

The Semiconductor Chip Shortage in India: Analyzing Causes, Impacts, and Strategic Solutions

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Abstract: *The semiconductor chip shortage has emerged as a significant global challenge, impacting various industries, from consumer electronics to automotive manufacturing. This paper explores the causes, impacts, and potential solutions to the semiconductor chip shortage in India. It examines both global factors, such as supply chain disruptions and geopolitical tensions, and domestic challenges, including limited manufacturing capabilities and reliance on imports. The research also reviews government policies and initiatives aimed at enhancing domestic semiconductor production. By analyzing the current landscape, this paper aims to provide strategic recommendations to mitigate the effects of the shortage and strengthen India's position in the global semiconductor supply chain.*

Keywords: semiconductor chip

I. INTRODUCTION

Semiconductor chips are the foundation of modern technology, powering everything from smartphones and computers to cars and medical devices. As a result, the recent global shortage of semiconductor chips has significantly impacted multiple sectors, highlighting the critical importance of these tiny but essential components. India, being a major player in the global technology landscape, has faced its own set of challenges due to this shortage. The shortage has affected India's automotive, electronics, and telecommunications industries, among others, causing delays, reduced production, and increased costs. This paper aims to analyze the various factors contributing to the semiconductor chip shortage in India, its impact on different sectors, and the steps being taken to address the crisis.

II. RESEARCH METHODOLOGY

This research adopts a qualitative approach to understand the semiconductor shortage in India, using secondary data from a range of sources including government reports, industry publications, academic papers, and news articles. The methodology includes:

- **Literature Review:** A comprehensive review of existing literature on semiconductor shortages globally and within India to identify key themes, patterns, and gaps
- **Data Collection:** Gathering secondary data from credible sources such as industry reports, government policies, and market analyses to assess the impact of the shortage.
- **Comparative Analysis:** Comparing India's semiconductor landscape with other countries to identify best practices and areas for improvement.
- **Policy Analysis:** Analysing current government policies and initiatives to determine their effectiveness and identify potential strategies for overcoming the shortage.

Limitations

This study faces several limitations. First, it relies heavily on secondary data, which may not capture the most recent developments or proprietary industry insights. Additionally, the fast-evolving nature of the semiconductor industry means that the findings could become outdated quickly as new policies and market dynamics emerge. The lack of primary data collection, such as interviews with industry experts or surveys, limits the depth of insights into the specific challenges faced by companies operating in India.

III. LITERATURE REVIEW

The global semiconductor shortage has been widely studied, with research pointing to a combination of factors such as supply chain disruptions, geopolitical tensions, and increased demand for digital products as the primary causes. According to McKinsey & Company (2023), the COVID-19 pandemic led to a significant mismatch between supply and demand, exacerbating the shortage. Studies by the International Data Corporation (IDC) and Boston Consulting Group (BCG) have highlighted the impact of the shortage on different sectors, particularly the automotive and consumer electronics industries. In India, several reports by the Ministry of Electronics and Information Technology (MeitY) and NITI Aayog emphasize the country’s heavy reliance on imports for semiconductor chips and the urgent need for building domestic manufacturing capabilities. However, there is limited research specifically focusing on India’s unique challenges and opportunities in navigating the global semiconductor crisis, underscoring the need for this study.

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Global Context:

The semiconductor chip shortage is a global issue, with research showing that it stems from a mix of pandemic-related disruptions, supply chain bottlenecks, and rising demand for electronic goods. According to a report by McKinsey & Company (2023), the COVID-19 pandemic severely affected the global supply chain, halting production at chip manufacturing plants and creating a backlog that persists today. Additionally, geopolitical tensions, particularly between the United States and China, have further restricted the global supply of chips. Research by the International Data Corporation (IDC) highlights that the global semiconductor market, which was valued at approximately **\$556 billion in 2021**, is expected to continue growing due to the increasing digitalization of industries worldwide. However, as demand increases, supply chain constraints persist, especially in critical manufacturing hubs such as Taiwan, South Korea, and China.

Indian Context:

India, while a global leader in software services, is heavily reliant on semiconductor imports for its rapidly growing electronics and automotive sectors. Studies by the Ministry of Electronics and Information Technology (MeitY) show that India currently imports **100%** of its semiconductors, with a significant portion coming from Taiwan, China, and the U.S. The growing reliance on imports has made India vulnerable to global supply disruptions. The Indian government has recognized this vulnerability, leading to the launch of initiatives such as the **Production Linked Incentive (PLI) Scheme** and the **Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS)**. However, reports from NITI Aayog and the Indian Electronics and Semiconductor Association (IESA) indicate that India’s progress in semiconductor manufacturing remains slow, largely due to the high capital costs and lack of technical expertise in the field.

Numerical Data Overview

The following table provides key numerical insights related to the semiconductor chip shortage in India and its global context. The data highlights the impact of global supply chain disruptions, the extent of losses in India's automotive sector, India's complete reliance on semiconductor imports, and the growing demand across various industries. It also covers crucial figures like the global lead time for chips, India’s semiconductor market size, and the projected market growth by 2030. This numerical overview underscores the severity of the crisis and its economic implications.

A. Numerical Insights on Semiconductor Shortage in India (2021-2024)

Category	Data
Global Lead Time for Chips	13 to 26 weeks
Global Auto Production Loss	9.6 million units
India Auto Production Loss	380,000 units

India Semiconductor Imports	100%
India Semiconductor Market Size (2021)	\$24 billion
India Semiconductor Market Forecast (2030)	\$110 billion
Maruti Suzuki Production Cut (2021)	60%
Smartphone Shipment Drop in India (2021)	10%
5G Rollout Delay	2023-2024
TSMC Global Market Share	53%
Cost to Build a Semiconductor Fab	\$10 billion

Impact on the Automotive Industry:

The shortage of semiconductor chips has significantly affected India's automotive industry. Modern vehicles rely on chips for various functions, such as engine management, infotainment systems, and advanced driver assistance systems (ADAS). Due to the shortage:

- Car production in India was reduced by **380,000 units** in 2021 alone.
- Maruti Suzuki, Tata Motors, and Mahindra experienced delays in production, with waiting periods for new vehicles extending to **6-12 months**.
- The shortage also impacted the pricing of vehicles, with manufacturers either reducing features to save on chips or passing the cost to consumers.

Impact on Consumer Electronics:

India, as one of the largest smartphone and electronics markets globally, has been hit hard by the semiconductor shortage. Key impacts include:

- **Smartphone Sales Decline:** Smartphone shipments in India fell by **10%** in 2021, despite high consumer demand, particularly for mid-range and premium models.
- **Price Increases:** Laptops, tablets, and televisions saw a **15-30% price increase** as a result of chip shortages and increased manufacturing costs.
- **Delayed Product Launches:** Many electronics companies postponed new product launches, especially smartphones and laptops that depend on advanced chipsets.

Telecommunications and 5G Rollout Delays:

India's ambitious **5G rollout**, which was originally planned for 2021-2022, has been delayed, now expected to launch around **2023-2024**. The delays have occurred due to:

- Shortages in network infrastructure equipment that rely on semiconductors.
- A bottleneck in the availability of 5G-enabled devices, as manufacturers struggle to meet production demands due to chip scarcity.

Impact on Startups and Small Businesses:

Startups and smaller electronics manufacturers in India have faced the brunt of the semiconductor shortage. Unlike larger firms, which can afford to stockpile chips or negotiate better supply terms, smaller companies have struggled to source necessary components, causing:

- **Production Delays:** Small-scale electronics manufacturers have had to slow down or stop production due to a lack of access to chips.
- **Financial Strain:** The increased cost of chips has led to higher production costs, which many startups and small businesses have struggled to absorb.

Economic Impact:

The semiconductor shortage has slowed down key sectors of the Indian economy, particularly manufacturing. This is evident from:

- **Automotive Losses:** A significant decline in automotive output has led to revenue losses across the entire value chain, including component manufacturers and dealerships.
- **Electronics Supply Chain:** Disruptions in consumer electronics have led to missed business opportunities in a rapidly growing market.

Government Initiatives and Proposed Solutions

Production Linked Incentive (PLI) Scheme:

In response to the semiconductor shortage, the Indian government launched the **Production Linked Incentive (PLI) Scheme** aimed at boosting domestic manufacturing of electronic components, including semiconductors. The PLI scheme offers financial incentives to companies investing in the production of high-value components like semiconductor chips.

- **Investment Boost:** The scheme is expected to attract investments worth over **\$10 billion** in the semiconductor sector over the next few years.
- **Increased Domestic Capacity:** The Indian government has approved proposals to set up new semiconductor fabrication plants, or "fabs," with the goal of reducing reliance on imports.

Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS):

The **SPECS** initiative is designed to promote the domestic production of critical electronic components and semiconductors through subsidies and grants for infrastructure development. The scheme aims to provide financial support for companies building semiconductor fabs in India.

- **Capital Subsidies:** Under this scheme, companies that invest in the creation of fabs or semiconductor facilities are eligible for capital subsidies, reducing the upfront cost of setting up advanced manufacturing plants.
- **Encouraging R&D:** The scheme also promotes research and development in semiconductor technology to improve India's design capabilities, making it competitive globally.

International Collaborations:

India is also exploring partnerships with countries like Taiwan, the USA, and Japan, which are leaders in semiconductor manufacturing:

- **Taiwan-India Collaboration:** India has proposed joint ventures with Taiwan to build semiconductor fabs in India, leveraging Taiwan's expertise in semiconductor technology.
- **Quad Agreement:** As part of the **Quad** (Quadrilateral Security Dialogue) alliance between India, the USA, Japan, and Australia, semiconductor collaboration has been a major area of focus. India hopes to benefit from these partnerships by gaining access to semiconductor technology and investment.

Proposed Future Solutions:

India's long-term solution to the semiconductor shortage lies in building a robust semiconductor ecosystem:

- **Government-Industry Collaboration:** India needs to establish strong public-private partnerships to support the semiconductor sector, leveraging private sector expertise and government support for financing and infrastructure.
- **Skill Development:** Building semiconductor fabs requires a highly skilled workforce. India must invest in training engineers and technicians in semiconductor fabrication technologies to build a sustainable talent pipeline.
- **Reducing Dependence on Imports:** The long-term goal is to reduce India's reliance on imports by promoting domestic production of both semiconductors and the raw materials required for their production, such as silicon wafers.

Additional Policy Reforms:

In addition to direct financial support, the government should focus on:

- **Infrastructure Development:** Improving water and energy infrastructure to support semiconductor fabs, as chip manufacturing requires a steady and cleanwater supply and uninterrupted electricity.
- **Tax Incentives:** Offering tax relief to companies that invest in semiconductor manufacturing and design

IV. FINDINGS

The analysis of the semiconductor shortage in India reveals several critical findings:

- **Production Losses in the Automotive Sector:** The automotive industry in India experienced a significant decline in production, with a reported loss of over **380,000 units** in 2021 due to the semiconductor shortage. Major manufacturers such as Maruti Suzuki and Tata Motors had to cut production significantly, leading to extended waiting periods for consumers.
- **Decline in Consumer Electronics Shipments:** The consumer electronics sector faced substantial disruptions, resulting in a **10% decrease** in smartphone shipments in 2021. The shortage also led to increased prices for various electronic devices, with costs rising by **15-30%** for items such as laptops and televisions.
- **Delayed 5G Rollout:** India's ambitious plans for a 5G rollout, initially scheduled for **2021-2022**, have been postponed to **2023-2024** due to delays in obtaining necessary semiconductor components. This delay hinders India's digital infrastructure development and economic growth.
- **Economic Implications:** The semiconductor shortage has had broader economic ramifications, slowing down the recovery of key sectors post-pandemic and contributing to bottlenecks in manufacturing and supply chains across the country.
- **Government Initiatives:** The Indian government has initiated programs like the Production Linked Incentive (PLI) Scheme and the Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS) to bolster domestic semiconductor production. These initiatives aim to attract investments and reduce dependency on imports.

V. CONCLUSION

The semiconductor shortage in India has exposed significant vulnerabilities in the nation's supply chains and highlighted the essential role of these components across multiple industries. The key findings from this research underscore the profound impacts of the shortage, including production losses in the automotive and consumer electronics sectors, delays in 5G deployment, and broader economic implications for recovery post-pandemic.

In response, the Indian government has launched several initiatives aimed at establishing a self-reliant semiconductor ecosystem. The Production Linked Incentive (PLI) Scheme and the Scheme for Promotion of Manufacturing of Electronic Components and Semiconductors (SPECS) are pivotal steps toward attracting investments and enhancing domestic production capabilities.

To fully realize these initiatives' potential, India must prioritize the development of a skilled workforce, improve infrastructure, and foster public-private partnerships.

Moreover, engaging in international collaborations with semiconductor leaders such as Taiwan and the USA will be crucial for technology transfer and investment.

In conclusion, while the semiconductor shortage poses significant challenges, it also presents an opportunity for India to strengthen its semiconductor manufacturing capabilities, reduce dependency on imports, and position itself as a key player in the global semiconductor market in the future. Strategic planning and concerted efforts will be essential for India to navigate this crisis and capitalize on potential growth avenues.

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