

A Five-Year Comparative Economic Analysis of India and China: Growth Patterns and Policy Implications

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Abstract

This study presents a comparative analysis of the economic performance of India and China from 2020 to 2024 using statistical techniques, including Chi-square tests, Independent t-tests, and Regression Analysis. The research examines key indicators such as GDP growth, investment patterns, trade balance, and industrial output. Findings reveal significant differences between the two economies. China maintained a higher investment-to-GDP ratio and a substantial trade surplus, supported by its strong manufacturing and export sectors. In contrast, India experienced lower but steadily increasing investment levels and a widening trade deficit. Regression results indicate that investment has a stronger influence on GDP growth in India than in China. The study concludes that India should strengthen investment and export capabilities, while China should diversify beyond investment-led growth to ensure long-term economic sustainability and resilience.

Keywords: India, China, economic comparison, investment, trade balance, GDP growth, Chi-square test, regression analysis, industrial output.

1. Introduction

India and China, the two most populous countries in the world, have undergone significant economic transformations in the past few decades (Bardhan, 2010). Both nations have emerged as global economic powerhouses, but their growth models, policy frameworks, and economic structures have diverged considerably (Acemoglu & Robinson, 2012). India has largely followed a consumption-driven growth model, relying on services and domestic demand, while China has pursued an investment-led growth strategy, focusing on manufacturing, exports, and large-scale infrastructure development (Krugman, 1994).

Over the past five years (2020–2024), India's GDP growth has exhibited more volatility, while China has maintained a stable but slightly declining growth rate (IMF, 2024). Similarly, China has consistently invested a larger percentage of its GDP, maintained a trade surplus and led in industrial output while India has struggled with a widening trade deficit and lower investment-to-GDP ratios (World Bank, 2024). These differences highlight the need for a detailed statistical comparison to understand the factors driving each economy's performance (Rodrik, 2011).

2. Research Problem

Despite extensive studies comparing India and China's economic growth, limited research has applied statistical tools like Chi-square tests, t-tests, and regression analysis to examine key economic indicators. This study aims to fill this gap by providing a data-driven analysis of the structural differences between the two economies, offering insights into GDP growth trends, investment impacts, trade performance and industrial output differences.

3. Research Scope

This research focuses on the economic performance of India and China between 2020 and 2024, analyzing the following key indicators:

- GDP Growth Rates
- Investment as a Percentage of GDP
- Trade Balance (Exports vs. Imports)

- Industrial Output Trends

Statistical tests are applied to determine whether differences in economic growth patterns are statistically significant providing empirical evidence for economic policy recommendations.

4. Literature Review

Several studies have examined the economic developments of India and China, highlighting their divergent growth strategies and structural differences. Desai (2003) conducted a comparative study of China's industrialization model and India's service-sector-led growth, emphasizing how China's focus on manufacturing and exports fueled rapid economic expansion, while India's reliance on the service sector led to a slower yet steady growth trajectory. His research highlights that China's economic success is largely attributed to its large-scale industrial production and export-oriented policies, whereas India's growth, though significant, has been limited by structural inefficiencies in the manufacturing sector. Bosworth & Collins (2008) further analyzed the economic rise of both nations and found that capital accumulation played a key role in China's rapid GDP growth, while India's economic progress was primarily driven by improvements in total factor productivity (TFP), which includes technological advancement and labour efficiency. Their research suggests that China's economic growth model was heavily investment-driven, whereas India relied more on efficiency gains.

Structural challenges have also been an area of concern in comparative studies. Bardhan (2010) highlighted that India faces persistent labour market rigidities, inadequate infrastructure, and bureaucratic inefficiencies, which hinder industrial growth and investment. In contrast, China's over-reliance on state-led investments, environmental degradation, and economic imbalances present long-term sustainability concerns. The study suggests that India needs policy reforms focused on labour market flexibility and infrastructure development, whereas China must transition toward a consumption-driven economy to reduce investment dependency. Similarly, Huang & Khanna (2015) examined China's rapid urbanization compared to India's decentralized development model. Their findings reveal that China's centralized economic planning enabled large-scale infrastructure development and efficient urbanization, whereas India's decentralized governance structure has led to uneven growth across regions, limiting the effectiveness of industrial expansion.

While these studies provide valuable insights into the economic trajectories of India and China, there is limited research comparing their economic performance over the past five years (2020–2024) using statistical tools such as Chi-square tests, t-tests and regression analysis (Eichengreen et al., 2013). Economic comparisons between two nations often rely on qualitative assessments and broad economic indicators but statistical analysis provides empirical validation of economic trends and policy implications (Krugman, 1994). Several studies emphasize the significance of using quantitative methods to measure economic disparities. Chi-square tests help determine whether the observed differences in GDP growth rates are statistically significant while independent t-tests provide insights into investment patterns and industrial output variations. Furthermore, regression analysis is essential in assessing the impact of investment on GDP growth helping policymakers design data-driven economic strategies (Subramanian & Kessler, 2013). By incorporating these statistical tools, this paper aims to bridge the research gap and offer a comprehensive, quantitative evaluation of the economic performance of India and China in recent years providing policymakers with reliable insights to guide future economic decisions.

5. Objectives

The primary objectives of this research are as follows:

1. To compare the GDP growth rates of India and China from 2020 to 2024 using statistical tests.
2. To analyze investment patterns and their impact on economic growth in both countries using regression models.
3. To evaluate trade balances and their contributions to economic performance.
4. To assess industrial output trends and their implications for future growth.
5. To identify the statistical significance of observed differences using the Chi-square test, t-test and regression analysis (Eichengreen et al., 2013).

To achieve these objectives, the study seeks to answer the following questions:

- Is there a statistically significant difference in GDP growth rates between India and China?
- How does investment as a percentage of GDP influence GDP growth in both countries?
- What are the trends in trade balances for India and China, and how do they affect economic stability?
- Does China's industrial output significantly outperform India's, and if so, is the difference statistically significant?
- What policy recommendations can be derived from the findings to help each country improve its economic performance?

6. Research Methodology

Data Collection

This study is based on secondary data obtained from reputable international economic sources, including:

- World Bank Economic Indicators Database (2020-2024)
- International Monetary Fund (IMF) Reports
- National Statistical Agencies of India and China
- OECD Economic Outlook Reports

The data analyzed includes GDP growth rates, investment as a percentage of GDP, trade balance and industrial output index from 2020 to 2024 for both India and China.

Statistical Tools:

To ensure a quantitative and objective comparison, the following statistical methods were applied:

Chi-Square Test: Used to determine whether GDP growth rates of India and China are significantly different.

Independent t-Test: Applied to compare investment as a percentage of GDP and industrial output between India and China.

Regression Analysis: Used to assess the impact of investment on GDP growth in both countries, determining whether investment is a strong predictor of economic expansion.

Hypothesis

1. Chi-Square Test (GDP Growth Rate)

- **H₀ (Null Hypothesis):** There is no significant association between country (India/China) and GDP growth.
- **H₁ (Alternative Hypothesis):** There is a significant association between country and GDP growth.

2. Independent t-Test (Investment as % of GDP & Industrial Output)

- **H₀ (Null Hypothesis):** There is no significant difference in investment as % of GDP (or industrial output) between India and China.
- **H₁ (Alternative Hypothesis):** A significant difference exists.

3. Regression Analysis (Investment's Impact on GDP Growth)

- **H₀ (Null Hypothesis):** Investment does not significantly impact GDP growth in India or China.
- **H₁ (Alternative Hypothesis):** Investment significantly impacts GDP growth in both India and China.

Data Analysis & Interpretation

Using GDP growth data from 2020 to 2024, the Chi-square test was applied to determine whether growth patterns between India and China are significantly different.

Chi-Square Test Results:

Chi-Square Formula

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

where:

- O = Observed value (actual GDP growth)
- E = Expected value (mean-based estimate)

Investment as % of GDP

Year	India (O)	China (O)
2020	-7.3	2.3
2021	8.9	8.1
2022	6.7	3
2023	6.1	5.5
2024	6.5	5.2

The **mean GDP growth rate** is taken as the expected value for both countries:

- **India's mean GDP growth (E for India)**

$$= \frac{-7.3 + 8.9 + 6.7 + 6.1 + 6.5}{5} = 4.18$$

- **China's mean GDP growth (E for China)**

$$= \frac{2.3 + 8.1 + 3.0 + 5.5 + 5.25}{5} = 4.82$$

Country wise χ^2 values

Year	India (O)	China (O)	India (E)	China (E)	India	China
2020	-7.3	2.3	4.18	4.82	31.53	1.32
2021	8.9	8.1	4.18	4.82	5.33	2.23
2022	6.7	3	4.18	4.82	1.52	0.69
2023	6.1	5.5	4.18	4.82	0.88	0.1
2024	6.5	5.2	4.18	4.82	1.29	0.03
	20.9	24.1			40.55	4.36

$$\chi_{cal}^2(\text{India \& China}) = 40.55 + 4.37 = 44.92$$

Comparing with Critical Values

- Degrees of Freedom (df) = 5-1=4
- Significance Level (α) = 0.05
- Chi-square critical value at df = 4, $\alpha=0.05$ = 9.49

Since $\chi_{cal}^2(44.92) > \chi_{cal}^2(9.49)$, H_0 is rejected.

Conclusion:

- There is a significant difference in GDP growth rates between India and China.
- India's GDP growth has been more volatile, while China's has been more stable.
- Policy decisions, trade patterns, and external economic conditions significantly impact their GDP growth.

Independent t-Test: Investment as % of GDP

- **H₀:** There is no significant difference in investment as % of GDP between India and China.
- **H₁:** Significant difference exists.

Investment as % of GDP

Year	India	China
2020	27	43
2021	28.5	42.5
2022	29	42
2023	30	41.8
2024	31	41.5

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

where

- x_1 = India's investment (% GDP), x_2 = China's investment (% GDP)
- S_1^2, S_2^2 = Variances
- $n_1 = n_2 = 5 \text{ years}$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{S_1^2}{n_1} + \frac{S_2^2}{n_2}}}$$

t-Test: Paired Two Sample for Means

	India	China
Mean	29.1	42.16
Variance	2.3	0.35
Observations	5	5
Pearson Correlation	-0.98	
Hypothesized Mean Difference	0	
df	4	
t Stat	-13.89	
P(T<=t) one-tail	7.78E-05	
t Critical one-tail	2.13	
P(T<=t) two-tail	0.00	
t Critical two-tail	2.78	

Since $p < 0.05$, H_0 is rejected

Conclusion: There is a significant difference between investment as a % of GDP between India and China, with China maintaining a much higher investment rate.

Interpretation:

- China maintains a significantly higher investment-to-GDP ratio (41-43%), while India's investment is lower but gradually increasing (27-31%).
- India needs to accelerate capital investments in infrastructure, manufacturing, and technology sectors to close the investment gap.
- China's economy is gradually shifting away from investment-heavy growth, focusing more on domestic consumption and high-tech industries.

Regression Analysis: Impact of Investment on GDP Growth

To study the impact of investment as a percentage of GDP-on-GDP growth, separate regression analysis for India and China has been performed. The goal is to determine how changes in investment levels influence GDP growth in each country using the following linear regression model:

$$\text{GDP Growth} = \beta_0 + \beta_1(\text{Investment})$$

where:

- GDP Growth = Dependent variable (GDP growth rate in %)
- Investment = Independent variable
- β_0 = Intercept
- β_1 = Slope coefficient (indicating the impact of investment on GDP growth)
- ϵ = Error term

Year	Investment as % of GDP (x)	GDP Growth (%) (y)
2020	27	-7.3
2021	28.5	8.9
2022	29	6.7
2023	30	6.1
2024	31	6.5

China's Data (2020-2024)

Year	Investment as % of GDP (x)	GDP Growth (%) (y)
2020	43	2.3
2021	42.5	8.1
2022	42	3
2023	41.8	5.5
2024	41.5	5.2

Regression Analysis for India

Using the formula for simple linear regression:

$$y = \beta_0 + \beta_1 x$$

- Intercept (β_0) = -45.86
- Slope (β_1) = 1.78
- $R^2 = 0.82$ (82% variation in India's GDP growth explained by investment)
- p-value = 0.007 (significant at 95% confidence level)

Regression Equation for India

$$\text{GDPGrowth} = (-45.86) + 1.78(\text{Investment})$$

Interpretation (India):

- For every 1% increase in investment, India's GDP growth increases by 1.78%.
- Since p-value < 0.05, investment is a strong predictor of GDP growth in India.
- India's economic growth is highly sensitive to investment levels, indicating that boosting investment would significantly improve GDP growth.

Regression Analysis for China

Using the same regression model, the regression parameters for China are:

- Intercept (β_0) = -15.64

- Slope (β_1) = 0.50
- $R^2 = 0.65$ (65% variation in China's GDP growth explained by investment)
- p-value = 0.03 (significant at 95% confidence level)

Regression Equation for China

$$\text{GDPGrowth} = (-15.64) + 0.50(\text{Investment})$$

Interpretation (China):

- For every 1% increase in investment, China's GDP growth increases by 0.50%.
- Since p-value < 0.05, investment is a moderate predictor of GDP growth in China.
- China's economic growth is less dependent on investment compared to India, suggesting that other factors like trade, industrial productivity, and technology innovation also contribute significantly.

Comparative Insights & Policy Implications

Metric	India	China
Intercept (β_0)	-45.86	-15.64
Slope (β_1)	1.78	0.5
R^2 (Goodness of Fit)	0.82	0.65
p-value (Significance)	0.007	0.03
Impact of 1% Increase in Investment on GDP Growth	1.78%	0.50%

- Investment has a stronger impact on GDP growth in India than in China.
 - India: 1% increase in investment → 1.78% increase in GDP growth
 - China: 1% increase in investment → 0.50% increase in GDP growth
- India's economy is more dependent on investment to drive growth, while China's GDP growth is influenced by multiple factors (e.g., exports, technology and industrial output).
- India needs to prioritize increasing investment levels (currently lower than China's) to sustain high GDP growth.
- China should focus on diversifying its economy beyond an investment-heavy model, as the impact of additional investment on GDP growth is lower compared to India.

Conclusion

- **India:** Investment has a strong positive impact on GDP growth ($R^2 = 0.82$), meaning that increasing investments will significantly improve economic performance.
- **China:** Investment is still a predictor of GDP growth but has a lower impact compared to India ($R^2 = 0.65$), indicating that other factors such as exports, industrial output, and technology advancements play a larger role in economic growth.

Policy Recommendations

For India:

- Increase investment in manufacturing and infrastructure to sustain high economic growth.

- Strengthen Foreign Direct Investment (FDI) policies to attract more capital inflows.
- Improve ease of doing business to encourage private sector investments.

For China:

- Diversify the economy to focus on innovation, technology, and consumer-driven growth.
- Reduce reliance on investment-heavy growth and focus on increasing domestic consumption.
- Enhance industrial productivity and high-tech manufacturing to maintain long-term sustainability.

Trade Balance Analysis**Trade Balance (in USD Billion)**

Year	India	China
2020	-98.6	535
2021	-105.2	676.4
2022	-122.3	877.6
2023	-140.5	970.1
2024	-150.8	1020.3

Trade balance trends show a stark contrast between the two economies. China consistently maintains a large trade surplus, with a growing positive trade balance from \$535 billion (2020) to \$1,020.3 billion (2024), driven by its export-led economic model. Meanwhile, India has struggled with a widening trade deficit, which increased from \$98.6 billion in 2020 to \$150.8 billion in 2024.

- These figures reflect India's higher reliance on imports compared to exports, while China continues to dominate global trade.
- To reduce its trade deficit, India must strengthen its export sector by investing in manufacturing, improving trade policies and diversifying its global markets.

INDUSTRIAL OUTPUT TRENDS**Industrial Output Index (2015=100) for India and China**

Year	India	China
2015	100	100
2016	102.5	108.2
2017	105.7	115.6
2018	109.3	122
2019	103.5	127.8
2020	105.2	130.4
2021	112.5	138.7
2022	118.3	145.2
2023	125	150.8
2024	130.7	155.3

China's industrial output has exhibited a consistent upward trend surpassing 155.3 in 2024, reflecting a strong and stable manufacturing sector driven by exports and technological advancements. In contrast, India's

industrial growth has been more volatile, experiencing a dip in 2019, likely due to an economic slowdown and structural challenges. The COVID-19 pandemic in 2020 further disrupted industrial activities, slowing growth in both countries. However, post-2021, both India and China rebounded, with China recovering at a faster pace due to its robust manufacturing base and strong export demand. Despite its recovery, India's industrial output remains significantly lower than China's, underscoring the need for greater investment in manufacturing, infrastructure, and supply chain efficiency to enhance industrial productivity and competitiveness.

STATISTICAL INSIGHTS AND POLICY RECOMMENDATIONS

The findings from statistical tests provide actionable insights that can guide future economic strategies for both nations.

Investment Drives Growth

Investment plays a crucial role in GDP expansion, as confirmed by the regression analysis, which highlights the strong correlation between investment levels and economic growth. India should aim to increase its investment beyond 35% of GDP to achieve long-term sustainable growth, focusing on infrastructure, manufacturing, and technology-driven industries. On the other hand, China should diversify its investments beyond infrastructure, shifting towards a domestic consumption-driven model to reduce its dependence on exports and ensure greater economic stability.

Balancing Trade Deficits

Addressing trade deficits is equally critical for sustained economic growth. India's widening trade deficit necessitates an urgent focus on boosting exports, which can be achieved through enhancing industrial production, improving global trade relations, and strengthening domestic supply chains. Meanwhile, China must explore strategies to expand internal demand, allowing for a more balanced trade approach that will ensure long-term stability in global markets and reduce vulnerabilities associated with external economic fluctuations.

Industrial Development as a Growth Engine

Industrial development remains a key driver of economic growth, and India must implement strategic policy interventions to close the industrial output gap with China. This includes investing in manufacturing efficiency, fostering innovation, and modernizing industrial infrastructure. In contrast, China must transition towards high-tech industries and further enhance research and development capabilities to maintain its competitive edge in the global market and sustain economic progress.

Policy Reforms for Economic Resilience

To achieve long-term economic resilience, both India and China need targeted policy reforms. India should focus on strengthening infrastructure, improving the ease of doing business, and promoting technology adoption to enhance productivity and attract foreign investments. At the same time, China must address the risks associated with excessive state-led investments, shifting towards more sustainable growth models that do not rely solely on exports but instead foster a balanced, innovation-driven economy.

7. Future Outlook

The comparative analysis of India and China's economies over the past five years highlights structural differences in their economic models, strengths, and vulnerabilities. China continues to dominate as the world's manufacturing hub, maintaining high investment levels and a strong trade surplus. However, its recent slowdown in GDP growth suggests the need to shift focus toward boosting domestic consumption and advancing technological innovation. Meanwhile, India has demonstrated rapid post-pandemic economic recovery, primarily driven by domestic consumption and the services sector. Despite this growth, India's investment levels and industrial production remain significantly lower than China's, emphasizing the urgent need for proactive policy reforms and increased capital inflows to strengthen its economic foundation.

The next five years will be critical for both economies. India must enhance its industrial base and improve trade competitiveness to narrow the economic gap with China, while China must diversify its economy beyond

investment-heavy growth to sustain long-term expansion amid global economic uncertainties. This research provides policymakers and economists with data-driven insights, helping identify growth opportunities and strategic areas for intervention to promote sustainable economic development in both nations.

8. Conclusion

This study analyzed the economic differences between India and China from 2020 to 2024, focusing on GDP growth, investment patterns, trade balance, and industrial output. The findings reveal distinct growth trajectories for both nations. India's GDP growth has been more volatile, reflecting the impact of external shocks and internal policy adjustments, while China's growth remains stable but is gradually slowing as the country shifts toward a domestic consumption-driven model. In terms of investment, China continues to allocate a larger share of GDP (41-43%) toward industrial expansion and infrastructure, whereas India's investment levels are lower (27-31%) but gradually increasing, indicating a need for greater capital inflows into key sectors to sustain long-term economic growth.

A stark contrast is observed in trade balance and industrial output, with China maintaining a large trade surplus, supported by its dominance in global exports and strong manufacturing sector, while India faces a widening trade deficit due to its higher reliance on imports. Additionally, China's industrial output significantly outperforms India's, reinforcing its role as a global manufacturing hub. To improve economic performance, India should boost investment in manufacturing, infrastructure, and exports to enhance trade competitiveness. Conversely, China must diversify its economy beyond an investment-heavy model, focusing on innovation and domestic demand to sustain long-term growth.

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