Performance of Indian Automobile Industry: An Economic Analysis

Sanjeev Kumar & Dinesh Gehlot

Automobile industry is one of the prominent sectors of the Indian economy, providing employment to around 19 million people directly and indirectly and contributing around 7.1 percent to the GDP. The present paper analyzes the performance of the sector based on secondary data during 2000-01 to 2019-20. The results reveal that the sales of automobile products increased rapidly during the last two decades and India achieved fifth position in the global market. Sales (two/ four-wheeler), production and exports have also recorded positive growth during the period. Multiple regression results show that trade openness, foreign direct investment (FDI) and industrial infrastructure index (III) have positive and significant impacts on the performance of the industry during the study period.

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Introduction

The automobile sector is one of the core sectors of the Indian economy since developed transportation infrastructure plays a critical role in the growth and development of an economy. A decade of continued high and stable growth has resulted in a significant rise in the demand for automobile products, particularly cars. The rise in demand for private vehicles can be attributed to the increase in income of middle-class families. The size of the middle class in India expanded sharply. The wealth per person in working age has substantially increased during the last two decades and the share of working age group in gross domestic product (GDP) has increased to 17.3 percent as compared to 15.6 percent in 2000 (Credit Suisse, 2021). The New Economic Policy (NEP), 1991allowed for 100 percent foreign direct investment (FDI) in Indian automobile market through automatic route which had a tremendous impact on the performance of the Indian automobile industry (MHI, 2022). The new industrial policy has liberalized the process to obtain industrial license to set up an automobile

manufacturing unit. Simultaneously, Government of India (GOI) liberalized the norms for FDI and made import of new technology easier to facilitate the growth of the Indian economy. These initiatives contributed to make the Indian automobile sector more competitive and efficient in the global market. Globally, automotive industry contributes significantly to employment generation as the employability has increased by 35. percent since the global financial crisis (ILO, 2020). Considering the concept of gestation period, the effects of liberalization, or any change in government policies would at least require 5 to 10 years before it starts showing results in the growth process. The progress in industrial sector due to liberalization gets reflected in the advanced and technologically efficient industrial sector. The policy objective behind liberalization was to make India a favorable destination for global market players in manufacturing, to attract FDI and to increase the credit worthiness of the nation. Indian automobile market is being referred to as "Sunrise Sector" of the Indian economy considering the huge profit and market share it has captured (UNIDO-ACMA-MHI Survey Report, 2022). As far as car manufacturing is concerned, Tata Motors and Mahindra & Mahindra constituted the domestic manufacturers whereas other manufacturers operate from foreign nations.

India produced 22.65 million vehicles annually in FY21, with 13 million vehicles being produced between April-October 2021(IBEF, 2022). The two-wheeler section dominates the market in terms of volume owing to the growing middle class and large demographic dividend. Moreover, the growing interest of the companies in exploring the rural markets aided the growth of the sector. India began as a prominent auto exporter. It has strong export growth expectations in the near future. Several initiatives, such as scrappage policy, Automotive Mission Plan 2026, and production-linked incentive scheme, by the GOI are aiming to make Indian automobile market more efficient and an emerging global competitor. These schemes have focused on various dimensions that would contribute to make India a powerful global leader in the two-wheeler and four-wheeler section, (IBEF, 2022).

The growing interest of the companies in exploring the rural markets aided the growth of the sector.

Indian automobile market constitutes a large product chain, two-wheelers being the most demanded and consumed product. This high demand and consumption is owed to the developing nature of the Indian economy, and the wide consumer base with low per capita income which could afford 2-wheeler vehicle more conveniently. George, Jha, and Nagarajan (2002) tried to analyze the government policies which contributed to the progress of the 2- wheeler segment. The paper focuses on the subjective reality of developing countries like India and suggested to maintaining a balance between competitiveness and economic growth through appropriate economic policies. They concluded that the Indian

automobile market is oligopolistic by nature. Since Independence, Indian economy has transitioned from the phase of automobiles being owned only by the rich and royal families to automobiles (especially two-wheeler) being owned by the middle -income group.

Literature Review

Vandana (2017) concluded that the automobile industry has a strong multiplier effect, with forward and backward linkages. As per the study, there is a strong positive correlation between the performance of the automobile industry and health of the economy. Transition of Indian economy is not possible without good economic policies. Kumar and Mridula (2017) explained that the new industrial policy has liberalized the automobile sector which resulted in a significant growth rate ranging from 5.0 percent to 8.0 percent. It helped India to become the sixth largest producer of automobile products with a turnover of approximately 38.3 million USD and employing nearly 19 million people in India. The increase in the consumption of vehicles led to high levels of air pollution further putting enormous pressure on the environment. Smita (2019) conducted a study to analyze the impact of government policy, infrastructure, and other enabling factors on the expansion of the automobile industry in India. In 2023, India became the third-largest automobile market and the demand for Indian vehicles continued to grow in the domestic and international markets (Hindustan Times, 2023). As the global demand for electric vehicles is increasing, the Indian automobile industry is upgrading the technology for manufacturing units, with digitization and automation in sync with the latest trends in the market.

Kanupriya and Sandeep (2018) proposed that the Indian automobile industry is a key factor in the development of the economy. They focus on the factors which influence the growth pattern of the automobile industry, for instance, FDI. They concluded that there is an increase in FDI inflow in the Indian economy, due to an increase in purchasing power of Indian consumers and the FDI (Rajesh & Dileep, 2013) norms which were liberalized in NEP, 1991. They recommended that the government should collaborate with the industry for skill development of the workforce to make them more productive. They found that the automobile industry in India receives a high amount of FDI with the latest technology which augments production efficiency. The liberalization policy of the government concerning FDI in the Indian automobile industry has a positive and significant impact on the sector. The growth of FDI in the automobile sector reflects the tremendous potential of the industry in employment generation and improving the living standards of the people. The study explains that FDI has a greater impact on the automobile industry because it comes with better technology, better management and better skills, which helps in achieving higher growth and makes the sector efficient, profitable and sustainable.

Kameshwar and Bhuvanesh (2014) explained that an increase in the share

of FDI in the retail sector results in increased employability and, it further helps in the skill development of the workforce to comply with the international standards. FDI plays an important role not only in employment generation but also helps in the overall development of the economy. The study is based on secondary data from different sources. Carton and Jimmy (2013) attempted to analyze the trends in the automobile industry with respect to production and sales. He concluded that an increase in domestic and international demand for Indian automobile products incentivizes the manufacturing units of the industry. This is reflected in the increased production of two-wheelers, three-wheelers, and commercial cars. Tachiki (2012) discussed the performance of the Automobile Industry in India. With the help of secondary data for the period 2001-2018, he analyzed the performance of the sector by calculating the compound annual growth rate (CAGR). This study explains the annual growth rate of production, export share in the total exports, CAGR of exports, global market share and the comparative advantage of the Indian automobile industry. The study concludes that the two-wheeler segment accounted for a considerable size of the total production of the automobile sector in the country which increased significantly between 2011 and 2018. After analyzing this study, it can be inferred that India has a trade surplus in total automobiles, except for the trade deficit only in categories of 'motor vehicles parts and accessories', and 'Trailers'. India was self-sufficient in all 6 product categories of automobiles in the year 2000 and in recent years the high cost of imported raw materials caused an increase in the cost of production of Indian automobiles making them less competitive on the global platform**.** In the cutting-edge, Indian automobile industry plays an important role in GDP and employment.

Objectives

Most of the above studies have been conducted before Covid-19 and there are very rare studies available after the pandemic. It is in this context; the present paper is to look at the emerging trends and patterns of Indian automobile sector during 2000-01 to 202021.

The major objective of the present study is to analyze the performance of the Indian automobile industry and also identify the drivers of its performance. The performance of the automobile industry has been estimated in terms of growth of sales, production, and foreign trade. Moreover, the present study also identifies some policy suggestions/ observations for the development of the industry.

Methodology & Data Base

Database: The following secondary database has been used for analysis. These secondary data sources are the Centre for Monitoring Indian Economy (CMIE) Economic Outlook; Society of Indian Automobile Manufacturers (SIAM) Statistics; Handbook of Statistics on Indian Economy, Reserve Bank of India (RBI), Trade Statistics, Department for Promotion of Industry and Trade (DPIIT), Ministry of Commerce and In-

dustry and STATISTA (www.statista.com). Basic statistics and econometrics tools were used for the analysis.

Growth Estimation: A widely accepted exponential model, $y = ab^t e^u$ has been fitted to the time series data for estimating the compound annual growth rate (CAGR) of various automobile parameters viz., sales, production and trade in India during 2000-01 to 2019-20. The compound annual growth rate is usually estimated by using the following semi log functional form;

$$\ln(y) = \ln(a) + t \ln(b) + u$$

Where, y is the dependent variable whose growth rate is to be estimated; t is the independent variable (time). The compound annual growth rate (CAGR) in percent term is estimated as

Compound Annual Growth Rate (CAGR) = {antilog (b) – 1} *100

Estimation of Regression Model

The multiple regression analysis was used to identify the relationship between the performance of the automobile sector (Sales) and explanatory variables, viz., trade openness (OPEN), foreign direct investment (FDI) and industrial infrastructure index (III). The natural log of all variables has been taken for smoothing of data. The following equation has been used for multiple regression analysis;

$$\text{Ln (Sales)} = \beta_0 + \beta_1 \text{Ln (III)} + \beta_2 \text{ Ln (OPEN)} + \beta_3 \text{ Ln (FDI)} + u_i$$

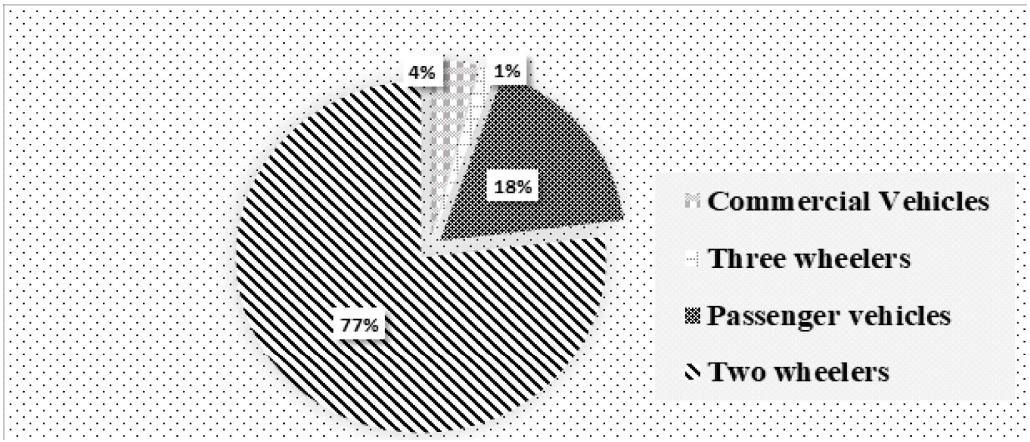
In this equation β_0 represents the intercept, β_1 is the coefficient of industry infrastructure index (III), β2 reparents the coefficient of trade openness, β_3 is the coefficient of foreign direct investment (FDI). u_i is the error term of the regression equation. The data of all explanatory variables was retrieved from Hand Book of Statistics on Indian Economy, Reserve Bank of India(RBI) Mumbai

Domestic Automobile Market

The market share diagram (Fig.1) of the Indian automobile market has four major categories: commercial vehicles, passenger vehicles, 3-whellers and 2-wheelers. The 2-wheeler segment dominates the overall market with 77.0 percent of the market share in terms of sales because of the large middle-class population, followed by the passenger vehicles at number two position with 18.0 percent share, commercial vehicles with 4.0 percent share and 3-wheelers with 1.0 percent share of the market in the FY-2022.

The key growth drivers of the industry are (i) rising industrial and agricultural output, (ii) growth in road infrastructure, (iii) rising per capita income, (iv) favorable demographic distribution with rising working population and middle class, (v) urbanization, (vi) increasing disposable income in rural/ agro-sector, (vii) availability of variety of vehicle models meeting diverse needs and preferences, (viii) greater affordability of vehicles, (ix) easier finance schemes, and (x) favorable government policies. These drivers associate with all the vehicle categories,

Fig. 1 Indian Automobile Market Share (%) by Segment, 2022



Source: Authors' calculations based on STATISTA database

enhancing our understanding of the automobile market and its growth.

Indian automobile industry produces almost all kinds of vehicles, which are broadly categorized in three categories, the first being 4-wheelers which are further divided into two heads one is Passenger Vehicles (PV) which include Utility Vehicles (UVs) Passenger Cars and the second head is Commercial Vehicles (CV) which includes Heavy Commercial Vehicles (HCVs), Light Commercial Vehicles (LCVs) and Medium Commercial Vehicles (MCVs). The second category of vehicle is the 3-wheelers which include Passenger Carriers and Goods Carriers. The third category of vehicles is the 2-wheelers which include Scooters, Motorcycles, Mopeds, and Electric. All these classifications are based on the SIAMs categorization.

Table 1 Segment -wise Growth Performance of the Indian Automobile Industry

Category	Time Period	Passenger Vehicles (%)	Commercial vehicles (%)	Three-Wheelers (%)	Two-Wheelers (%)	Grand Total (%)
Production	2000–2010	15.84	16.45	13.17	11.31	12.26
	2011–2020	2.91	1.30	4.01	6.10	5.37
	2000-2020	10.74	9.41	9.22	10.39	10.34
Sales	2000–2010	13.19	16.76	9.74	10.07	10.75
	2011–2020	10.12	1.71	3.03	5.72	5.05
	2000-2020	8.44	9.47	6.36	9.60	9.45
Exports	2000–2010	31.34	20.59	31.66	33.18	31.83
	2011–2020	4.97	0.55	5.66	8.34	7.32
	2000-2020	16.45	11.69	18.43	20.15	18.85

Source: Author's calculations based on SIAM database.

The segment -wise growth performance of Indian automobile industry is presented in Table 1. The result has been made on two periods of 2000 to 2010 and

2011 to 2020 of different segments of Indian automobile sector. The compound annual growth rates (CAGR) of production, sales and exports show the rapidly growing demand for commercial and passenger vehicles. These segments i.e., production of PV and CV grew at a compound annual growth rate (CAGR) of 15.84 percent and 16.45 percent respectively. On the other hand, the growth rate of 3-wheelers and 2-whellers production has been found 13.17 percent and 11.31 percent respectively during the first subperiod of the study and in the second subperiod CAGR of PV, CV, 2-wheelers and 3-wheelers has been found 2.91 per cent, 1.3 per cent, 6.1 per cent and 4.01 per cent respectively. The overall the CAGR of PV, CV, 2-wheelers and 3-wheelers has been found to be 10.74 per cent, 9.41 per cent 10.39 percent and 9.22 percent respectively. In the case of sales, the CAGR of PV, CV, 2-wheelers and 3-wheelers has been found to be13.19 percent, 16.76 per ent, 10.07 percent and 9.74 respectively during the period 2000 to 2010 and the CAGR of PV, CV, 2-wheelers and 3-wheelers become 10.12 percent, 1.71 percent, 5.72 percent and 3.03 respectively during the second subperiod of the study. The overall CAGR of PV, CV, 2-Wheelers and 3-Wheeers has been found as 8.44 percent. 9.47 percent, 9.6 percent and 6.36 percent respectively. In terms of exports, the CAGR of PV, CV, 2-wheelers and 3-wheers has been 31.34 percent, 20.59, 8.34 and 5.66 percent respectively during the first sub-period of the study and in the second sub-period CAGR of PV, CV, 2-Wheelers and 3-wheelers has been 4.97 percent, 0.55 percent, 8.34 percent and 5.66 per cent respectively. The overall performance of exports has increased rapidly during the study period.

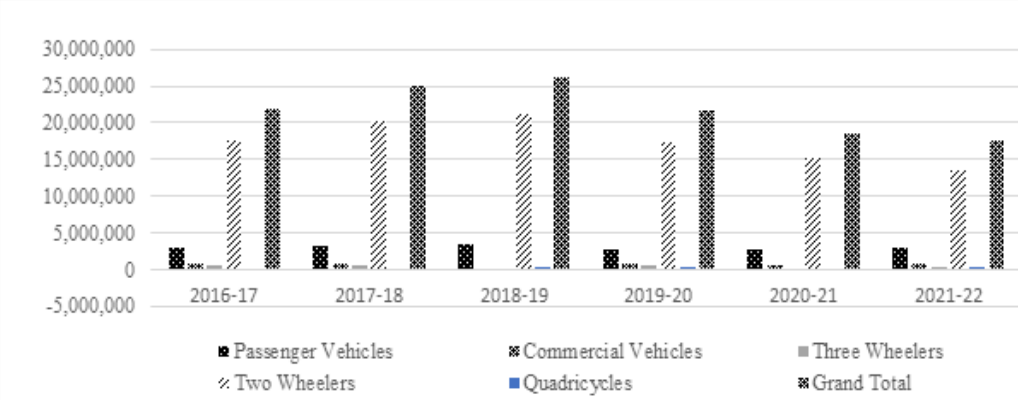
Domestic Sales

The Indian domestic market provides a strong demand base for the growth of the automotive industry. Fig. 2 presents the emerging trends of domestic sales of automobiles in India. In the domestic market, sales shows that the Indian automobile industry registered growth on a year-on-year basis, it also represents the domination of 2-Wheeler's segment, followed by the passenger vehicles, commercial vehicles and 3- wheelers. In the year 2018-19 domestic sales were maximum in all the categories and then they started to fall due to Covid-19 pandemic. In the year 2010-22 the 2-wheeler sales recorded negative growth from 15120783 units in the year 2021 to 13466412 units in the year 2022 (1654371 units decline) but all the other categories recorded positive growth.

The Indian domestic market provides a strong demand base for the growth of the automotive industry.

Domestic automobile production increased at 2.36 percent CAGR between FY16 and FY20 with 26.36 million vehicles being manufactured in the country in FY20. Overall, domestic automobile sales increased at 1.29 percent CAGR between FY16-FY20 with 21.55 million vehicles being sold in FY20. In FY21, the total passenger vehicle production reached 22,652,108. Passenger car sales

Fig. 2 Trends of Domestic Sales of Indian Automobile industry



Source: Authors' calculations using SIAM database.

are dominated by small and mid-sized cars. Two- wheelers and passenger cars accounted for 80.8 percent and 12.9 percent of the market share, respectively, accounting for a combined sale of over 20.1 million vehicles in FY20 (SIAM, 2021).

Indian Automobile Industry Performance at Global Level

The performance of the Indian automobile industry at the global level with respect to the sales of commercial vehicles, passenger cars and total vehicles are presented in fig. 3.1, fig. 3.2 and fig. 3.3 respectively. In the global top 7 countries the total sales (including all types of vehicle sales) the leading player is China which sold 25.77 million units. India's contribution to global sales is around 85.0 percent less than the sales by China in FY 2019. India comes at 5th position and contributes 7.0 percent in the total global sales with the 3.82 million units, which is quite low. The fig. 3.2 shows that in Commercial Vehicles, USA contributed around 59.0 percent of the total global sale with 12.76 million units, followed by China with 4.32 million units that is 20.0 percent of total sales. In this category, India stands with rank 5th and 0.85 million units which is 4.0 percent share of the international sales among of top seven global players. On the other hand, figure 3.3 demonstrates that the passenger cars (PC) segment is led by China with 42.0 percent of world's market share and India with 2.96 million units that is 6.0 percent of the world's market, holding 5th position.

Trends in Indian Automobile Industry

Fig. 4 explains the trends in production and sales for the period 2000-01 to 2019-20. The trend clearly indicates that the total production and sales have been increasing rapidly during the study period except during the years of Covid-19. It can be clearly observed that sales and production of the automobile industry recorded similar fluctuations during the

Fig. 3.1 The Shares of Global Big 7 in Total Sales (%) : 2019

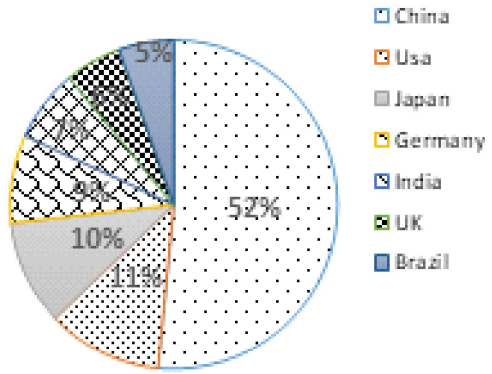


Fig.3.2 The Shares of Global Big 7 in Commercial Vehicle Sales (%) : 2019

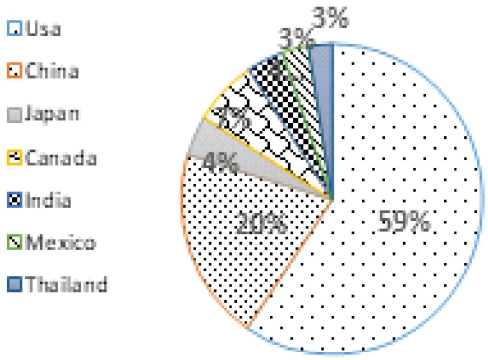
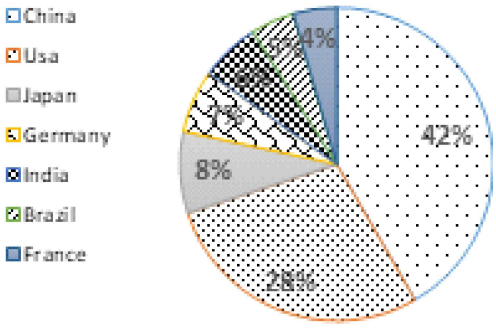


Fig. 3.3 The Shares of Global Big 7 in Passenger Car Sales (%): 2019



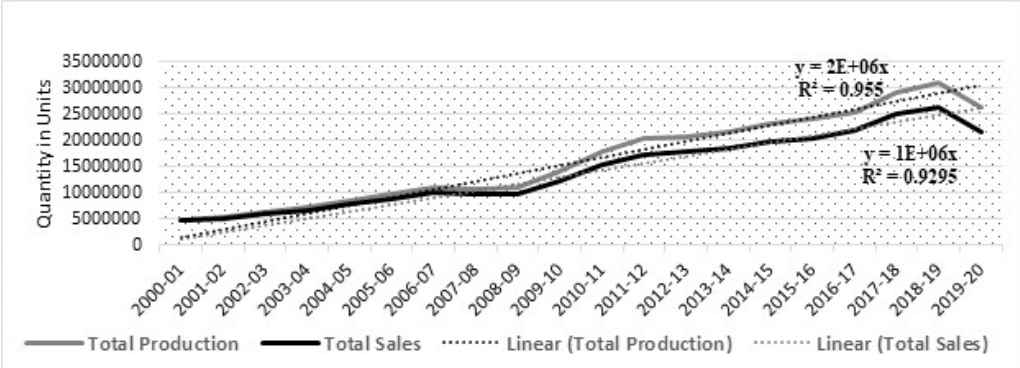
Source: Authors' calculations based on SIAM Annual Report

periods of the financial crisis and corona pandemic.

Trend in Sales

The automobile sector was hit hard in FY 2019-20 as sales fell across all vehicle segments. The sector recorded 20.3 per cent decline in domestic sales in the year 2020, while it was showing 5.9 per cent upward growth in 2019. The Passenger Vehicle segment declined by 17.3 per cent in the year 2020, due to weak consumer sentiments, rising cost of vehicle ownership, and general economic

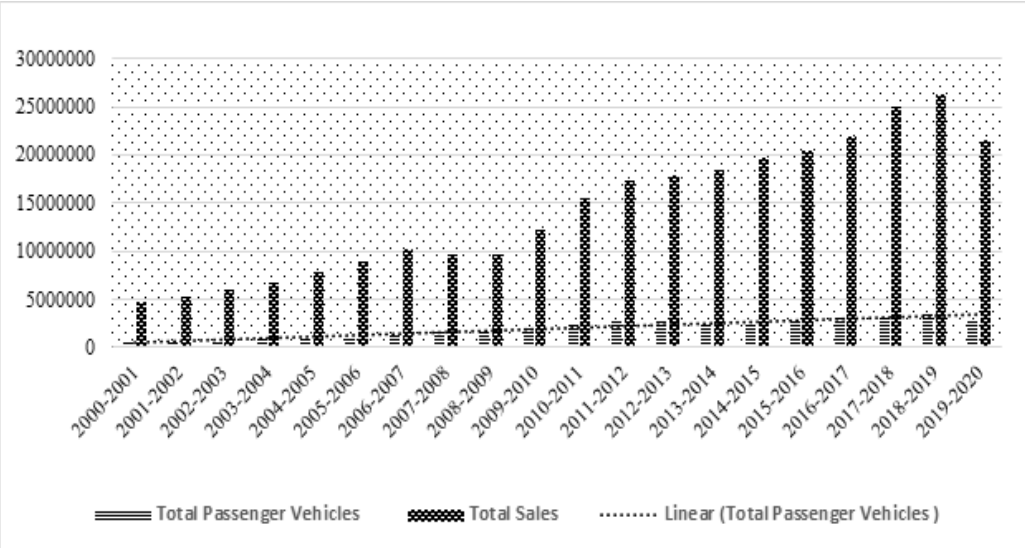
Fig. 4 Trends of Sales & Production in Indian Automobile Sector (Nos)



Source: Authors' calculations based on SIAM database

slowdown (SIAM-2021). Fig. 5 presents trends of passenger vehicle sales and total vehicle sales of automobile sector in India. The data shows that both the total PV sales and total vehicle sales increase and decrease together. Since 2000-01 to 2019-20 we found continuous upward growth except for the years 2008-09 and 2019-2020. The dip in 2008-09 was due to global financial crisis which impacted Indian vehicles sales. The data shows sharp fall in the year 2019-20, due to corona pandemic and the sequential lockdown which affected both manufacturing and sales of automobile industry drastically.

Fig. 5 Trends in Total Sales & Total PV Sales of Indian Automobile Industry (Nos)



Source: Authors' calculations based on SIAM database

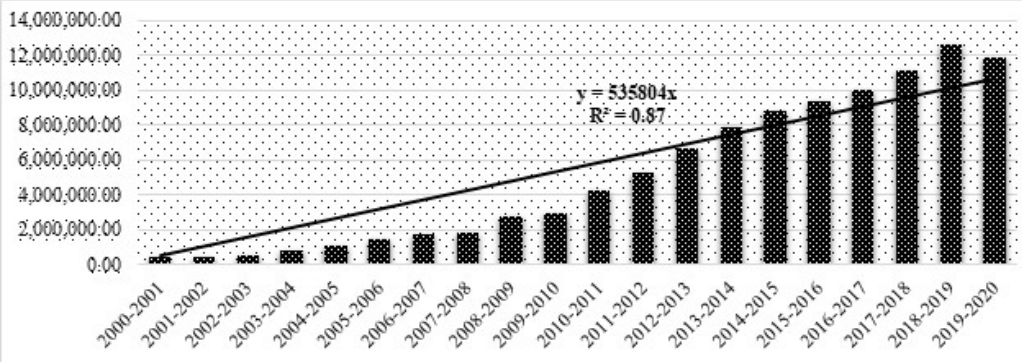
The Commercial Vehicle segment of the industry in India registered a 30.0 percent decline in the year 2020 compared to 17.1 per cent growth in the year 2019, because of the subdued demand, and greater capacity enhancement from the transition from BS-IV to BS-VI norms. After a remarkable growth in the year 2019, domestic sales of motorcycles saw a decline of 17.5 per cent in the year 2020 (SIAM-2020). It was not just the relative shortage of demand as the motorcycle industry was subjected to several regulations which significantly increased the cost of ownership.

Trends in Export

The trends of export (in INR) of Indian Automobile Sector are presented in Fig. 6. The fig. 6 shows that in the last two decades, the export of Indian automobile industry grew from 426124.86 INR in 2000-01 to 12653335.85 INR in year of 2018-19. This kind of growth attracts the foreign investment and foreign players in Indian automotive market. But this increase in exports was abruptly in the year 2019-20 due to the covid-19 pandemic. This was not the result of covid-19 pandemic only, but the situation was further worsened due to pandemic

induced lockdown, this extremely affected the Indian automobile industry as the production units was almost stopped in that period, and this resulted in sharp fall in exports in the year 2019-20 to 11840349.4 INR.

Fig. 6 Trends of Export (in INR) of the Indian Automobile Sector during the Last Twenty Years



Source: Authors' calculations based on the Ministry of Commerce and Industry database

Segment-Wise Trends in Export

Segment-wise trends of export of automobile industry is given in Table 2. The table shows that India is a major exporter of automobile products and automobile components. Among automobile products, the export segments include commercial vehicles, passenger cars, two-wheelers, three-wheelers. All automobile segments reported growth in exports in the year 2019. But in the year 2019-20 commercial vehicle exports reported negative growth by -39.24 per cent at 39220 units, followed by small increase in passenger vehicles 0.16 percent and two-wheelers segment reported positive growth of 10.34 per cent.

Among the automobile segments, two-wheelers accounted for the largest export share at 73.94 percent with 3.52 million units, followed by passenger cars with 11.18 percent share with 0.53 million units in the year 2019-20. During the study period the compound annual growth rate of the two-wheeler segment recorded 20.15 percent, followed by PV with 16.45 percent, passenger cars and commercial vehicles with 15.10 percent and 11.69 percent respectively. This shows that the two-wheeler segment is the dominant one, in the domestic as well as international markets. Low cost of labor and economies of scale have made India an ideal export hub for small cars. The Indian auto industry is expected to be the world's third largest automotive market in terms of volume by 2026. Promotion of exports has been part of companies' business strategies for better utilization of installed capacities. The low cost of manufacturing and economies of scale achieved because of catering to

Among the automobile segments, two-wheelers accounted for the largest export share at 73.94 percent.

Table 2 Segment-Wise Trends in Export of Indian Automobile Industry

Year	Passenger Cars (Nos)	Passenger Vehicles (Nos)	Commercial Vehicles (Nos)	Two Wheelers (Nos)
2000-2001	22990	27112	13770	111138
2001-2002	49273	53165	11870	104183
2002-2003	70263	72005	12255	179682
2003-2004	125320	129291	17432	265052
2004-2005	160670	166402	29940	366407
2005-2006	169990	175572	40600	513169
2006-2007	192723	198452	49537	619644
2007-2008	211112	218401	58994	819713
2008-2009	331535	335729	42625	1004174
2009-2010	441709	446145	45009	1140058
2010-2011	438214	444326	74043	1531619
2011-2012	501546	508783	92258	1975111
2012-2013	547222	559414	80027	1956378
2013-2014	551218	596142	77050	2084000
2014-2015	542,112	621,341	86,939	2,457,466
2015-2016	5,32,630	653053	103,124	2,482,876
2016-2017	6,02,134	758727	108,271	2,340,277
2017-2018	5,80,153	748366	96,865	2,815,003
2018-2019	5,13,912	676192	99,933	3,280,841
2019-2020	4,90,748	677311	60,713	3,520,376
CAGR	15.10	16.45	11.69	20.15

Source: Author's calculations based on SIAM database

overseas markets have allowed vehicle makers to become competitive and offset weak demand in the domestic market. Companies that had partnerships with foreign players or received FDI have benefited in terms of engagement in global value chains(GVCs).

Trends in Trade

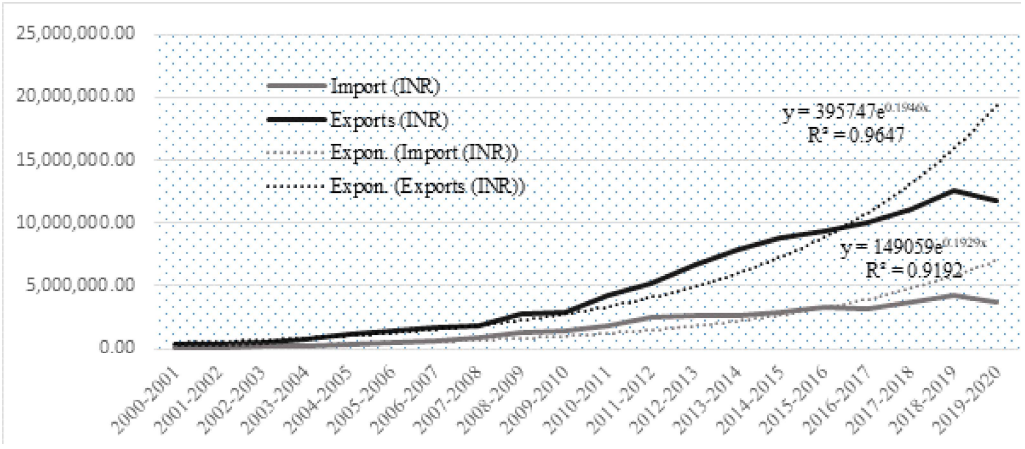
In the trade diagram (Fig. 7) the export records a sharp rise from 2008-09 to 2018-19. On the other hand, the imports experienced a smooth growth.in the initial phase of the two decades. The imports and exports of the automobile industry seem to be equal but start splitting after the year 2010.

The difference between the export and imports shows the net value. If the value is positive, it means the exports are in surplus and vice versa. The result clearly shows that the net value of Indian export is increasing over the last two decades. The rising trend of foreign trade could enhance and strengthen the economic growth of the country.

Growth Trends in Sales, Production & Export

Last two decades of growth in total sales in the automobile sector in India is clearly seen in fig. 8 The period of 2000-01 to 2006-07 total sales recorded positive growth. In the year 2007-08 it recorded -4.86 percent decline. This was

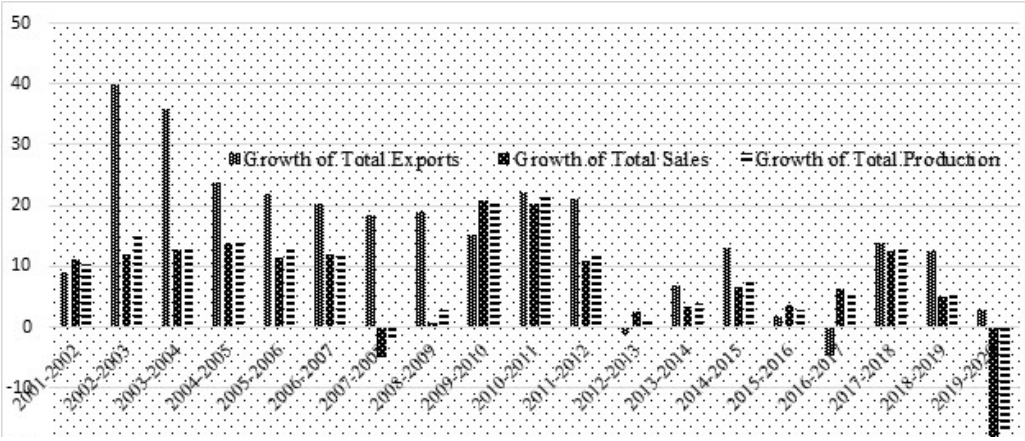
Fig. 7 Trends in Trade of Indian Automobile Industry



Source: Author's calculations based on the Ministry of Commerce and Industry database

because of the impact of international financial crisis. From the year 2008 the Indian automobile industry recorded positive till the pandemic of 2019. Highest growth by the industry achieved in the years of 2009-10 and 2010-11 being 20.91 percent and 20.42 percent respectively.

Fig. 8 Growth Trends in Sales, Production & Exports in Indian Automobile Industry (percent)



Source: Authors' calculations based on SIAM annual reports.

On the other hand, the year 2008-09 recorded the highest growth of 52.46 per cent in exports of automobiles. The growth rate is not linear in the last two decades. The industry recorded negative growth of -3.06 per cent and -6.43 per cent in the years 2001-02 and 2019-20 respectively.

The regression result of determinants of the performance Indian automobile sector (sales) are presented in Table 3.

The result of multiple regression shows the impact of industrial infrastructure index (III), Trade openness (OPEN) and foreign direct investment (FDI) on the sales of Indian automobile sector. All variables i.e., dependent and independent variables are present in the form of natural log.

Table 3 Regression Results of Determinants of Indian Automobile Sector

Dependent Variables: Sales of Automobile Sector				
Independent Variable	Coefficient	Standard Error	t-Value	p-Value
Industrial Infrastructure Index (III)	0.2257	0.0694	3.25	0.005
Foreign Direct Investment (FDI)	0.1536	0.0385	3.99	0.001
Trade Openness (OPEN)	2.1074	0.1955	10.78	0.000
Constant	7.8333	0.4525	17.31	0.000
Number of Observations = 21	F (3, 17) = 492.37		Prob> F = 0.0000	
R-squared = 0.9886	Adjusted R-squared = 0.9866		Root MSM = 0.06248	
Variance Inflation Factor (VIF) Result				
Variable	VIF		1/VIF	
Industrial Infrastructure Index (III)	5.35		0.187	
Foreign Direct Investment (FDI)	6.01		0.166	
Trade Openness (OPEN)	4.82		0.207	
Mean VIF	**5.393**			

Source: Authors' calculations based on RBI database

The values of R^2 and adjusted R^2, 0.9886 and 0.9866 respectively, imply that the regression model explained around 98.86 percent of the total variation. The F value is also found significant**.** The regression result reveals that the impact of industrial infrastructure index, trade openness and foreign direct investment had been positive and significant on the performance of the Indian automobile industry, implying that these are its key drivers. To avoid the problem multicollinearity, the explanatory as well as dependent variables have been taken in the natural logarithmic form. The variance inflation factor (VIF) values of independent variables and their means had been found less than 10. It shows that there is no problem of multicollinearity in the regression model. Moreover, the multiple regression result indicates that trade openness has been found highest influencing factor in the performance automobile sector in India during the study period followed by the industrial infrastructure index and foreign direct investment respectively. The regression results suggest that the government should take the step for reducing import quota, permit 100 per cent FDI by the automatic route and develop better infrastructure facilities for enhancement of the

The impact of industrial infrastructure index, trade openness and foreign direct investment had been positive and significant on the performance of the Indian automobile industry.

performance of the Indian automobile sector.

Conclusion & Policy Suggestions

The Indian automobile sector is one of the main and fastest-growing sub-sectors of the Indian economy. It is also providing significant employment opportunities to the youth of the nation and contributes around 7.1 percent to the gross domestic product (GDP). This paper shows that the sales of automobile products have increased rapidly during the last two decades and India attained fifth position in the world market. It also indicates that the sales (two/ four-wheeler), production and exports have also recorded positive and significant growth during the study period. The multiple regression model shows that trade openness, foreign direct investment (FDI) and industrial infrastructure index (III) have positive and significant impacts on the performance (sales) of the Indian automobile sector. It implied that these are the key drivers of the automobile sector in India. The present paper suggests that the performance of the automobile industry could be enhanced by improving the industry infrastructure structure, inspiring foreign direct investment through automatic route and liberalizing trade policies through reduced import duties and quotas. Moreover, there is a need to promote competitiveness, reduce customs duty on inputs and develop a potentially strong base of infrastructure for the automobile industry. Despite the recent slowdown, this sub-sector of the economy can continue to make major contributions to India's economic growth, not only leading its integration into worldwide markets, but also generating enormous beneficial spillover effects in terms of social development.

References

Carton & G. Jimmy (2013), "Production and Sales Trends of Automobile Industry in India", *Global Institute for Research &Education*, Vol. 2(4): 24-33.

Credit Suisse (2021), Global Wealth Databook Report. https://www.credit-suisse.com/about-us/en/reports-research/global-wealth-report.html

George S., R. Jha, & H.K. Nagarajan (2002), "The Evaluation and Structure of the Two-Wheeler Industry in India", *International Journal of Transport Economics,* 29 (1): 63-89.

Hindustan Times (2023), India Become Third Largest Auto Market Globally-Report, 6th January.

https://www.hindustantimes.com/car-bike/india-becomes-3rd-largest-auto-market-globally-surpasses-japan-report-101672999951094.html

IBEF Report (2022), Automobile Industry in India, India. https://www.ibef.org/industry/india-automobiles

ILO Consulting (2020) Subsidies within the Automobile Industry in India. Available from: Subsidies within the Automobile Industry in India (iloconsulting.in) [Accessed 10th October 2021]

International Labor Organization Report (2021), International Organization of Motor Vehicle Manufacturers OICA. https://www.oica.net/category/production-statistics/2022-statistics/

Kale, D. (2012), "Sources of Innovation and Technology Capability Development in the Indian Automobile Industry", *Institutions and Economies*, 4 (2) :121-50.

Kameshwar, J & S. Bhuvanesh (2014), FDI in Retail and Impact on Employment Creation in India: Study on Automobile. https://www.researchgate.net/publication/283508033

Kanupriya & Sandeep (2018), "Study on Automobile Industry in India", *ABS International Journal of Management*, 1: 79-83.

Kumar, Sujeet & S. Mridula (2017), "A Study on Automobile Industry Growth in India and Its Impact on Air Pollution", *Journal of Advanced Research in Dynamical and Control System,* 17 (1): 1901-09.

Ministry of Heavy Industries (2022), Annual Report 2021-22, Government of India. Available from: https://heavyindustries.gov.in/ViewData/index?mid=1117

Rajesh T. & A. S, Dileep (2013), "Foreign Direct Investment in Automobile Industry", *International Journal of Current Research and Academic Review*, 1(3): 33-37.

Smita, M. (2019), "The Growth of the Indian Automobile Industry: Analysis of the Role of Government Policy and Other Enabling Fars", Innovation, Economic Development, and Intellectual Property in India and China : Springer.

Tachiki D. S. (2012), "The Political Economy of the Indian Automobile Industry: A Research Note", *Bulletin of Business Administration*, 18 (1):1-19.

UNIDO-ACMA-DHI Survey Report (2022), Indian Automotive Sectorial System of Innovation: Measurement, Analysis, & Policy Recommendations, United Nations Industrial Development Organization (UNIDO), Vienna, Austria. https://hub.unido.org/sites/default/files/publications/2022%20IASSI%20SURVEY%20REPORT.pdf

Vandana, V. (2017), "Growth of Automobile Industry and Its Economic Impact", *International Journal of Commerce and Management Research*, 3 (8): 06-10.