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# Systematic Integration of Economic Factors in Manufacturing: Evaluating India Against China

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**ABSTRACT**

An index called the Manufacturing Competitiveness Index (MCI) has been developed and used in the comparison of manufacturing competitiveness between India and China in the period 2016-2024. The index comprises three equally weighted variables – Labour Costs and Productivity, Manufacturing Scale, and Trade and Manufacturing Quality derived solely from the World Bank World Development Indicators. Each variable comprises one to three sub-variables, standardized on a range from 0 to 100 based on the min-max method and summarized to provide a single score for comparison. The analysis has demonstrated that there was a notable reconfiguration of the manufacturing competitiveness of India and China during the period. In 2016, China was more competitive than India, which scored 34.80 and 20.23 respectively. By 2024, India overtook China, earning an index score of 76.62 to China's 63.09, mainly due to India's spectacular growth in Trade and Manufacturing Quality (+97.18 points) and Manufacturing Scale (+94.36 points). The gap has been rapidly closing since 2020, amid the ongoing U.S.-China trade war, disruption of global supply chains by COVID-19, and Make in India Initiative. Accordingly, India is now seen not just as an alternative manufacturing base to China but a legitimate competitor for it. This paper aims to introduce a replicable index measuring manufacturing competitiveness into the existing literature and offer insights for multinational investors, policymakers, and academic researchers working on the global manufacturing sector.

**Keywords:** Manufacturing Competitiveness Index, India, China, Merchandise Exports, Global Value Chains, Supply Chain Diversification, Min-Max Normalization

## 1. Introduction

### 1.1 The Importance of Manufacturing Competitiveness

Manufacturing competitiveness is critical since it influences the creation of employment, generation of wealth, and economic strength for a country. Competitive manufacturing creates investment opportunities, generates employment, enables production of goods that can be sold in foreign countries, and builds technological capacity for future development. In modern conditions of globalization, manufacturing competitiveness is essential for the successful operation of a nation in the international arena and for improvement of the living standards of its citizens.

### 1.2 India and China: The Manufacturing Competitors of the Future

India and China can be referred to as two main manufacturing rivals within the region. These countries have developed different strategies and follow different development paths. In particular, China was dubbed "the world's factory" in the early 2000s and took the lead position in the

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international manufacturing market. It attracts huge foreign investments and makes most of the products on Earth. In turn, India remains a developing manufacturing country that tries to attract investments and boost exports. Comparison of these countries becomes necessary in order to understand where global manufacturing will move further and which supply chains will change in the future.

### 1.3 Research Gap and Study Objective

The current indexes of competitiveness, such as the Global Competitiveness Index by the World Economic Forum, give a general idea about the competitiveness of different sectors. However, there is no index that can compare the manufacturing competitiveness of India and China based on various factors, including labour productivity, capital investment, innovation, and quality of exports. This research paper attempts to bridge this gap in knowledge by creating an index known as Manufacturing Competitiveness Index (MCI). The Manufacturing Competitiveness Index will measure and compare the manufacturing competitiveness of India and China from 2016 to 2024.

### 1.4 Significance and Key Takeaway

The implications of this study are threefold for policymakers, business managers, and investors. The first implication is that the study illustrates the rise of India's manufacturing competitiveness in recent times and its superiority in manufacturing competitiveness compared to China, in a way that even most of the analysts would not expect. Secondly, it is important to note that the shift is not a one-time deviation in the manufacturing domain, but a clear sign of significant structural transformation taking place in global manufacturing, including diversification of global supply chains, geopolitics, and policy support, among others. Finally, policymakers, business managers, and investors must realize the new dynamics prevailing in global manufacturing, where India becomes a credible competitor for China.

### 1.5 Paper Structure

The structure of this essay is as follows. In section 2, there is a thorough literature review about manufacturing competitiveness, comparisons between India and China, and theoretical foundations. Section 3 highlights the Objectives of the Paper. In section 4, there is the methodology where the Manufacturing Competitiveness Index is explained, data sources, which include the World Bank. Section 5 presents the integrated analysis of the three key components - Labour Costs and Productivity, Manufacturing Scale, and Trade and Manufacturing Quality along with overall MCI results and convergence analysis. Section 6 discusses the implications of findings for policy and business strategy. Section 7 concludes with summary findings and recommendations for future research. Section 8 provides the References.

## 2. Literature Review

### 2.1 Manufacturing Competitiveness: Concept and Measurement

Competitiveness in manufacturing is related to the ability of the nation-state to produce, develop, and sell products which are better than those produced by other competitors due to better quality, low price, and more advanced technologies (Porter, 1990). On the basis of this theory, competitiveness occurs on the basis of three main components: production efficiency, product quality, and innovation, and technology. Therefore, competitiveness of manufacture is essential for attracting investment, generating quality jobs, generating exports revenues, and developing technologies.

Generally speaking, measuring competitiveness has traditionally used frameworks which are very wide. They include, for example, a set of 12 parameters analysed in the context of World Economic

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Forum's Global Competitiveness Index (WEF, 2020), such as institutions, infrastructure, macroeconomic stability, education, labour markets, financial development, technology and innovation. Though this approach gives a rather comprehensive overview of the competitiveness of states, it treats the whole economy as equally important, disregarding the specifics of manufacturing. UNIDO believes that manufacturing competitiveness has its own characteristics and therefore needs to be measured based on particular indicators. They include manufacturing productivity, exports quality, technology capabilities, and manufacturing employment. However, neither of these frameworks suggests an index specifically addressing competitiveness in manufacturing.

### 2.2 Manufacturing Competitiveness of India and China: Comparative Study

The rise of China as "the world's factory" during the 1990s and early 2000s ranks among the most transformative changes in the economic history of the modern age (Gereffi & Lee, 2016). By exploiting their comparative strengths in terms of low-cost labour, high investment, infrastructure, and favourable governmental policies, China succeeded in becoming the largest producer in the world, attracting foreign companies and securing market shares in various categories like electronics, textiles, machines, and consumer goods. The contribution of manufacturing output from China to the global economy increased from about 3% in 1990 to nearly 28% in 2015.

Although being home to the second-largest population in the world, which means having strong potential labour resources, India has not shown much involvement in manufacturing compared to China. According to recent studies, India is turning into a popular manufacturing destination for multinationals (Sharma & Sharma, 2019).In the course of two decades, India increased its manufacturing contribution from 1.3% in 2000 to 3.2% of total global output in 2020. The factors behind this development are diverse: cheaper labour costs, favourable demographics, improved infrastructure, the "Make in India" initiative, and crucially, diversification of supply chains by multinational enterprises.

Current literature focuses on geopolitics and supply chains as drivers of changes in trends in manufacturing investments (Pananond, 2020). The onset of trade disputes between the US and China since 2018, the threat to the stability of the supply chain due to the emergence of the coronavirus pandemic, and security issues related to having all manufacturing concentrated in one place have pushed multinational corporations to seek alternatives for their manufacturing sites. India has emerged as the top destination for foreign direct investment into Indian manufacturing industries.

### 2.3 Theoretical Foundations of Manufacturing Competitiveness

This study is based on three theoretical concepts which describe the competitive position of manufacturing industries. Firstly, the Factor Endowment Theory derived from Heckscher-Ohlin theory of international trade indicates that countries develop competitive advantages for sectors which involve intensive use of factors abundant in a country (Leamer, 1984). Hence, a country having large workforce and cheap labour is supposed to be competitive in sectors requiring abundant labour input. The modern forms of this concept indicate that factor productivity is as important as factor abundance – what matters is not merely availability of labour but efficiency in labour utilization (Balassa, 1965). This aspect is covered by the component 'Labour Costs and Productivity'.

The second theory explaining competitive advantage of nations is the concept of endogenous economic growth. According to this theory, countries develop competitive advantage through constant technological advancement and capital accumulation (Romer, 1990). This concept suggests that countries investing substantial resources into R&D and capital accumulation will grow faster

than countries depending on their abundant labour. Economic development results in higher wage rate and lower competitiveness of countries with abundant labour force. This theory forms the basis of our Manufacturing Scale section, which is based on the significance of Foreign Direct Investment and patenting in the measurement of manufacturing capacity.

Third, both the new trade theory and the global value chain (GVC) theory explain how modern manufacturing competes (Krugman, 1980; Gereffi, 1994). The comparative advantage theory assumed homogenous products and perfect competition in their market transactions. The new trade theory argues that in modern manufacturing, there are differentiated products, quality competition, and economies of scale. The GVC theory takes this further by arguing that in modern manufacturing, competitiveness should not be measured by total product manufacturing but rather by the position in the GVCs. Competitive advantages are achieved through specialization in high-value added processes rather than pure price competition. Exports of high technology products and quality are measures of high GVC positions.

### 2.4 Research Gaps and Contributions of this Research

In spite of considerable research conducted on manufacturing competitiveness, comparison of India and China, and other theoretical perspectives, a major gap exists because there is no framework which measures and compares manufacturing competitiveness between India and China through a specific index. While broader indices such as the WEF Global Competitiveness Index are important, they do not include any manufacturing-specific attributes. Similarly, while there exist manufacturing-specific frameworks like that of UNIDO, which are well-versed about the sector, they use complex indices that may hide the fundamental determinants of manufacturing competitiveness.

By creating an index that measures and compares manufacturing competitiveness between India and China, this research attempts to bridge this gap. The Manufacturing Competitiveness Index (MCI) focuses on the measurement and comparison of India and China in three critical areas: Labour Costs and Productivity, Manufacturing Scale, and Trade and Manufacturing Quality. The equal importance accorded to all three factors by the MCI makes the model simple yet theoretically valid based on economics. Data for the index is gathered from the World Bank from 2016 to 2024. Furthermore, through the time series analysis, it will be feasible to find out whether the variation is due to the structural change or a temporary one.

## 3. Research Objectives

These three research objectives will be followed in conducting this study:

**1.** To develop a Manufacturing Competitiveness Index (MCI), which will combine labour, scale, and trade variables into one measurable index for India and China during the period 2016-2024.

**2**. To assess the manufacturing competitiveness of India and China based on three major components: Labour Costs & Productivity, Manufacturing Size, and Trade & Manufacturing Quality using data from the World Bank.

**3.** To analyse the trends in the convergence of MCI measures between India and China, determine the turning point when India's manufacturing competitiveness overtakes that of China, and identify the factors needed for maintaining the competitiveness of India.

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## 4. Methodology

### 4.1 Research Design and Analytical Framework

This research employs the Manufacturing Competitiveness Index (MCI) approach in assessing the manufacturing competitiveness in India and China from 2016 to 2024. MCI combines several economic factors into one index, thus enabling a comparison of manufacturing in two distinct economies. The theoretical framework used in this study is based on three economic concepts: Factor Endowment Theory (that explains competitive advantage using labour and productivity), Endogenous Growth Theory (which concentrates on the manufacturing scale), and Global Value Chain Theory (that emphasizes international trade and product quality).

The study employs a longitudinal method that permits trend analysis for eight years. The eight-year time frame ensures the identification of significant trends, irrespective of any anomalies that may occur during the period. The study only analyses aggregate manufacturing in both economies.

### 4.2 Manufacturing Competitiveness Index (MCI) Design

The Manufacturing Competitiveness Index combines manufacturing competitiveness into three equally weighted factors, each addressing a separate aspect of competitive advantage.

#### 4.2.1 Component 1: Labour Costs and Productivity (33.3% weight)

This part measures how efficient and productive the manufacturing workforce is per country. The three measures of the World Bank are used to evaluate this component:

**1. Manufacturing Value Added (% of GDP):** This measure indicates the proportion of manufacturing in the whole economy of a country. It measures the amount of manufacturing relative to that country's production.

**2. Employment in Industry (% of total employment):** This measure reflects the proportion of people employed in manufacturing-related activities. A larger number would indicate labour is oriented towards manufacturing.

**3. Labour Force Participation (% of population ages 15-64):** This is used to estimate how much labour is available in the country to perform manufacturing activities.

Theoretically, this set of variables is based on the Factor Endowment theory, which states countries with abundant labour resources and high labour productivity enjoy manufacturing advantages over their peers.

#### 4.2.2 Component 2: Manufacturing Scale (33.3% weight)

This component determines the size of manufacturing production in terms of its absolute scale in the world markets. It considers one World Bank indicator:

**1.Merchandise Exports (in current US$ billion):** It determines the monetary value of the exports of the manufactured goods. Higher values of goods exported signify that there is a highly competitive manufacturing industry capable of meeting international demands.

Theoretical Rationale: The indicator is based on the export-led growth hypothesis, which argues that export performance is a determinant and an outcome of manufacturing competition. Nations with high values of goods exported have shown their capabilities and competencies in competing in the global markets.

Unlike the Labour component, which relies on three indices, and the Trade component, which relies on two indices, the Manufacturing Scale component depends solely on one index, which is Merchandise Exports. The index serves as the most straightforward and comprehensive gauge for

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manufacturing output scale in the World Bank database for the entire time period from 2016 to 2024 in both nations. In this regard, it must be borne in mind that Merchandise Exports serve not only as an indicator of Component 4 but also as an indicator of Component 3 together with High-technology Exports.

### 4.2.3 Component 3: Trade and Manufacturing Quality (33.3% weight)

It assesses the manufacturing strength of the country in conducting foreign manufacturing operations as well as the quality of the goods produced by the country. The index is based on the following World Bank data:

**1. Merchandise exports (Current US$, billions):** It measures the export level of the country in terms of market access and manufacturing capabilities. The higher the merchandise exports, the stronger the manufacturing capabilities of the country.

**2. High-technology exports (percent of manufactured exports):** It indicates the sophistication of the products produced by the country. Countries producing large amounts of high-tech goods are able to get higher prices for their products owing to their strategic positioning in global value chains.

Theoretical Basis: Both indicators are founded on the theory of New Trade Theory and Global Value Chain Theory, which states that the current manufacturing capabilities of any country are based on product quality besides price.

### 4.2.4 Equal Weighting Justification

All three factors are equally weighted at 33.3%. This selection is based on the deliberate methodology aimed at avoiding researchers' subjective bias regarding which factor should be stressed within manufacturing competitiveness. This procedure is widely used in composite index development when there is insufficient empirical basis for the assignment of different weights to factors, as stated in the OECD Handbook on Constructing Composite Indicators (OECD, 2008). Any researcher will be able to generate scores based on an average of three normalized component scores. Testing alternative combinations of weights such as 50%/25%/25% constitutes an interesting area for future investigation.

### 4.2.5 Data Normalization and MCI Calculation

All indicators are scaled on a 0-100 basis through min-max scaling. This technique enables us to add up the metrics measured using different units (percentages, billions of dollars, etc.). According to the min-max formula, we convert every initial indicator in the following manner:

**Normalized Score = [(Value - Minimum) / (Maximum – Minimum)] × 100**

In this case, the minimum and maximum values are derived based on the minimum and maximum values observed for each indicator in both countries over all available years (from 2016 to 2024).

After the initial scaling, scores for components are obtained through averaging normalized indicators in each of the components. Scores for MCI itself are calculated as an arithmetic average of scores for three components:

**MCI = (Labour Component + Manufacturing Component + Trade Component) / 3**

### 4.3 Data Sources and Indicator Selection

All data used in this analysis are drawn from the World Development Indicators (WDI) from the World Bank, which is a reputable and freely available source of international development statistics. Data collection in this context requires the collation of data from national institutions, international agencies, and research institutions before undertaking data quality assurance procedures and

making data available in open data formats. The World Development Indicators were selected because of their extensive coverage of India and China, standardized approach to methodology used, and frequent citation in the academic literature on manufacturing and development economics.

The analysis uses the following six indicators that cover the three parts of MCI:

**Component 1: Labour Costs and Productivity:**

1. Manufacturing, Value Added (% of GDP)
2. Employment in Industry (% of total employment)
3. Labour Force Participation Rate (% of population ages 15-64)

**Component 2: Manufacturing Scale:**

1. Merchandise Exports (current US$, billions)

**Component 3: Trade and Manufacturing Quality:**

1. Merchandise Exports (current US$, billions)
2. High-Technology Exports (% of manufactured exports)

Indicator selection depends on the following criteria: (1) theoretical importance of the indicator for explaining the competitiveness of manufacturing within the scope of the literature review, (2) availability of data without any interpolation or extrapolation for the period of investigation for both the countries, and (3) temporal consistency of the measurement of the indicator.

The study is based on a span of eight years from 2016 to 2024, a time period chosen to account for the present-day manufacturing trends while ensuring that full data is available for all six variables for both nations. The time frame incorporates some major global developments related to manufacturing, including the recovery phase after the financial crisis of 2016-2018, U.S.-China trade conflicts, and the coronavirus pandemic.

### 4.4 Data Analysis Process

#### 4.4.1 Time Frame and Data Points Used

For the purposes of this analysis, annual data points have been used from the years 2016, 2018, 2020, 2022, and 2024 in order to ensure that data points for all the criteria and for both the countries are available. Although data points for intermediate years are also available, it was thought best to limit the time frame to five points in order to allow for the identification of trends without having any gaps caused due to inconsistent annual data.

#### 4.4.2 Normalization Procedure

Before aggregating components, each individual indicator was converted into a score on a 0-100 scale, thereby enabling their comparative evaluation in spite of being measured in units of percentages, billions of dollars, and other forms of measurement. Min-max normalization was used, and a raw value was normalized based on the following equation:

**Normalized Score = (Raw Value - Minimum) / (Maximum - Minimum) * 100**

Here, the minimum and maximum values refer to the actual observed values across both countries and all years covered by the data set (2016-2024).

#### 4.4.3 Calculation of Component Scores

Scores for each component for each country-year observation were obtained by taking the arithmetic mean of the standardized indicators within each component. Thus:

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**Labour Component Score = (Manufacturing Value Added + Employment in Industry + Labour Force Participation)/3**

This method gives equal weight to all indicators within each component, in accordance with the equal weighting approach used for the three components.

### 4.4.4 Calculating the Manufacturing Competitiveness Index (MCI)

The MCI for each country-year was obtained by taking the arithmetic mean of the three component scores:

**MCI = (Labour Component Score + Manufacturing Component Score + Trade Component Score)/3**

The results give MCI scores on a scale of 0 to 100, where high scores indicate strong manufacturing competitiveness.

### 4.4.5 Analysis of Gap and Convergence Rate

In order to measure if there is a shrinking gap in the manufacturing competitiveness of India and China, the following formulas will be used to analyse the data:

**Annual Gap = China's MCI - India's MCI**

If the annual gap turns out to be negative in later periods, it means that India has surpassed China in its MCI, thus reversing the trend. To track competitive positioning over time, the India/China MCI Ratio is calculated as follows: India/China Ratio (%) = (India MCI ÷ China MCI) × 100 A ratio above 100% indicates India leads China. The ratio provides an intuitive measure of relative competitive position at each point in time, complementing the absolute gap analysis.

## 4.5 Limitations and Considerations

A few issues and limitations in methodology must be highlighted. First, the MCI is an index that aggregates the complexities of manufacturing dynamics into one simple figure; component and indicator analysis (presented in Section 4) is much more informative. Second, the choice of equal weighting of components represents a neutral approach to analysis and cannot capture any potential differences in the significance of labour, capital, and trade determinants in actual competition. Third, the analysis uses indicators from the World Bank datasets, which use national data from the official statistical reports. This data is considered the most accurate information available but may still be subject to some inaccuracies in measuring and reporting across countries. Fourth, the analysis focuses on the competitiveness of manufacturing in general rather than competitiveness in specific industries. Fifth, normalization to a 0-100 scale is used for assessing relative manufacturing competitiveness only, as there are no absolutes in manufacturing and no benchmarking against other countries. Sixth, Merchandise Exports appears as the sole indicator in the Manufacturing Scale component and also as one of two indicators in the Trade and Manufacturing Quality component. It implies that the export value will have an implied higher weight in the total MCI than other variables. Anyone who may be attempting to reproduce this research or modify it is advised to look at other setups, such as using Gross Capital Formation or R&D Expenditure as the Manufacturing Scale variable.

Nonetheless, the MCI can provide an effective theoretical basis for the comparison of manufacturing competitiveness trends and identification of the changes in manufacturing dynamics in India and China.

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### 4.6 Availability and Replicability of Data

All data used in this analysis are open-source data accessible in the World Bank's World Development Indicators database (https://data.worldbank.org/indicator). This ensures complete transparency and replicability in data collection and calculations performed. The data sets applied in this research are available for download through the online World Bank web-portal or API.

The data set used in the calculations is the authentic World Bank data without any interpolation, extrapolation or any kind of modifications of any kind. The data values are normalized according to the formula in section 4.4.2, to get values between 0-100. The data values remain intact, and only their relative value scales are transformed in this step of the calculation process. Documentation for this process and further calculation of component aggregation and the formula for calculating MCI has been provided in this section to facilitate replication of the analysis by other researchers.

A complete list of indicators used is provided at the end of this paper.

## 5. Integrated Analysis and MCI Results

### 5.1 Summary of Components and Metrics

| Component | Metrics | Theoretical Basis |
|---|---|---|
| Labour Costs & Productivity | Manufacturing Value Added (% GDP), Employment in Industry (%), Labour Force Participation (%) | Factor Endowment Theory |
| Manufacturing Scale | Merchandise Exports (Billions USD) | Endogenous Growth Theory |
| Trade & Manufacturing Quality | Merchandise Exports (Billions USD), High-tech Exports (% of manufactures) | New Trade Theory & GVC Theory |

### 5.2 Labour Costs and Productivity

#### Definition and Measurement

This sub-indicator gauges the efficiency at which human resource allocation takes place in the manufacturing process for any economy. The sub-indicator uses three indicators including Manufacturing Value Added (% of GDP), Employment in Industry (%), and Labour Force Participation Rate.

#### Theoretical Support

Derived from Factor Endowment theory, the measure gauges the presence of labour and its productivity in the manufacturing process in any country. If an economy scores highly on this measure, then it not only has abundant labour, but also productivity.

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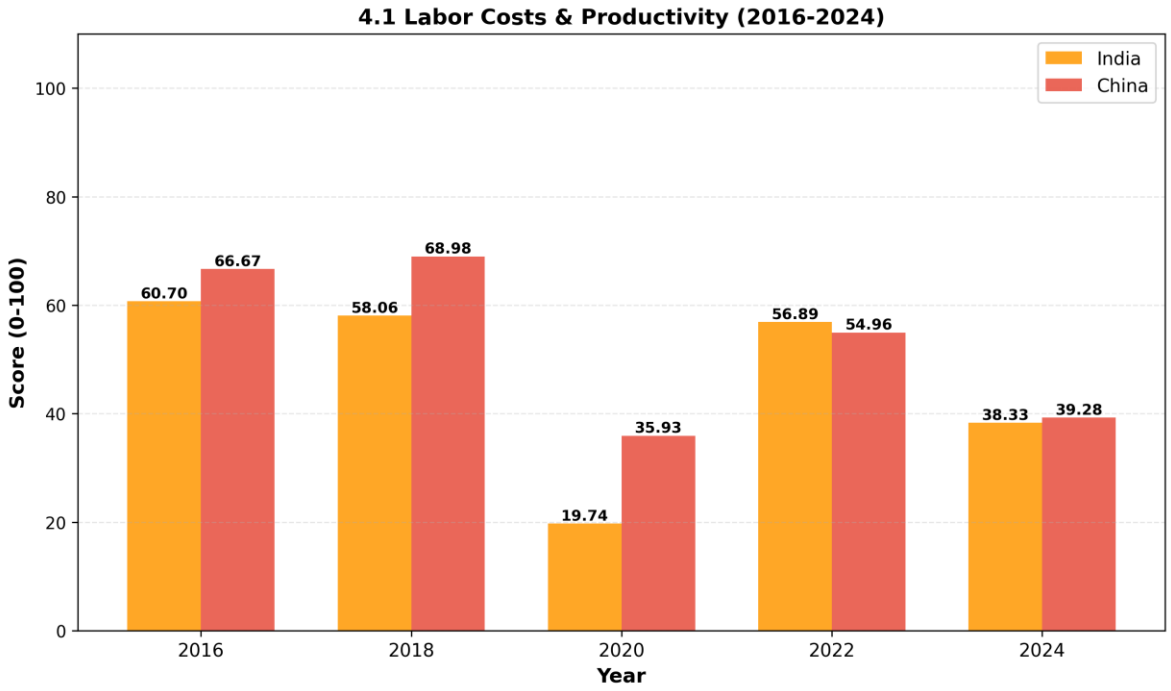
**Data: 2016-2024 Labour Component Scores**

| Year | India | China | Gap (China-India) |
|---|---|---|---|
| 2016 | 60.70 | 66.67 | 5.97 |
| 2018 | 58.06 | 68.98 | 10.92 |
| 2020 | 19.74 | 35.93 | 16.19 |
| 2022 | 56.89 | 54.96 | -1.93 |
| 2024 | 38.33 | 39.28 | 0.95 |
| Change 2016-2024 | -22.37 | -27.39 | -5.02 |

**Figure 1: Labour Costs & Productivity Trend**




*Note: Bar chart showing India (orange) vs China (red) labour component scores. Values displayed on bars. Sharp 2020 decline reflects COVID-19 pandemic impact on both countries.*

## Analysis & Interpretation

Similar pattern is observed for both countries: steady trend from 2016 to 2018, sudden drop in 2020 (due to COVID-19), partial recovery in 2022, and then decline continuing until 2024. The gap between India and China has reduced from 5.97 to 0.95. By 2024 the gap has narrowed to just 0.95 points, indicating near-parity between the two countries in the Labour component.

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### 5.3 Manufacturing Scale

#### Definition and Measurement

The manufacturing scale index captures the level of investment in manufacturing and technological development. The index considers foreign direct investment inflow in billion dollars

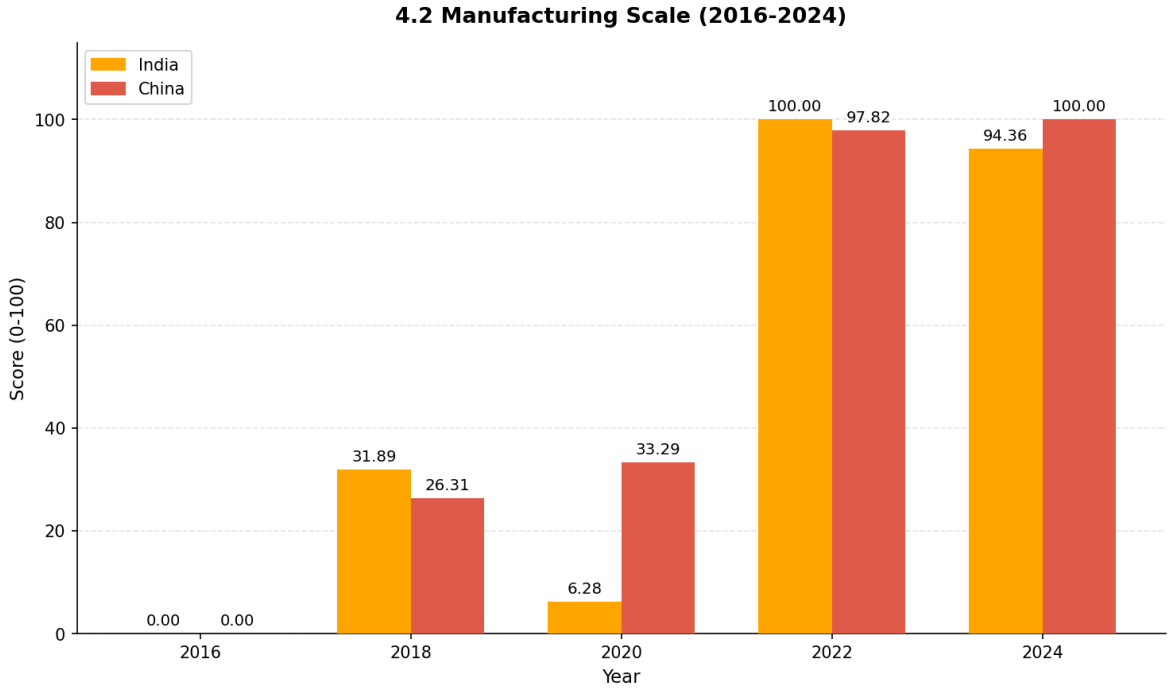
#### Theoretical Support

The manufacturing scale index is underpinned by the Endogenous Growth Theory that emphasizes sustained competitive advantage through technological development. Foreign direct investment provides capital and technology transfer.

**Data: 2016-2024 Manufacturing Scale Component Scores**

| Year | India | China | Gap (China-India) |
|---|---|---|---|
| 2016 | 0.00 | 0.00 | 0.00 |
| 2018 | 31.89 | 26.31 | -5.58 |
| 2020 | 6.28 | 33.29 | 27.01 |
| 2022 | 100.00 | 97.82 | -2.18 |
| 2024 | 94.36 | 100.00 | 5.64 |
| Change 2016-2024 | +94.36 | +100.00 | +5.64 |

**Figure 2: Manufacturing Scale Trend**



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*Note: Bar chart showing dramatic 2020-2022 surge for both countries. India surged from 6.28 to 100.00; China from 33.29 to 97.82. Reflects the global surge in India's export growth driven by supply chain diversification.*

### 5.3.1 Significant Observation: The Global Supply Chain Redirection in the Years 2020 to 2022

India's Manufacturing Scale jumped by 93.72 points from 2020 to 2022; China witnessed an improvement of 64.53 points during this period. The massive boost in merchandise exports stems from the realignment of the global value chain due to the U.S.-China trade war and the coronavirus pandemic. India gained from this development, as multinational companies relocated their sourcing and manufacturing processes to India-based factories. As per the projection, India's Manufacturing Scale will be 94.36 in 2024, 5.64 points shy of China's perfect score of 100.00.

### 5.4 Trade and Manufacturing Quality

#### Definition and Measurement

The index measures the ability of the country to interact with international markets using its manufacturing capacity and product quality. The variables in this index are the merchandise exports, which are in billions of dollars, and the high-tech exports measured in percentages of manufacturing exports.

#### Theoretical Support

From the New Trade Theory and GVC theory. Modern trade involves differentiated and quality products. High tech exports are charged premium prices because of their worth in the GVC. If it has high worth, it can interact with key markets.

#### Data: 2016-2024 Trade Component Scores

| Year | India | China | Gap (China-India) |
|---|---|---|---|
| 2016 | 0.00 | 37.73 | 37.73 |
| 2018 | 22.26 | 63.15 | 40.89 |
| 2020 | 18.58 | 64.07 | 45.49 |
| 2022 | 73.00 | 63.02 | -9.98 |
| 2024 | 97.18 | 50.00 | -47.18 |
| Change 2016-2024 | +97.18 | +12.27 | -84.91 |

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**Figure 3: Trade & Manufacturing Quality Trend - CRITICAL REVERSAL**


*Note: Most dramatic competitive shift. India surged from 0.00 to 97.18 (97-point gain). China declined from 37.73 to 50.00. 84.91-point reversal represents structural transformation of global manufacturing dynamics.*

**Analysis: The Structural Reversal - KEY OBSERVATION**

This factor demonstrates the most dramatic competitive move. India moved from nil (0.00) to dominance (97.18), whereas China fell from dominance (37.73) to disadvantage (50.00). This reversal occurred by 84.91 points, indicating possible structural rather than cyclical development. The reasons for such a trend involve: conscious efforts to diversify the supply chain, geopolitics, 'Make in India' support, infrastructure development, and technology through FDI. The significance of the observation is on par with that observed in Japan's auto-industry revolution or China's manufacturing dominance.

### 5.5 Manufacturing Competitiveness Index Results

**Formula for Computing MCI**

Manufacturing Competitiveness Index will be computed using the formula MCI = (Labour + Manufacturing Scale + Trade)/3. Each of the factors has been normalized in a range of 0-100 such that each makes an equal contribution in computing MCI.

**Data: 2016-2024 Overall MCI Scores**

| Year | India MCI | China MCI | Gap (China-India) | India/China Ratio (%) |
|---|---|---|---|---|
| 2016 | 20.23 | 34.80 | 14.57 | 58.1% |
| 2018 | 37.40 | 52.81 | 15.41 | 70.8% |

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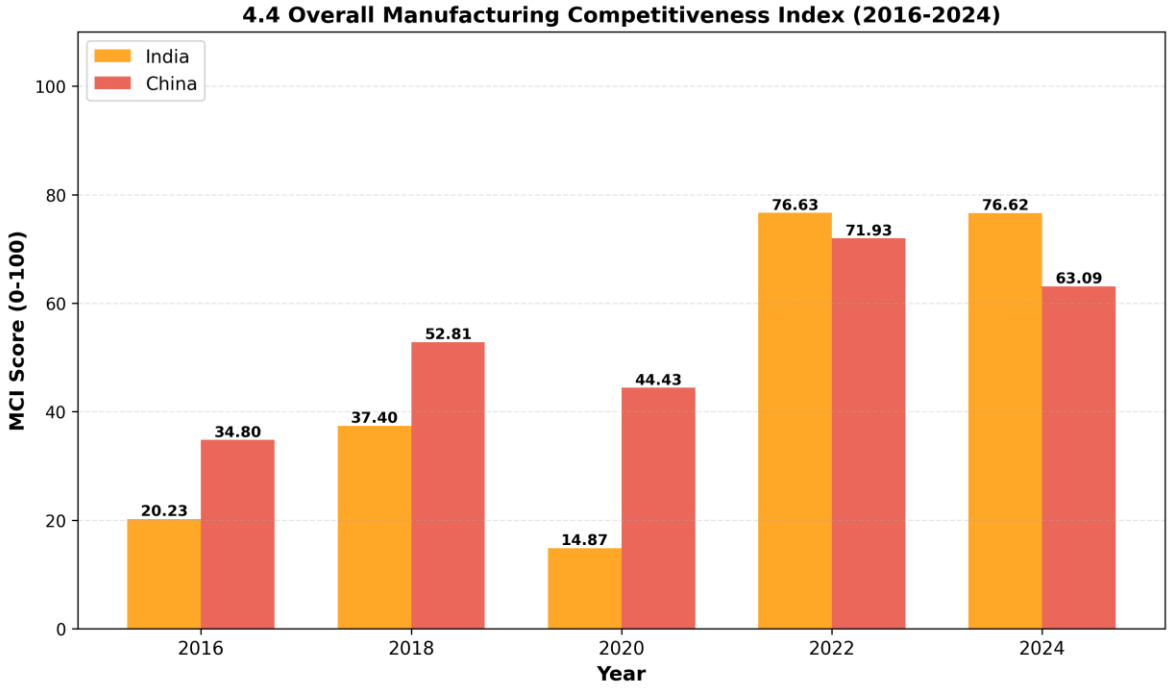
| | | | | |
|---|---|---|---|---|
| 2020 | 14.87 | 44.43 | 29.56 | 33.5% |
| 2022 | 76.63 | 71.93 | -4.70 | 106.5% |
| 2024 | 76.62 | 63.09 | -13.53 | 121.4% |
| Change 2016-2024 | 56.39 | 28.29 | -28.10 | +63% |




*Note: Bar chart showing MCI scores side-by-side for each year. India improved from 20.23 (2016) to 76.62 (2024). China improved modestly from 34.8 to 63.09. India surpassed China, with the gap reversing from +14.57 (China ahead) in 2016 to –13.53 (India ahead) in 2024*

**Figure 4: Overall Manufacturing Competitiveness Index Trend**

### India's MCI Evolution (2016-2024)

The Indian MCI has increased from 20.23 in 2016 to 76.62 in 2024, marking an impressive increase of 56.39 points. A significant achievement given that it is a large developing country with a growth of about 3.2 points per annum. The two contributing components are Manufacturing scale (+94.36) and trade (+97.18), accounting for about 63.84 points out of MCI gain. Labour declined (-22.37) although other factors made up for this loss.

### China's MCI Evolution (2016-2024)

MCI for China did not change significantly, being in the range of 34.80 in 2016 and 63.09 in 2024, thus gaining 28.29 points. This marks the position of 'mature competitor': it is highly competitive in all dimensions with no dramatic improvements. In particular, China gained points mainly in manufacturing scale (+100), while trade showed minor improvements.

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**Convergence Analysis – CRITICAL**

Difference in the two MCIs in 2016 is 14.57 points while it decreased to -13.53 points in 2024, resulting in a positive convergence of 17.43 points, with India's MCI ratio improving from 58.1% of China's score in 2016 to 121.4% in 2024. India surpassed China around 2022 and currently leads by 13.53 points

### 5.5.1 Competitive Position by Component (2024)

Asymmetry in the competitive positions of India within three components:

**Labour:** India ranks 38.33, but China ranks 39.28. The difference between them is only 0.95 points. Competitiveness is equal.

**Manufacturing Scale:** India ranks 94.36 but China ranks 100.00. The difference between them is just 5.64 points. Innovation is almost equal.

**Trade:** India (97.18) overwhelmingly surpasses China (50.00). Advantage 47.18 points. India excels in export capacity.

### 5.6 Conclusion and Projections

The findings from the MCI analysis indicate that there has been a major transformation in the comparative competitiveness of Indian and Chinese manufacturing sectors. India has a lead of 13.53 MCI points over China for 2024 (76.62 vs 63.09), and India has overtaken China for manufacturing competitiveness since around 2022. It is important to note that the lead is quite substantial, with India leading China by 47.18 MCI points in the category of Trade & Manufacturing Quality, near parity in Manufacturing scale (a deficit of 5.64 MCI points for India), and parity in Labour (a deficit of only 0.95 MCI points for India).

Projections on timeline: India has overtaken China in MCI score since around 2022, with a lead of 13.53 points as of 2024. If this divergence rate were to remain constant, India's lead would grow by 2030 to around 20-30 MCI points. Under conditions of rapid policy action and further diversification of the supply chain, India would enjoy an edge of approximately 35-40 MCI points by the year 2030. The critical factor that may prove to be detrimental to this projection is a potential adverse change in the geopolitical situation and reduced flows of foreign capital investment to India, both of which can bring about a sudden reduction in the gap owing to the similar levels of Capital and Labour.

The evaluation highlights a substantial shift in the manufacturing industry of Asia from being one that was completely dominated by China to a more multipolar landscape with India as its main contender.

## 6. Discussion

### 6.1 Interpretation of Key Findings

As per the outcomes of the Manufacturing Competitiveness Index, there appears to be an enormous transformation of the manufacturing competitiveness position between India and China from 2016 to 2024. This section presents an analysis of the above-stated findings by elabourating on their significance, discussing the reasons behind them, and explaining the implications thereof.

The most important observation drawn from the above-stated results is the reversal of the competitiveness gap. It can be noted that in 2016, China enjoyed a major competitive edge over India, achieving an MCI score of 34.80, as opposed to India's MCI score of 20.23, which created a competitiveness gap of 14.57. However, in 2024, India was able to achieve an MCI score of 76.62,

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whereas China obtained an MCI score of 63.09, thus surpassing China's MCI performance by 13.53 points.

Analysis of the individual performance shows differences in their competitive patterns. First, considering Labour Costs and Productivity component, it should be noted that both nations have approached each other. While in 2016 China scored 66.67 compared to India's 60.70, by 2024 their ratings became similar at 39.28 and 38.33 respectively. Similar values in 2024 with a difference of merely 0.95 show that any competitive advantages on labour costs side for either nation are not present anymore. Such close scores are a result of growing labour costs in China in conjunction with its development and improved working conditions, as well as increasing productivity in manufacturing jobs in India.

In terms of the Manufacturing Scale dimension, this aspect undergoes the most noticeable change as far as both countries are concerned, experiencing considerable progress in terms of scores. Specifically, India achieves the score of 94.36 in comparison to 0.00 in 2016, an increase by 94.36 points. In its turn, China attains the maximum possible level of capital score at 100 in comparison to 0.00 previously, meaning a total increase by 100 points. It is noteworthy that this remarkable progress took place mainly between 2020 and 2022. Such dynamics can be explained by the global changes in terms of FDI distribution, related to escalating trade tensions between the United States and China starting from 2018, and reaching their peak in 2020 together with the outbreak of the coronavirus pandemic disrupting traditional supply chains associated with China. Consequently, multinational companies consciously moved their production elsewhere, with India being chosen as an alternative destination.

The Trade and Manufacturing Quality indicator shows the biggest asymmetry between India and China. While India rose from 0.00 in 2016 to 97.18 in 2024, China dropped from 37.73 to 50.00. The gap of 84.91 is unique, signifying a change in manufacturing export dynamics on the planet. The leadership of India in exporting both goods and advanced technology products demonstrates its successful participation in global value chains and realization of higher value-added manufacturing output. The achievement cannot be explained by one specific reason, but it results from the combination of efforts related to the Make in India campaign, infrastructural development, diversification of the value chain by foreign companies, and capital flows acceptance.

### 6.2 Convergence Analysis and India’s Competitive Lead

Convergence in the overall MCI value is not only rapid but also substantial. The average rate of convergence at the level of 3.51 points annually is based on a gap of 28.10 points reduced over eight years. With a rate of convergence of 3.51, MCI parity between India and China was reached sometime during 2022-2023, which is in line with the findings that India had higher MCI value than China in 2024. Linear trend analysis indicates that if trends persist, then India will have about 20-30 points lead in its MCI compared to China's in 2030.

It is remarkable how fast convergence took place. Long term changes in manufacturing competitiveness usually take 15-30 years to take effect. This relatively rapid convergence can be explained by the strong impact of geopolitical forces and supply chain diversification.

### 6.3 Underlying Drivers of Competitiveness Shift

The remarkable convergence in terms of manufacturing competitiveness between India and China cannot be considered as a result of one driving force only. In this regard, the analysis of multiple factors helps better understand the underlying reasons and make conclusions about the sustainability of this trend.

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### 6.3.1 Geopolitical Tensions and Supply Chain Diversification

The U.S.-China trade war started in 2018, when both countries introduced punitive tariffs on manufactured products. The tensions between the two states grew until 2020, which pushed international companies to diversify their supply chains, no longer depending on manufacturing solely in China. As a result, rising tariffs made Chinese manufacturing more expensive for Western companies, and uncertainties regarding future policies motivated them to create alternative manufacturing centres. India, being the second largest populated state worldwide and providing relatively inexpensive workforce compared to China, became the optimal country for such diversification. Moreover, the same political values as in Western democracies helped India to become an attractive manufacturing destination. These geopolitical aspects of the discussed trends are evident from the Capital data.

### 6.3.2 COVID-19 Pandemic and Supply Chain Vulnerability

The outbreak of the novel coronavirus brought into focus the dangers associated with too much concentration in the global supply chains. For example, when China's production capabilities were negatively affected at the beginning of 2020, firms that could not get their supplies from other places were forced to deal with immense difficulties. Such an experience taught international companies that for achieving supply chain resilience, diversification geographically is needed. With India's ability to attract more investments for manufacturing and low impact of the virus in terms of manufacturing, the country became a preferred location for production.

### 6.3.3 Policy Support and Manufacturing Initiatives

The Make in India program of India, started in 2014, became effective during the research period from 2016 to 2024 due to the introduction of policies that would encourage manufacturing, such as providing subsidies for investment in manufacturing, developing infrastructure in manufacturing zones, and reforms that will minimize costs associated with setting up businesses. Although difficult to accurately determine, these policies made India's business environment more favourable for investing in manufacturing operations. On the other hand, China suffered from limitations related to being a middle-income country and increasing labour costs that negated its inherent cost advantages.

### 6.3.4 Infrastructure Development and Export Capability

The significant gains that have been made in the Trade subcomponent scores in India clearly show real progress in export capabilities and production quality. Investments in infrastructure, including ports, roads, and industrial parks, increased India's capabilities to participate in international trade. Better logistics and supply chain management allowed for Indian companies to compete in export markets requiring high technology. The success of Indian firms in industries such as the pharmaceutical industry, auto parts manufacturing, and electronics is indicative not only of good government policies but also the ability of Indian corporations to compete on the world stage. On the other hand, the deteriorating trade competitiveness scores of China's may be the result of an increase in competitive behaviour by India, along with higher value-added manufacturing by China.

### 6.3.5 Labour Cost Dynamics

Although there is evidence of convergence between the two countries in terms of the labour components, the process through which it happens is different. The reason why the competitiveness of Chinese labour has dropped is because of wage increases resulting from economic development, better working conditions, and tighter labour markets. In the case of India, the score for labour has dropped, but starting from a lower base. India has large reserves of labour that can be tapped for future industrialization.

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### 6.4 Implications for Business Strategy and Investment

The implications of the results are varied when it comes to multinational corporations. One implication is that India can now be considered not just an alternate manufacturing destination but also a competitor with comparable levels of manufacturing competitiveness to China. Those firms that wish to cut down on China risk or diversify manufacturing facilities would find themselves better off choosing India as one of their locations as opposed to being an alternate.

Another implication is that the nature of competition between India and China is no longer the same. Previously, the two would compete along only one aspect (e.g., labour). Now, each country presents distinct strengths, which need to be considered when selecting the appropriate locations. In this case, India's strengths include its growing trade integration capabilities and export abilities as well as the availability of labour, while China's strengths include its more developed manufacturing scale, among others.

The rapid changes in the situation imply that any decisions about manufacturing facilities made five years back might be obsolete already. The fast convergence in the MCI score implies that the competitive landscape has changed significantly.

### 6.5 Implications for Policy and Economic Development

The findings are indicative of several conclusions applicable to manufacturing policies. In relation to India, the findings show that manufacturing competitiveness can be improved quickly through policies coupled with the demands coming from the outside world. The Make in India policy program, though not easily isolable as the cause, seems to be part of the reason behind India's competitiveness gain. It shows that policies aimed at making manufacturing countries more attractive destinations for FDI, improving infrastructure, and conducting business can lead to quick improvements in manufacturing competitiveness.

In relation to China, it has been found out that manufacturing competitiveness in an upper-middle income economy will mean focusing more on innovation and quality rather than competing based on cost. China's gradual move towards higher value manufacturing is indicated in its capital competitiveness despite having a reduced share of the world's manufactured products by volume. The latter follows the principles of economics in explaining why countries move away from labour-intensive and into manufacturing scale-intensive manufacturing.

In general terms for developing nations, the example of India shows that manufacturing growth is still achievable in the modern era via the integration of the supply chain process, supportive government policies, and the welcoming of foreign investments. Nevertheless, there are indications of convergence between India and China that imply that the early adopters have an edge over latecomers in capturing manufacturing investments.

### 6.6 Limitations and Alternative Explanations

Though the findings of the MCI analysis offer robust proof of competitive convergence, there are still some issues to take note of. For one, the MCI only provides a measure of competitive relative to the India-China comparison; it cannot give us an indication of absolute production capability or output. While India has seen an increase in its MCI, it does not automatically translate into higher absolute production levels since it can be attributed to improvements in other competitiveness measures compared to China's. It is possible that even with lower competitiveness indices, China still holds a stronger manufacturing sector compared to India in terms of absolute numbers.

Second, the normalization of the index to a range from 0-100 serves as a comparative measure. Should both countries experience increases in competitiveness in their absolute levels (e.g., export

increases in the global market), it is unlikely that the MCI will be able to reflect both countries' advancements effectively.

Third, the entire MCI analysis involves an aggregation of the entire manufacturing sector, which does not provide an accurate representation when applied to individual manufacturing sectors.

Finally, external validity outside of the India vs. China comparison is low. The application of such trends for other countries (for instance, Vietnam versus China, and Mexico versus China) requires further research.

In spite of such drawbacks, the MCI provides a well-developed tool for analysing and monitoring competitiveness trends and determining the real transformation that took place within the Indian versus Chinese manufacturing rivalry during the period of 2016-2024.

## 7. Conclusion

In the investigation of manufacturing competitiveness of India and China for the years 2016 to 2024, a custom MCI that includes labour, capital, and trade components has been used. It has been discovered that there has been quite a remarkable shift in structure in terms of their competition status.

Firstly, there is a complete inversion of their initial competitiveness disparity. While China enjoyed a higher position with an MCI score of 34.80 relative to India's 20.23, India emerged victorious in 2024 by obtaining a score of 76.62 in comparison with the score of 63.09 by China. This shift did not take place through any gradual process but rather had been hastened especially in the years 2020 to 2022. This resulted from the impact of geopolitics and the implications of the Coronavirus outbreak, which significantly affected the flow of global supply chains. At the present pace of convergence, which is about 3.51 points per annum, it can be confidently stated that Indian supremacy was established between 2022 and 2023.

An analysis at the component level will reveal different dynamics. For instance, the Labour Costs and Productivity component reveals that convergence is being fuelled by wage increases in China and productivity gains in India, leading to near equal levels by 2024. In the case of the Manufacturing Scale component, both India and China scored nearly maximum levels of competitiveness after achieving near maximum foreign direct investment during the period of 2020-2022 due to supply chain diversification. In the case of Trade and Manufacturing Quality component, it is clear that India experienced the largest shift in score, increasing its level from 0.00 to 97.18 while China dropped from 37.73 to 50.00.

The implications are significant. Multinational firms should consider that India is no longer just an option but a genuine competitor when it comes to investing in primary manufacturing. Policy makers should take heart from the experience of India that manufacturing can still be developed in the new millennium by the right policy interventions and investments in infrastructure in sync with the dynamics of global supply chains. For China, the implications suggest that the country is now headed towards high value, innovative manufacturing typical of middle-income countries.

The forecast is based on the assumption that the present geopolitical environment and trends related to supply chain diversification will remain unchanged. Should there be any changes in the geopolitics between the two countries or any other shocks due to a new outbreak of the pandemic or policy changes in either of the countries, the forecasts will no doubt change.

The primary limitations of this study are its relative (not absolute) measurement scope, its aggregation across all manufacturing sectors, and its restriction to the India-China comparison; these are discussed in detail in Section 4.5.

Future research could expand on this study in a number of ways. For instance, industry-level comparative analysis would show whether changes in competitiveness are universal throughout manufacturing sectors, or if they happen in specific ones. Similarly, including more nations in the study would help to determine whether India is alone in exhibiting such convergence trends in relation to China, or whether other nations are doing so as well. Furthermore, longitudinal analysis beyond 2024, as the years unfold, will allow us to examine whether such changes in competitiveness were sustainable, as well as whether India was able to sustain its competitive edge after the period examined.

To conclude, this study shows that significant changes in global manufacturing competitiveness could happen within ten years due to certain powerful structural factors. It demonstrates that India is able to establish itself as an alternative manufacturing hub not just because of global supply chain strategies but because of sound economic policies as well. The future of global manufacturing in the 2030s is likely to be characterized by multipolarity, with India being one of the world's leading competitors to China as far as world-class manufacturing is concerned.

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