporary. Longitudinal studies extending beyond 2024 would help determine whether these shifts represent permanent structural changes or transitory responses to the pandemic shock. Additionally, as Roll (1977) cautioned in his critique of CAPM testing, beta calculations are sensitive to the choice of market proxy. Future research might explore whether these sectoral shifts are consistent across different market indices or when using global rather than domestic benchmarks.

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**Endnote:**

1. Bombay Stock Exchange (BSE) is a national stock exchange of India. It is also the oldest stock exchange in Asia.