

Statistical Trends in Registered Vehicles and Economic Growth in India

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ABSTRACT

This study investigates the statistical evolution of registered motor vehicles in India and examines their relationship with the nation's economic growth between 2001 and 2020. Using time-series data on vehicle registration, production, sales, and exports—along with gross domestic product (GDP)—the analysis reveals a strong interdependence between the automobile sector and India's economic development. Two-wheelers remain the dominant category in production, sales, and export volumes, reflecting affordability and mobility demand in both domestic and emerging markets. Although road infrastructure has expanded, vehicle penetration has far outpaced it. Correlation and regression results demonstrate a close link between GDP growth and automobile indicators, confirming the sector's significance as a driver of economic output, employment, and trade. The findings highlight the necessity of integrated policies that sustain sectoral growth while addressing congestion, safety, and environmental concerns.

KEYWORDS

Registered vehicles, automotive sector, GDP of India, Economic Growth.

1. Introduction

India's automobile industry functions as a critical engine for economic growth, contributing substantially to employment generation and global trade [12, 14]. Over the past two decades, the sector has witnessed exponential growth, propelled by rising income levels, rapid urbanization, and supportive government policies. Consequently, registered motor vehicles have surged, positioning India as a global leader in two-wheeler and passenger car ownership [2, 8].

Several scholars have examined the intricate relationship between economic development and vehicle ownership [2]. Studies focusing on India have confirmed a strong, positive correlation between the automobile industry's performance and national GDP [5], and official estimates place the sector's contribution at roughly 7.1% of GDP with large direct and indirect employment effects [3, 12]. Industry reports from SIAM [14]

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and MoRTH [8] provide vital statistics but often lack in-depth analytical frameworks linking these trends to broader macroeconomic indicators. While Verma et al. [1] explored the evolution of urban transport policies and urban transport growth in India, their analysis did not extend to vehicle-type bifurcation or long-term export trajectories. Other research has investigated determinants of vehicle ownership and found that household income, household size, and access to transport infrastructure are consistently strong predictors [9, 20, 21]. Global literature, such as the *World Road Statistics* [18], situates India within global mobility trends, yet few academic works comprehensively contextualize this data within India's specific macroeconomic trajectory.

This study aims to bridge these gaps by integrating quantitative time-series data on vehicle trends with qualitative insights into their economic implications. This paper investigates the trends in registered vehicles and their correlation with economic growth indicators such as GDP, vehicle exports, and road infrastructure development from 2001 to 2020.

2. Objectives of the Study

- To analyze and present the statistical trends in registered vehicles across various categories in India between 2001 and 2020.
- To assess the growth patterns and volatility in the Indian automobile sector.
- To examine the relationship between vehicle registration, production, sales, and export trends, and their correlation with GDP.
- To evaluate the development of road infrastructure and its impact on vehicle penetration and road safety.
- To situate India's automotive growth in a global context regarding ownership.

2.1. Data and Methodology

This study utilizes secondary data aggregated from multiple official and academic sources. Data pertaining to the production, sales, exports, and registration of motor vehicles were sourced from:

2.2. Data Sources

- MoRTH Annual Reports and Road Transport Yearbooks
- SIAM Annual Reports (1995–2023)
- GDP data from the Ministry of Finance and World Bank
- International Road Federation (2022)
- State-level transport data

2.3. Methodology

The analytical approach employed a quantitative, longitudinal design. Key statistical methods included:

- Calculation of Compound Annual Growth Rate (CAGR), Year-on-Year (YOY) growth, and Average Annual Growth Rate (AAGR) to measure temporal trends.

- Time-series analysis (2001–2020) to identify underlying patterns, trends, and turning points in the data.
- Correlation and regression analyses to examine the statistical relationship between vehicle metrics (production, sales, registration) and national GDP.
- Comparative analysis of state-wise trends to identify regional disparities in motorization.
- Graphical visualizations and trend lines for data interpretation and to highlight volatility.

The results are interpreted using both descriptive and inferential statistics to establish linkages among motorization, infrastructure, and economic performance.

3. Analysis and Interpretation of Results

This section presents statistical findings and interpretations from 1995–2023 for production, sales, and exports, and from 1995–2020 for registered vehicles. The analysis combines descriptive statistics and growth indicators to illustrate the evolution of India’s motorization and its linkage with economic indicators.

3.1. Production Trends (1995–2023)

This section examines the long-term production trajectory of India’s automotive sector, providing a foundational context for its scale and growth.

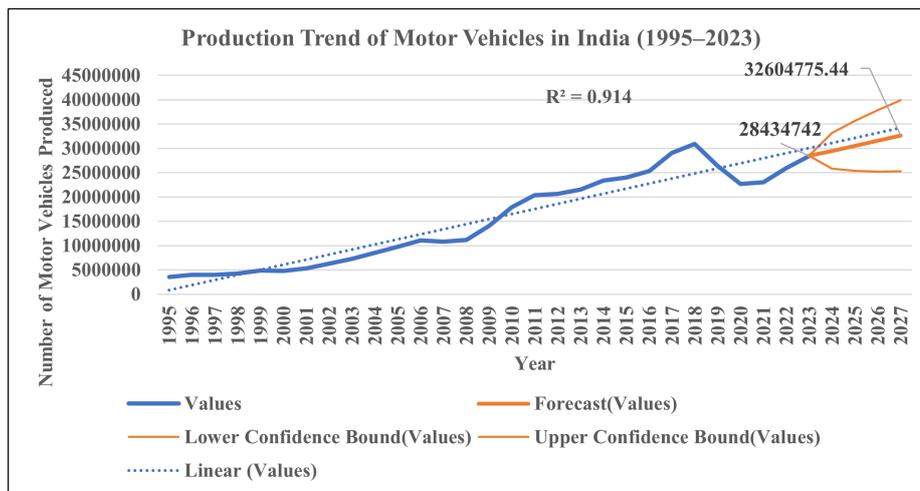


Figure 1. Production of Motor Vehicles in India (1995–2023)

As shown in Figure 1, the production of motor vehicles in India has demonstrated a consistent and significant upward trend over nearly three decades. This growth trajectory is a key indicator of the industry’s expanding capacity and its response to rising domestic and international demand. The total production value in 2023–24 reached 28,434,742 units. Utilizing Holt’s linear exponential smoothing technique, the forecasted production value for the year 2027 is projected to be 32,604,775 units, suggesting continued growth.

A disaggregated view of this production data (Figure 2 and Table 1) reveals the

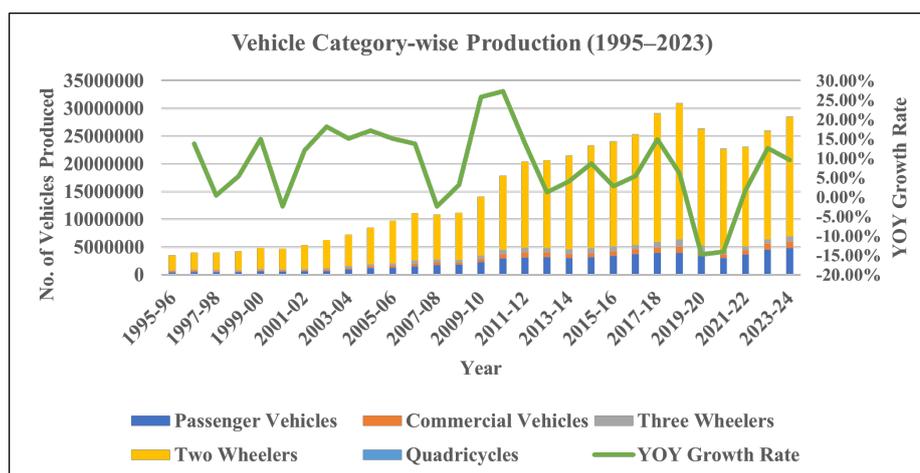


Figure 2. Vehicle Category-wise Production (1995–2023)

dominance of the two-wheeler segment, which reflects market preferences for affordability and utility [14]. Passenger vehicles also display robust growth, with a CAGR of 8.9% and an AAGR of 9.7%. Notably, Quadricycles, a relatively new segment introduced post-2015, have shown explosive growth (CAGR 32.4%), although this is largely attributable to a small initial base value. These trends collectively highlight the expanding demand for personal mobility and the increasing diversification of vehicle categories available in the Indian market.

Table 1. CAGR and AAGR for Vehicle Production in India (2023/1995)

Category	CAGR (%)	AAGR (%)
Passenger Vehicles	8.9	9.70
Commercial Vehicles	5.8	8.04
Three Wheelers	6.4	8.00
Two Wheelers	7.7	8.18
Quadricycles	32.4	55.88
Grand Total	7.8	8.22

Electric Vehicle (EV) Production in India

India's electric vehicle (EV) manufacturing segment has emerged as one of the fastest-growing components of the automobile industry during the last five years.

Government initiatives such as FAME-II, state-level EV policies, and growing consumer awareness of sustainable mobility have accelerated the adoption of EVs across all categories. Production data from 2019–20 to 2023–24 show exponential growth, especially in the two- and three-wheeler segments, reflecting India's focus on affordable electrification and last-mile connectivity.

Figure 3 depicts India's sharp rise in EV production from 174.5 thousand units in 2019–20 to 1.68 million units in 2023–24, marking a nearly ten-fold increase. Two- and three-wheelers together comprise over 90% of total output, underscoring India's

Table 2. Total Annual Production of Electric Vehicles (EVs) (in thousands)

Category	2019–20	2020–21	2021–22	2022–23	2023–24
Passenger Vehicles	3.3	5.83	22.36	62.28	92.17
Commercial Vehicles	0.53	0.41	2.22	3.11	8.66
Three Wheelers	143.83	91.97	185.38	404.88	632.78
Two Wheelers	26.84	44.83	252.78	728.21	948.42
Grand Total	174.5	143.04	462.74	1198.48	1682.03

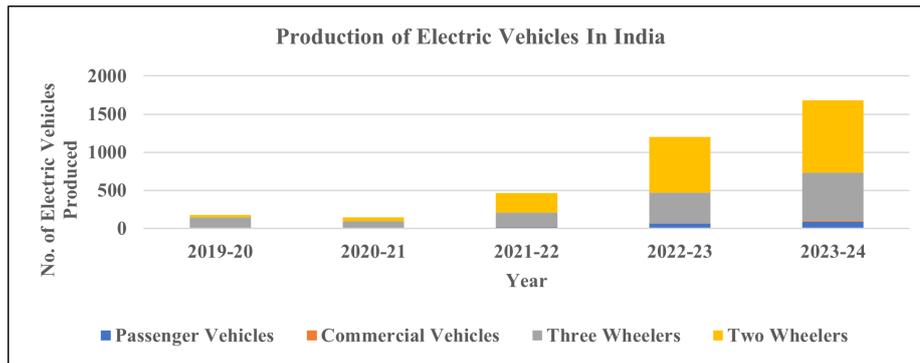


Figure 3. Electric Vehicle Category-wise Production (2019–2024)

emphasis on affordable, mass-market electrification and its steady transition toward sustainable mobility.

3.2. Sales Trends (1995–2023)

Following production, this section analyzes domestic sales trends, which serve as a direct measure of consumer demand and market absorption.

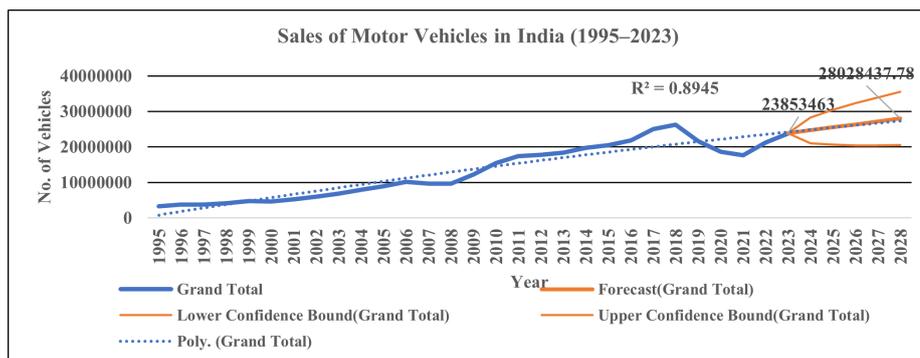


Figure 4. Sales of Motor Vehicles in India (1995–2023)

The data presented in Figures 4 and 5 clearly indicate that domestic sales trends closely mirror the production patterns observed previously. Two-wheelers again lead the market, reinforcing their role as the primary mode of personal transport for a large segment of the population, driven by accessibility and consumer-driven demand.

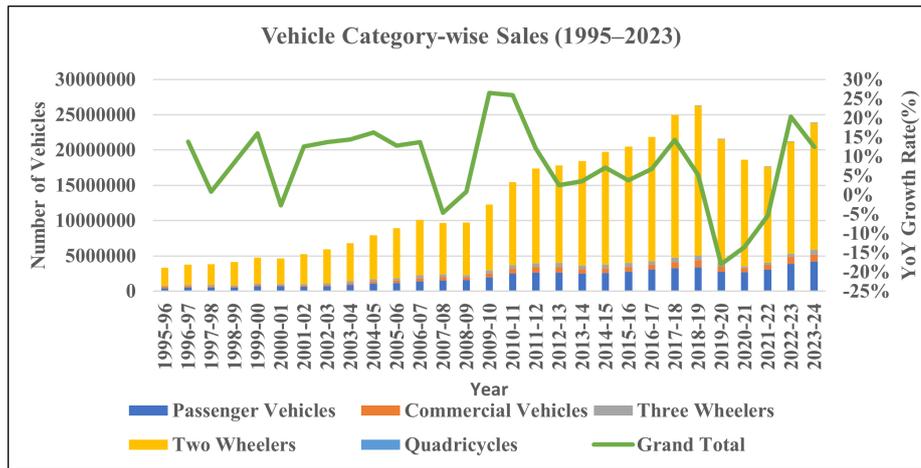


Figure 5. Vehicle Category-wise Sales (1995–2023)

Table 3. CAGR and AAGR for Vehicle Sales in India (2023/1995)

Category	CAGR (%)	AAGR (%)
Passenger Vehicles	8.6	9.42
Commercial Vehicles	5.8	7.95
Three Wheelers	5.7	9.02
Two Wheelers	7.2	7.76
Quadricycles	2.9	273.9
Grand Total	7.3	7.83

This strong alignment between production and sales, noted earlier, is statistically confirmed by a near-perfect positive correlation of 0.9981. As detailed in Table 3, the overall CAGR for vehicle sales stands at 7.3%. Passenger vehicles achieved the highest CAGR among the core segments at 8.6%. It is crucial to note the significant volatility observed in the Y-O-Y growth, with pronounced dips corresponding to major macroeconomic shocks, such as the 2008–09 global financial crisis and the 2019–21 COVID-19 pandemic. This volatility underscores the sector’s high sensitivity to the overall health of the economy, consumer sentiment, and global events.

EV Sales in India

Electric vehicle (EV) sales in India have witnessed remarkable acceleration in recent years, driven by policy incentives, improved charging infrastructure, and rising consumer acceptance—particularly in the two- and three-wheeler segments that dominate the domestic market.

Figure 6 illustrates India’s rapid growth in EV sales, particularly after 2020. Total sales increased from negligible levels in 2014 to over 1.8 million units by 2024, with the two-wheeler segment accounting for the majority share. The share of EVs in total vehicle sales—EV penetration—rose sharply from 0.67% in 2020 to 8.58% in 2025, reflecting strong policy support, cost competitiveness, and rising consumer adoption. The upward trajectory highlights India’s accelerating shift toward electric mobility

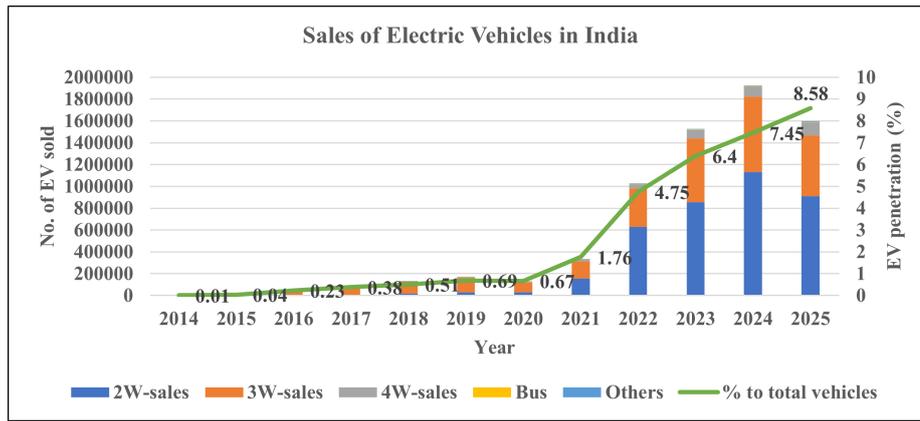


Figure 6. Sales of Electric Vehicles in India

and its emerging role in the global EV market.

3.3. Export Trends (1995–2023)

This analysis now shifts to the industry’s performance in the global market, examining export trends to understand India’s role as an automotive manufacturing hub.

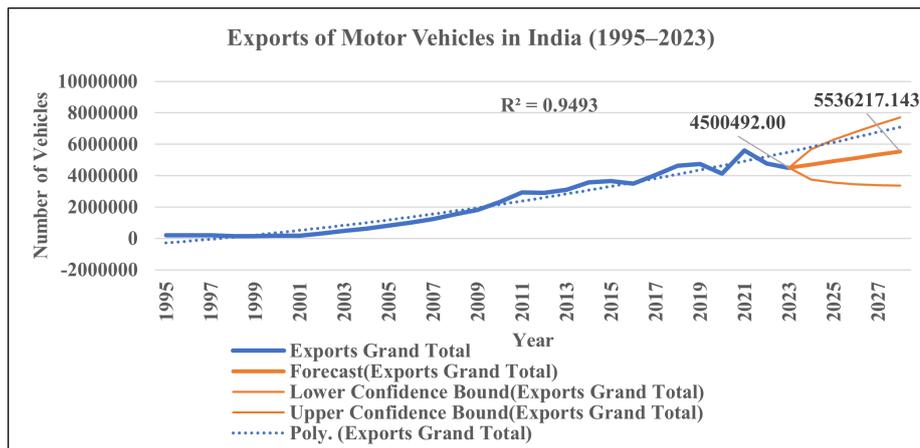


Figure 7. Exports of Motor Vehicles in India (1995–2023)

The data in Figures 7 and 8 show that Indian vehicle exports have grown substantially, with two-wheelers leading this segment at a remarkable CAGR of 13.0%. Passenger vehicles (11.5% CAGR) and three-wheelers (8.3% CAGR) have also demonstrated robust export growth. This trend signifies India’s growing competitiveness in manufacturing. This export growth is primarily volume-driven, indicating that India competes by shipping a large number of units, particularly to other developing nations.

As shown in Table 4, the overall CAGR for exports (11.9%) is significantly higher than that for domestic sales (7.3%), highlighting the increasing importance of international markets for Indian manufacturers. It is widely reported that Indian two-wheelers and three-wheelers are exported in large volumes to markets in Africa (e.g., Nigeria), Latin America (e.g., Colombia, Mexico), and Asia (e.g., Philippines, Nepal)

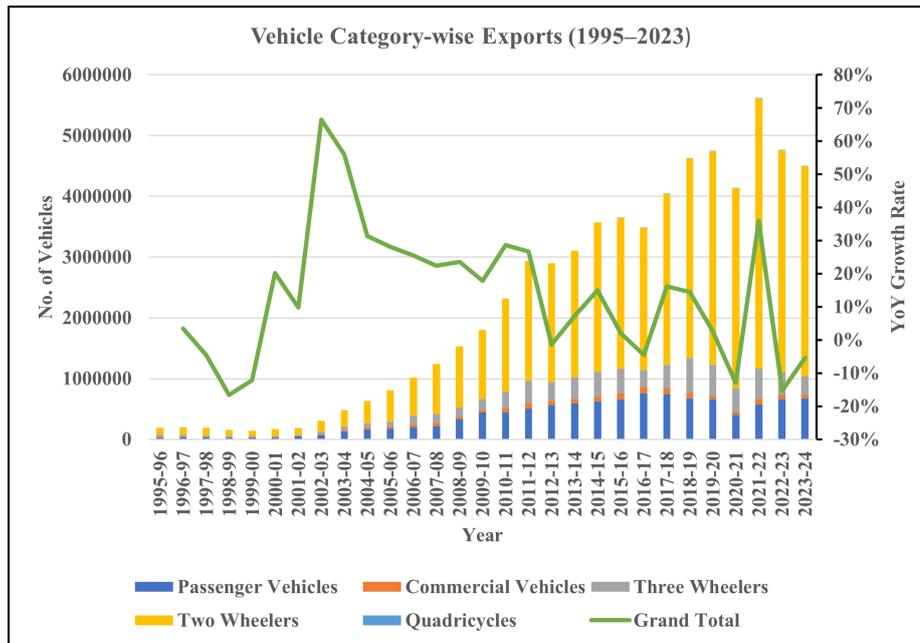


Figure 8. Vehicle Category-wise Exports (1995-2023)

Table 4. CAGR and AAGR for Vehicle Exports (2023/1995)

Category	CAGR (%)	AAGR (%)
Passenger Vehicles	11.5	14.57
Commercial Vehicles	5.3	9.11
Three Wheelers	8.3	14.47
Two Wheelers	13	14.97
Quadricycles	37.1	73.45
Grand Total	11.9	13.58

[7]. In these markets, affordability, fuel efficiency, and reliability are key purchasing drivers, playing to the strengths of Indian-made products, as evidenced by industry reports and successful case studies in the African market [6, 14, 19]. In summary, the export trend underscores India’s emergence as a major supplier of vehicles worldwide, especially in high-volume, affordable segments.

3.4. Registered Motor Vehicles Trends (1995–2020)

Having examined production, sales, and exports, this section focuses on the cumulative stock of vehicles in the country through registration data.

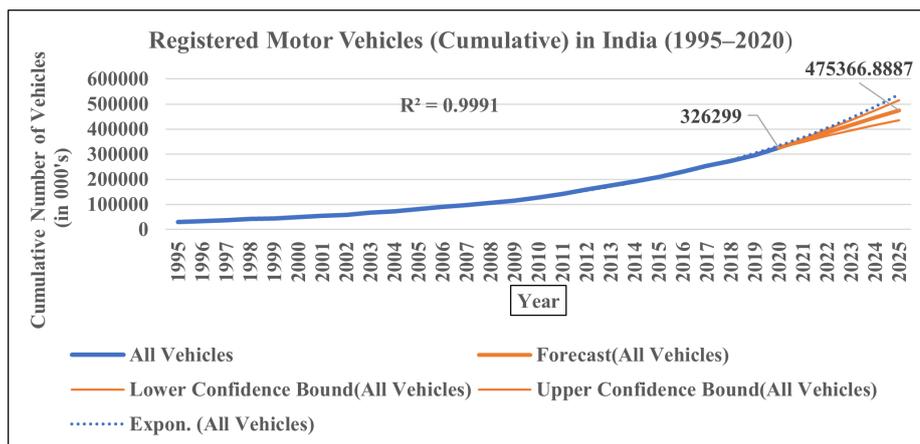


Figure 9. Registered Motor Vehicles in India (1995–2020)

Figure 9 illustrates the exponential growth in the total number of registered motor vehicles, a clear proxy for the deepening motorization of Indian society.

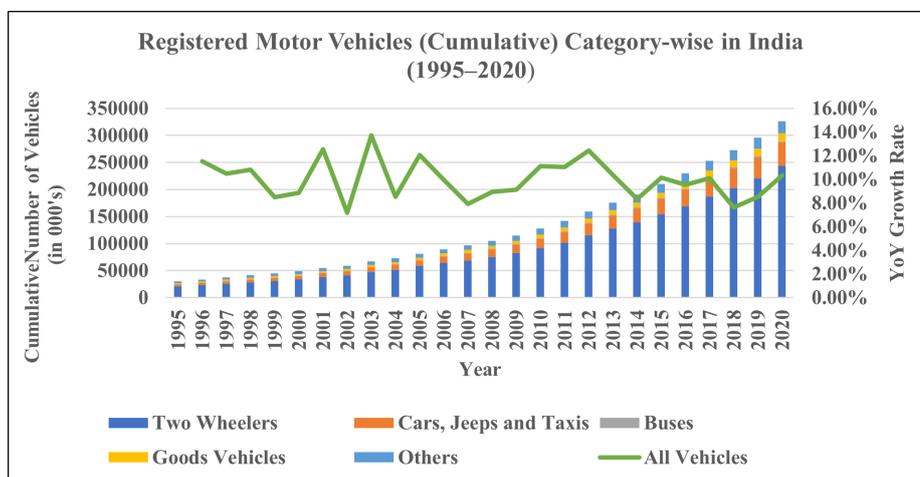


Figure 10. Registered Motor Vehicles Category-wise in India (1995–2020)

As seen in Figure 10 and Table 5, two-wheelers form the dominant share (CAGR 10.34%), followed by cars, jeeps, taxis (CAGR 10.21%), and goods vehicles (CAGR 8.65%). This shift towards personal motorized transport is well-documented and is often linked to rising household incomes and the limitations of public transit [2, 21].

India's global ranking in vehicle registrations has improved notably; it now stands first in motorcycles and mopeds, third in buses, and eighth in passenger cars [18]. While the graph shows the statistical trend, this growth is associated with broader socio-economic factors such as rising incomes, urbanization, and improved access to financing, which have collectively enabled greater vehicle ownership [9, 21].

Table 5. CAGR and AAGR for Registered Motor Vehicles in India (2020/1995)

Category	CAGR (%)	AAGR (%)
Two Wheelers	10.34	10.35
Cars, Jeeps and Taxis	10.21	10.23
Buses	6.81	7.08
Goods Vehicles	8.65	8.74
Others	7.84	7.91
Grand Total	9.97	9.99

State Level Variations

To understand if this national trend is uniform, this section explores the regional disparities in vehicle registration growth.

Table 6. CAGR and AAGR for Registered Motor Vehicles in India (2020/2001)

States/UTs			States/UTs		
STATES /UTs	CAGR	AAGR	STATES /UTs	CAGR	AAGR
A & N Islands	10%	10%	Madhya Pradesh	10%	10%
Andhra Pradesh	6%	8%	Maharashtra	9%	9%
Arunachal Pradesh	13%	34%	Manipur	8%	9%
Assam	12%	12%	Meghalaya	10%	12%
Bihar	13%	15%	Mizoram	12%	12%
Chandigarh	5%	7%	Nagaland	6%	7%
Chhattisgarh	12%	12%	Odisha	12%	12%
D & N Haveli	17%	21%	Puducherry	8%	8%
Delhi	6%	7%	Punjab	7%	8%
Goa	8%	8%	Rajasthan	10%	10%
Gujarat	9%	9%	Sikkim	8%	9%
Haryana	8%	8%	Tamil Nadu	10%	10%
Himachal Pradesh	11%	12%	Telangana	38%	11%
Jammu & Kashmir	10%	10%	Tripura	13%	14%
Jharkhand	9%	12%	Uttar Pradesh	11%	11%
Karnataka	11%	12%	Uttarakhand	12%	12%
Kerala	11%	11%	West Bengal	10%	12%
Lakshadweep	10%	10%	All India	10%	10%

Table 6 shows the state-wise growth in terms of CAGR and AAGR for registered

motor vehicles from 2001 to 2020. Telangana stands out with a remarkable 38% CAGR, far exceeding any other state. This anomaly may be attributable to a combination of factors, including administrative changes (state formation in 2014), rapid economic development in its capital region, or potential improvements in the vehicle registration database. Conversely, Arunachal Pradesh shows the highest AAGR at 34%, a spike potentially linked to improved road infrastructure and greater integration into national economic networks.

Meanwhile, most other states exhibit a steady growth range of 8% to 13%, reflecting the widespread nationwide motorization trend. States like Bihar and Jharkhand show higher-than-average growth (around 15%), possibly indicating an expansion of ownership from a previously low base. In contrast, states like Maharashtra and Gujarat reflect more moderate growth, which may be due to higher existing saturation levels.

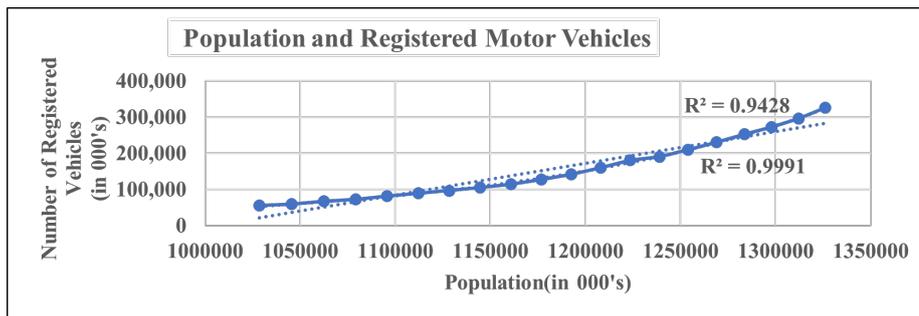


Figure 11. Population and Registered Motor Vehicles

Further analysis (Figure 11) reveals a strong exponential correlation between population and vehicle registration. This implies that vehicle ownership is rising at a faster rate than population growth, signaling rising income levels, increased accessibility, and changing lifestyle aspirations.

3.5. Road Infrastructure and Penetration (2001–2020)

This section contextualizes the growth in vehicles by comparing it against the expansion of the road network, a critical factor for mobility and safety.

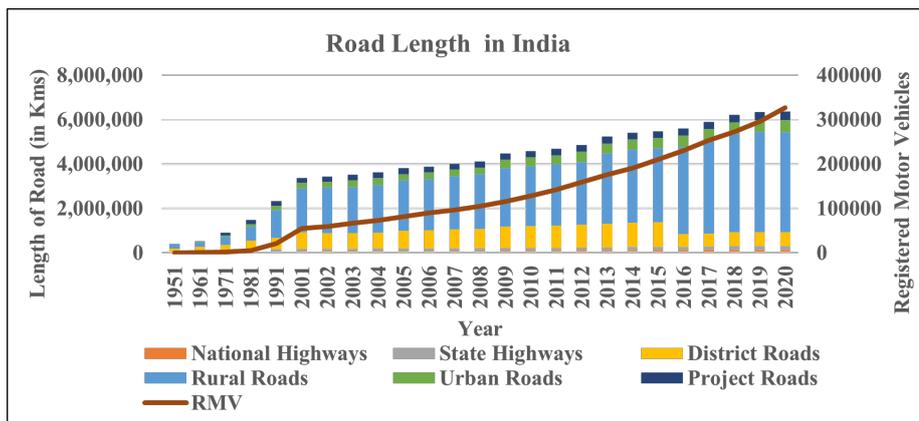


Figure 12. Road Length in India (2001–2020)

Figure 12 reflects the changing landscape of mobility in India. Over the past few decades, both road length and vehicle ownership have grown, but at significantly different rates. While registered motor vehicles grew at a CAGR of 9.97%, the total road length increased much more slowly at a 3.65% CAGR. This gap is visually evident; the explosion in motor vehicle numbers has significantly outpaced infrastructure growth.

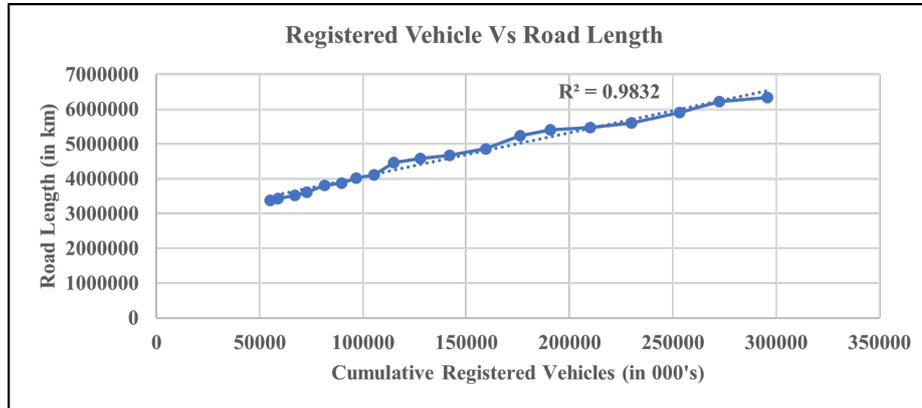


Figure 13. Registered Vehicles vs Road Length

Figure 13 shows a very high correlation between registered vehicles and road length. However, this statistical relationship masks an underlying pressure: the sharp rise in vehicles relative to road expansion contributes to increased traffic congestion, pollution, and road-safety challenges. Prior studies have documented how rapid motorization outstrips infrastructure capacity, producing congestion and adverse externalities, and national road-safety data confirm rising harms associated with this mismatch [13, 23]. The development of quality infrastructure is a well-established prerequisite for sustained economic activity, and therefore the vehicle–road gap represents a significant bottleneck to equitable and safe growth [11].

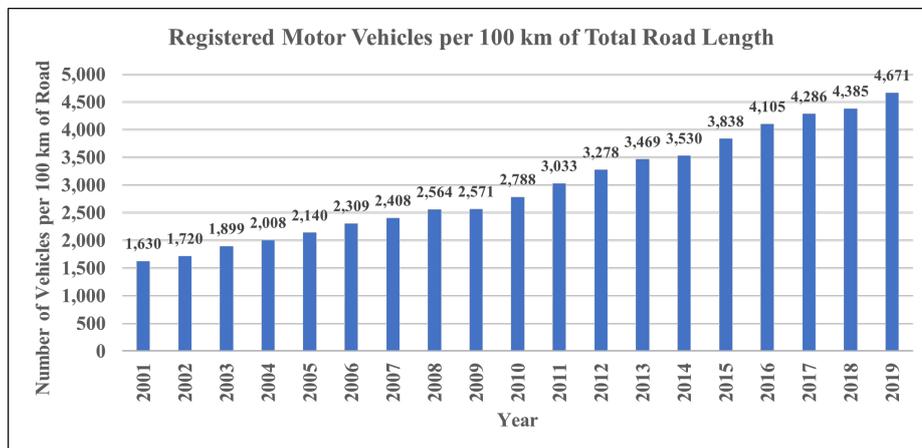


Figure 14. Registered Motor Vehicles per 100 km of Total Road Length

This pressure is quantified in Figures 14 and 15. In 2001, there were approximately 1600 vehicles per 100 km of road (Figure 14). By 2019, this density rose to over 4600—nearly tripling in less than two decades. Similarly, the number of vehicles per 1000 population increased from about 50 in 2001 to over 240 in 2020 (Figure 15). This

data clearly signals rising mobility but also brings attendant challenges of congestion, pollution, and road safety.

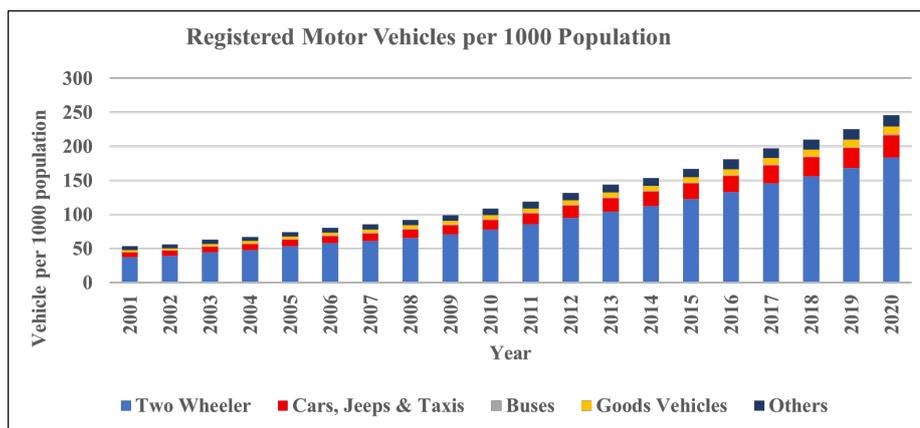


Figure 15. Registered Motor Vehicles per 1000 Population

3.6. GDP and Automobile Sector Contribution

This section directly investigates the core hypothesis of the paper: the symbiotic relationship between the automobile sector and India’s broader economic growth.

The automobile sector is a substantial component of the Indian economy, contributing approximately 6% to the national GDP, with the auto component sector alone contributing about 2.3%. Together, they directly employ around 1.5 million people, underscoring the sector’s vital role in both economic output and employment generation [3, 12].

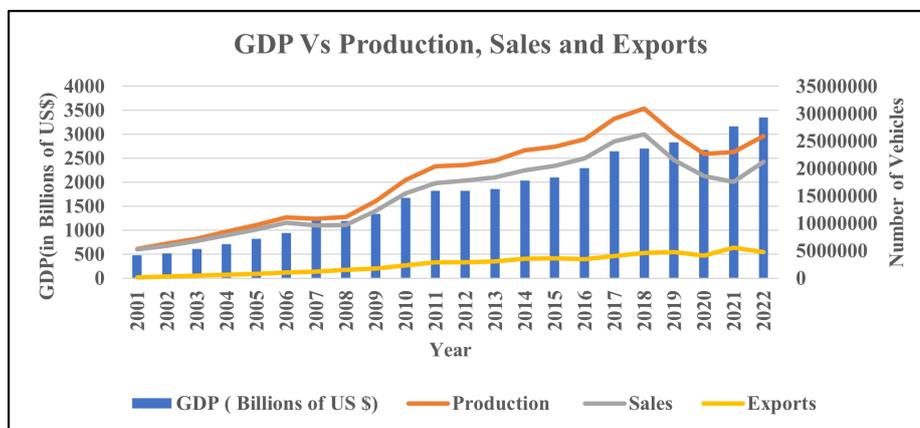


Figure 16. GDP vs Production, Sales, Exports and Registered Vehicles

Figure 16 visually confirms the strong positive correlation between these variables. As India’s GDP has steadily increased, there has been a parallel rise in vehicle production, sales, and exports. This reflects a clear, positive, and cyclical relationship: economic growth drives vehicle demand, and in turn, the automotive sector’s activity contributes significantly back to GDP growth [5].

3.7. Vehicle Income Elasticity

To quantify the relationship identified in the previous section, this part presents a regression analysis to measure the sensitivity of vehicle demand to income changes.

Vehicle income elasticity measures how sensitive vehicle demand (sales) is to changes in income (typically GDP). A log-linear regression ($R^2 = 0.957$, $p < 0.0001$) indicates a strong relationship between income and vehicle demand. The estimated income elasticity was 0.85 ($p < 0.0001$), implying that a 1% increase in GDP leads to a 0.85% increase in vehicle demand. This suggests that vehicle demand is income inelastic; while income growth is a primary driver of motorization, the response is less than proportional.

SUMMARY OUTPUT								
Regression Statistics								
Multiple R	0.97838963							
R Square	0.95724627							
Adjusted R Square	0.95487106							
Standard Error	0.1063903							
Observations	20							
ANOVA								
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>			
Regression	1	4.561694613	4.56169	403.016	9.02744E-14			
Residual	18	0.203740121	0.01132					
Total	19	4.765434734						
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	4.39742084	0.59893357	7.34208	8.1E-07	3.139108104	5.6557336	3.1391081	5.655733579
log gdp	0.84871887	0.042276866	20.0753	9E-14	0.75989847	0.9375393	0.75989847	0.937539268

To further understand the predictors of GDP, a multiple linear regression model was executed. The dependent variable GDP (millions of US\$) along with the predictor variables like Vehicle Production (in thousands), Road Length in km (Urban), Road Length in km (Rural) and Road Length in km (Other: which includes National and State Highways, District Roads and Project Roads) were normalised before running the regression model which gave the following output.

SUMMARY OUTPUT							
Regression Statistics							
Multiple R	0.9926228						
R Square	0.9853						
Adjusted R Square	0.98138						
Standard Error	107157.74						
Observations	20						
ANOVA							
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>		
Regression	4	1.15449E+13	2.88621E+12	251.351	1.50882E-13		
Residual	15	1.72242E+11	11482780518				
Total	19	1.17171E+13					
	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	
Intercept	-1428820.2	323601.3548	-4.41537161	0.0005	-2118560.196	-739080.27	
Vehicle Production (in thousands)	0.0270821	0.01238239	2.187143741	0.04498	0.000689627	0.05347451	
Road Length in kms (Urban)	0.9913022	1.264795213	0.783764979	0.44538	-1.704544988	3.68714937	
Road Length in kms (Rural)	0.5099274	0.125519931	4.062521249	0.00102	0.242387986	0.77746678	
Road Length in kms (Other)	0.4838685	0.210849708	2.294849996	0.03659	0.034452937	0.93328397	

The multiple linear regression model yielded a high R^2 value of 0.9853 and an adjusted R^2 of 0.9814, indicating that the chosen independent variables explain over 98% of the variation in GDP. The F-statistic of 251.35 ($p < 0.0001$) confirms the model's overall statistical significance.

In our regression model, Vehicle Production ($\beta = 0.03$, $p = 0.04$), Rural Road length ($\beta = 0.51$, $p = 0.001$) and Other Road length ($\beta = 0.48$, $p = 0.04$) emerged as

statistically significant contributors to GDP growth. These findings are consistent with empirical literature linking infrastructure investment to economic growth and with impact evaluations showing that rural-road expansion measurably improves economic outcomes [11, 22].

Overall, the analysis demonstrates that GDP growth not only drives the automobile sector but is also fundamentally supported by infrastructure development and demographic scale.

4. Discussion

The automobile sector embodies both the progress and the challenges of India's economic development. The dominance of two-wheelers represents accessibility and affordability for the middle and lower-income groups, yet it also underscores infrastructure constraints and income disparity. The sector's cyclical volatility, as observed during economic recessions and global crises, reveals its dependence on macroeconomic conditions.

Regression and elasticity results confirm that motorization is closely tied to GDP growth but remains income inelastic. This suggests that while rising incomes drive vehicle demand, the pace of ownership growth eventually stabilizes in mature markets. These findings align with international evidence showing that vehicle ownership saturates at higher income levels [2, 20].

India's experience also mirrors the global trend of increasing motorization leading to environmental and safety challenges. Hence, the results underscore the need for policy frameworks that simultaneously encourage industrial growth and sustainability through emission standards, fuel diversification, and electric vehicle adoption [4, 10].

5. Implications and Recommendations

- (1) **Policy Integration:** Transportation, urban development, and environmental policies must be harmonized to create coherent strategies for sustainable mobility. Coordinated efforts between national and state governments can enhance data sharing, policy monitoring, and infrastructure planning.
- (2) **Infrastructure Investment:** Priority should be given to road expansion, maintenance, and smart traffic management, particularly in high-growth states. Public-private partnerships can accelerate the modernization of highways and urban transport corridors.
- (3) **Sustainable Mobility:** Incentives for electric vehicles, hybrid technologies, and public transport should be strengthened. Policies such as the Faster Adoption and Manufacturing of Hybrid and Electric Vehicles (FAME II) scheme can be extended to promote cleaner mobility options.
- (4) **Data-Driven Decision Making:** Enhanced collection of granular data on vehicle type, age, and emissions can support predictive modeling and policy evaluation.

These measures will not only sustain sectoral growth but also mitigate congestion, pollution, and safety concerns.

6. Limitations

- The study relies on annual data, which may obscure important seasonal or short-term fluctuations in sales and production.
- The unavailability of disaggregated data on electric vehicles, vehicle lifespan, or scrappage rates limits the depth of the sustainability analysis.
- Regional policy effects and specific behavioral aspects (e.g., cultural ownership preferences) are not deeply analyzed and remain an area for future research.

7. Conclusion

India's motorization trajectory from 2001 to 2020 reveals robust and sustained growth closely associated with macroeconomic indicators. Two-wheelers dominate the market, contributing significantly to mobility and employment. Simultaneously, the imbalance between vehicle growth and road expansion highlights the urgent need for infrastructure investment and environmental safeguards.

The statistical relationship between vehicle registration and GDP underscores the automobile sector's pivotal role in driving economic development. However, the accompanying challenges—accident rates, congestion, and pollution—necessitate a paradigm shift toward safer, inclusive, and greener mobility. The findings provide a baseline for evidence-based policymaking, guiding India's transition toward sustainable automotive growth in the coming decades.

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