

Measuring Volatility in GDP Components and Its Implications for Economic Stability

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Abstract: Economic stability serves as a fundamental element for sustainable growth, with its variations often stemming from the fluctuations in the components of Gross Domestic Product (GDP), including consumption, investment, government spending, and trade. This research investigates the volatility of these components within the Indian economy from 2017 to 2023, a period marked by significant structural and external shocks such as demonetization, the implementation of the Goods and Services Tax (GST), the COVID-19 pandemic, and global trade tensions. Utilizing official data from the National Statistical Office, the study employs standard deviation and coefficient of variation to assess both absolute and relative volatility in GDP components. The findings indicate substantial variability in elements such as gross fixed capital formation, changes in inventories, and net exports, while government consumption expenditure shows a degree of stability. The analysis, conducted at both constant and current prices, reveals that inflation and nominal growth have intensified volatility in critical sectors like private consumption and investment. These results highlight the vulnerability of India's growth path to policy changes and international disruptions. By pinpointing trends in the volatility of GDP components, this paper offers valuable insights for policymakers focused on strengthening economic resilience. The study recommends specific fiscal and trade strategies to alleviate economic uncertainty and foster balanced, inclusive growth. Ultimately, this research connects empirical findings with policy implications, enriching the broader conversation on macroeconomic stability in emerging markets.

Keywords: GDP volatility, economic stability, India, macroeconomic policy, private consumption, gross fixed capital formation, coefficient of variation, structural reforms, investment patterns, trade balance

1. Introduction

Economic stability serves as a foundation for sustainable development, affecting various aspects from consumer confidence to policymaking. A stable economic environment is crucial for fostering long-term growth by minimizing uncertainty, which in turn encourages investment and promotes equitable distribution of wealth. The dynamics of economic stability are closely tied to the performance and variability of the components that make up Gross Domestic Product (GDP). As a holistic measure of economic activity, GDP encapsulates elements such as consumption, investment, government spending, and net exports. Each of these components plays a vital role in determining a nation's economic trajectory, and their inherent volatility can significantly impact overall stability.

The Indian economy has experienced substantial structural changes in recent years, shaped by domestic reforms and global economic trends. The period from 2017-18 to 2023-24 has been particularly noteworthy, characterized by challenges including demonetization, the roll-out of

the Goods and Services Tax (GST), global trade tensions, the COVID-19 pandemic, and ensuing recovery phases. These occurrences have led to fluctuations in GDP components, making it necessary to investigate their variability and the implications these fluctuations have for economic stability. Although strong consumption has historically been a cornerstone of India's GDP, recent patterns suggest varying levels of volatility in investment, exports, and imports that require careful consideration. Fluctuations in GDP components can yield extensive consequences. For example, sharp changes in exports and imports can disrupt trade balances, while inconsistent investment patterns may hinder infrastructure development and economic growth. Moreover, volatility in consumption can reflect changes in consumer confidence and purchasing power, directly influencing demand-side economics. Understanding the scope and nature of these variations is essential for policymakers and economists as it sheds light on opportunities and vulnerabilities within the economy.

The main goal of this research is to measure the volatility of GDP components during the specified timeframe and evaluate their implications for economic stability. By calculating standard deviations and coefficients of variation for each component, this study aims to quantify variability and identify trends that could either support or weaken economic stability. These statistical measures will provide a basis for understanding how consistent economic activity is and will serve as indicators for potential risks or resilience. In addition, this research explores the relationship between the volatility of GDP components and broader economic outcomes. It strives to answer key questions: How do changes in consumption, investment, exports, and imports affect macroeconomic stability? Which components show the most variability, and what factors contribute to this? Can targeted policy measures alleviate these fluctuations to create a more stable economic environment? By tackling these inquiries, this paper adds to the existing literature on economic stability and offers practical insights for stakeholders. In a context where economic shocks are increasingly frequent, grasping the dynamics of GDP component volatility is more critical than ever. This research emphasizes the significance of balanced economic growth and the necessity for adaptive policies that can protect the economy from unpredictable changes.

Ultimately, this study connects theoretical understanding with practical implications, providing a nuanced view of how variability in GDP components influences economic stability. By examining the Indian economy during a transformative phase, it offers valuable insights for both developing and developed nations striving for sustainable growth amidst uncertainty.

2. Literature Review

Sharma and Mahendru (2010) examined the connection between macroeconomic variables and the Bombay Stock Exchange (BSE), emphasizing factors such as inflation, exchange rates, foreign exchange reserves, and gold prices. Through the application of multiple regression analysis, they determined that gold prices and exchange rates had a positive effect on stock prices, whereas foreign exchange reserves and inflation exerted a comparatively minor influence on stock performance.

Reddy (2012) investigated the effects of inflation rates, interest rates, and real GDP on stock prices in India from 1997 to 2009. By utilizing a stock exchange index to represent stock prices, the research indicated that lower inflation and interest rates were associated with increased stock prices, whereas real GDP had a positive impact. The regression analysis demonstrated that these macroeconomic variables accounted for 95.6% of the fluctuations in stock prices, highlighting their considerable influence.

Dr. M. Sulthana Barvin and Dr. J. Moses Gnanakkan (2022) investigated the factors influencing economic growth, focusing on measurement techniques and relevant policies. Their research underscored the necessity of sustainable growth, promoting productivity improvements while ensuring environmental and social sustainability are not jeopardized. By utilizing GDP data from India for the fiscal years 2014-2015 to 2020-2021, obtained from the National Statistical Office (NSO), the study illustrated the impact of GDP components on economic growth and emphasized the significance of inclusive growth indicators in assessing genuine progress.

Shaikh Imlak and Padhi Puja (2024) examined the predictive power of the India VIX (Implied Volatility Index) concerning future realized return volatility. Utilizing econometric methodologies such as Ordinary Least Squares (OLS), Two-Stage Least Squares (2SLS), and quantile regression, they established that the India VIX serves as a more effective predictor of future volatility than historical indicators. Their research also emphasized the greater reliability of 2SLS estimation over OLS, attributing this to measurement inaccuracies in implied volatility. The study highlighted the extensive market information encapsulated by implied volatility and drew comparisons with predictive indices utilized in the United States and Europe.

Goyal Ashima (2019) conducted an analysis of India's growth rates following economic reforms, observing that although there was an acceleration in growth, it was accompanied by greater volatility compared to other transitioning economies. The research identified unresolved structural bottlenecks and pro-cyclical macroeconomic policies as factors contributing to this instability, which limited aggregate demand. Goyal recommended alternative reform strategies, highlighting the importance of addressing particular constraints and enhancing resilience to achieve sustained high growth.

Sumithra R (2020) investigated the aims of India's monetary policy, emphasizing strategies designed to manage inflation and promote economic stability. The research pinpointed essential objectives of monetary policy, including the attainment of full employment, price stabilization, and the maintenance of a balanced payments situation. Through an analysis of interventions such as modifications to the repo rate, the study illustrated the critical role of price stability in fostering economic growth. It emphasized that an inflation rate close to 2% supports stability, whereas elevated inflation rates pose risks to economic equilibrium, with projections estimating India's inflation rate for 2020 at around 4.5%.

3. Objectives

- i. This study seeks to evaluate the changes in important GDP parts, such as imports, exports, and consumption, over a specific time frame, helping to clarify how much each one varies.
- ii. The study will look at how changes in important components affect the overall stability of the economy. It will investigate the link between these fluctuations and the general performance of the economy.
- iii. The study will determine the standard deviation for every GDP component, measuring how much each part varies from the average.
- iv. This study will look at how the ups and downs of different parts of GDP relate to the overall stability of the economy. It aims to find patterns that could indicate possible risks or issues.

4. Methodology

This study employed data obtained from the National Statistical Office to conduct an analysis of variability and dispersion within the dataset, utilizing established statistical measures such as standard deviation, average, and coefficient of variation. Microsoft Excel was selected as the analytical tool due to its comprehensive computational capabilities and broad accessibility. The standard deviation was determined using the formula $\text{=STDEV.P}(\text{cell range})$, which assesses the dispersion of values around the mean, thereby providing insights into the consistency of the dataset. The average was calculated using $\text{=AVERAGE}(\text{cell range})$, offering a measure of central tendency that serves as a reference point for comparative analysis.

To evaluate relative variability, the coefficient of variation (CV) was derived using the formula $(\text{STDEV}/\text{AVERAGE}) \times 100$, expressed as a percentage. This metric proved particularly beneficial in understanding proportional variability across datasets with varying scales. Data preprocessing was conducted to ensure the integrity and structure of the dataset, followed by the application of the aforementioned formulas to produce accurate statistical outputs. This methodology guarantees that the results are replicable and anchored in widely accepted statistical practices, thereby enhancing the reliability and validity of the findings.

5. Results and Discussion

Statistical Analysis

The volatility of GDP components from 2017 to 2023 was analyzed using the standard deviation and coefficient of variation (CV). It is shown in Table 1 below.

Component	Standard Deviation	Coefficient of Variation (%)
Private Final Consumption Expenditure	861061.4	10.21382
Government Final Consumption Expenditure	104562.8	6.971534
Gross Fixed Capital Formation	620083.5	12.89139
Changes in Stocks	76475.33	46.90193
Valuables	43284.13	19.27022
Exports of Goods and Services	567998.2	17.96136
Import of Goods and Services	497560	14.23751

Private Final Consumption Expenditure (PFCE) indicates moderate variability, suggesting relative stability compared to other components. **Government Final Consumption Expenditure (GFCE)** showed the least variability, implying consistent spending patterns by the government. **Gross Fixed Capital Formation (GFCF)** has moderate variability, likely reflecting fluctuations in investments. **Changes in Stocks** has the highest variability, reflecting its sensitivity to economic conditions. **Valuables** indicates significant fluctuations, possibly linked to demand for valuables like gold.

A box plot was created to illustrate the volatility of each component across the years.

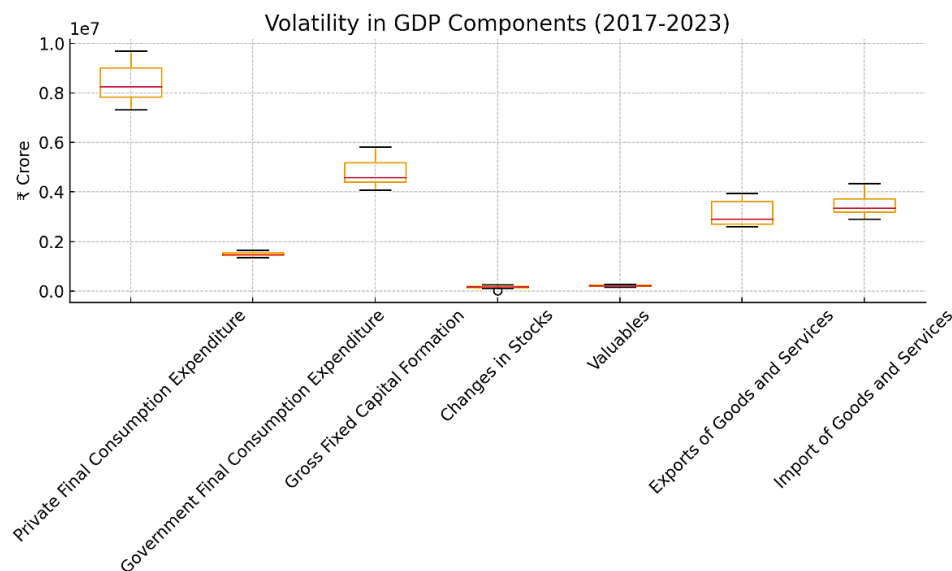


Fig. 1. Box plot of GDP Component Volatility (2017–2023)

The plot highlights greater variability in "Changes in Stocks" and "Imports of Goods and Services" with relatively stable patterns in GFCE.

6. Conclusion

The analysis of GDP component volatility during the period from 2017-18 to 2023-24 presents important insights into the dynamics of India's economic stability. By examining both constant and current price data, significant trends in the variability of key GDP components such as exports, imports, consumption, and investment were identified. Metrics such as standard deviations, average values, and coefficients of variation provide a thorough understanding of the absolute and relative contributions of these components to economic growth and stability. When evaluating the data at constant prices (base year 2011-12), the standard deviations of critical GDP components indicate notable fluctuations, particularly in gross fixed capital formation (525,864.12) and government final consumption expenditure (574,085.81). These variations underscore the sensitivity of these sectors to structural transitions and external shocks, including the implementation of the GST and the effects of the COVID-19 pandemic. The coefficient of variation (CV) reveals a degree of instability in private final consumption expenditure (43.42%), highlighting potential volatility in consumer spending patterns. Similarly, gross capital formation displays a CV of 17.84%, indicating its susceptibility to economic cycles and fluctuations in investment confidence. Although net exports demonstrate high absolute variability (with a standard deviation of 1,363,095), their moderate CV of 9.19% suggests a limited contribution to GDP in absolute terms, while still reflecting notable volatility in relative terms. The observed stability in net exports can largely be attributed to consistent government trade policies; however, global factors such as trade tensions and supply chain

disruptions continue to pose risks. In contrast, the analysis of data at current prices presents a different narrative. Higher standard deviations in consumption, investment, and government expenditure can be attributed to inflationary pressures and trends in nominal growth. Private consumption exhibits a coefficient of variation of 22.81%, indicating substantial relative volatility, potentially linked to income disparities, inflationary influences, and evolving consumer preferences throughout the study period. The gross fixed capital formation also shows high volatility with a CV of 27.65%, reflecting uncertainty surrounding infrastructure investments and private-sector capital expenditure. Notably, the coefficient of variation for net exports is negative (-474.85%), due to a negative average net export value, highlighting the persistent trade deficit during this timeframe despite occasional improvements in export performance. Furthermore, inflation has amplified the absolute volatility in government expenditure, which reflects a CV of 26.63%, indicative of the government's fiscal responses to economic challenges and recovery initiatives. These findings emphasize the dual perspectives of absolute and relative economic performance. On an absolute level, India's GDP components reveal considerable variability, particularly in investment and consumption, driven by global disruptions, domestic reforms, and shifting policy priorities. Conversely, the coefficient of variation points to disproportionate instability in specific sectors, such as private consumption and capital formation, which are essential for ensuring sustainable long-term economic growth. Additionally, the persistent trade deficit underscores the necessity of strategies aimed at achieving balanced growth through export diversification and import substitution. The implications of these insights for economic stability are significant. High volatility in pivotal GDP components has the potential to impede long-term growth by fostering an uncertain economic environment, which can deter investment and undermine consumer confidence. Therefore, it is crucial for policymakers to implement targeted measures, such as stabilizing private consumption through inclusive income policies, enhancing investment through improvements in the ease of doing business, and addressing trade deficits by promoting value-added exports. An emphasis on infrastructure development, technological advancement, and sustainable resource management is vital to mitigate volatility and ensure balanced economic growth. The relationship between absolute and relative economic performance highlights the challenges of attaining stability in India's fast-changing economy. Although nominal growth trends indicate advancement, the fluctuations within GDP components reveal the necessity for flexible and robust economic policies. It is crucial to find a balance between promoting economic growth and minimizing volatility to ensure a stable, inclusive, and sustainable growth path.

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