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Comparison of diesel and petrol cars operational costs in the long term

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Abstract

The choice between diesel and petrol vehicles is often influenced by both initial purchase costs and long-term operational expenses, including fuel and maintenance. This paper presents a comprehensive cost analysis of various Indian car company variants, specifically examining the diesel and petrol models across different trims (NY2, NY3, X6, X8, X8 (O), BY5, and BY5L) over 1, 5, 10, and 15-year periods. Using a detailed financial model, this study accounts for initial vehicle cost, fuel consumption based on varying fuel prices, and routine maintenance costs. The research applies real-world data on fuel efficiency and prices, considering both minor and major servicing costs.

Keywords: Diesel Cars; Petrol Cars; Purchase Cost; Operational Cost

1. Introduction

The choice between diesel and petrol vehicles is a significant decision for many consumers, influenced by a complex interplay of factors including initial purchase price, fuel efficiency, and long-term operational costs. As vehicle technology evolves and fuel prices fluctuate, understanding the total cost of ownership (TCO) becomes increasingly crucial for prospective car buyers[2]. This research paper provides an in-depth analysis of the total cost of owning various Indian car company variants, specifically comparing diesel and petrol models across multiple trims.

The Indian car company, a popular compact SUV in India, is offered in several variants, each with differing fuel types, efficiency ratings, and associated costs. Diesel engines generally offer better fuel efficiency compared to their petrol counterparts, which can lead to lower fuel expenditures over time. However, diesel vehicles often come with a higher initial purchase price and potentially higher maintenance costs. Conversely, petrol vehicles typically have a lower initial cost and lower maintenance expenses but may incur higher fuel costs due to lower fuel efficiency[3].

This paper aims to elucidate these trade-offs by developing a detailed financial model that accounts for the initial vehicle cost, fuel consumption, and annual maintenance costs for both diesel and petrol variants of the car company. The model considers different ownership periods—1, 5, 10, and 15 years—to provide a comprehensive view of the long-term financial implications[4].

By analyzing real-world data on fuel prices, vehicle efficiency, and servicing costs, this study seeks to offer valuable insights for consumers making an informed decision between diesel and petrol options. The findings will help prospective buyers evaluate the cost-effectiveness of each vehicle type in the context of their personal driving habits and financial priorities.

In addition to addressing consumer concerns, this research contributes to the broader discussion on environmental and economic impacts of vehicle choices. As governments and regulatory bodies increasingly focus on emissions and fuel efficiency, understanding the long-term financial benefits of various vehicle types becomes crucial for both individuals

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and policymakers[1]. The analysis reveals significant differences in total cost of ownership (TCO) between diesel and petrol variants across different time horizons. While the initial cost of diesel vehicles is higher, their superior fuel efficiency often results in lower operational costs over extended periods. Conversely, petrol vehicles, despite higher operational costs, exhibit a lower initial purchase price and lower servicing costs. The findings indicate that the total cost parity between diesel and petrol variants varies depending on the duration of ownership, fuel price fluctuations, and maintenance schedules.

This study provides valuable insights for prospective vehicle buyers by illustrating the financial implications of vehicle choice over time, helping them make informed decisions based on their specific usage patterns and budgetary constraints.

2. Define the Variables

- Purchase Costs

  - Diesel car cost: $C_d = $ Rs1,401,588
  - Petrol car cost: $C_p = $ Rs1,247,988

- Fuel Prices

  - Diesel price: $P_d = $ Rs 88per liter
  - Petrol price: $P_p = $ Rs 92.51per liter

- Mileage (Fuel Efficiency)

  - Diesel car mileage: $M_d = 20.6$ km per liter
  - Petrol car mileage: $M_p = 18.89$ km per liter

    - Service Costs

  - Annual minor service cost: Rs 5,000
  - Annual major service cost: Rs 10,000
  - Total annual service cost: Rs 15,000

3. Fuel Costs per Kilometer

Cost per Kilometer for Diesel Car

$$\text{Cost per km for Diesel} = \frac{P_d}{M_d} = \frac{88}{20.6} \approx 4.27 \text{Rs/km}$$

Cost per Kilometer for Petrol Car

$$\text{Cost per km for Petrol} = \frac{P_p}{M_p} = \frac{92.51}{18.89} \approx 4.89 \text{Rs/km}$$

4. Total Cost Function Over Time

Let x be the number of kilometers driven per year, and t be the number of years. The total cost for each car includes the purchase cost, fuel cost, and annual service costs.

4.1. Total Cost for Diesel Car Over t Years

$$\text{Total Cost}_d = \text{Purchase Cost}_d + (\text{Cost per km for Diesel} \times x \times t) + (\text{Annual Service Cost} \times t)$$

$$\text{Total Cost}_d = 1,401,588 + (4.27 \times x \times t) + (15,000 \times t)$$

4.2. Total Cost for Petrol Car Over t Years

$$\text{Total Cost}_p = \text{Purchase Cost}_p + (\text{Cost per km for Petrol} \times x \times t) + (\text{Annual Service Cost} \times t)$$

$$\text{Total Cost}_p = 1{,}247{,}988 + (4.89 \times x \times t) + (15{,}000 \times t)$$

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5. Time t When Both Costs Are Equal

5.1. Set the total costs equal to each other

$$1{,}401{,}588 + (4.27 \times x \times t) + (15{,}000 \times t) = 1{,}247{,}988 + (4.89 \times x \times t) + (15{,}000 \times t)$$

5.1.1. Simplify the equation

$$1{,}401{,}588 + 4.27xt = 1{,}247{,}988 + 4.89xt$$

5.1.2. Subtract $1{,}247{,}988$ *from both sides:*

$$153{,}600 + 4.27xt = 4.89xt$$

5.1.3. Subtract $4.27xt$ *from both sides:*

$$153{,}600 = (4.89 - 4.27)xt$$

$$153{,}600 = 0.62xt$$

Solve for t:

$$t = \frac{153{,}600}{0.62 \times x}$$

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6. Substitute the Value for x

To find t, you need to know the number of kilometers driven per year. For example, if you drive 15,000 km per year, substitute $x = 15{,}000$:

$$t = \frac{153{,}600}{0.62 \times 15{,}000}$$

$$t = \frac{153{,}600}{9{,}300} \approx 16.5 \text{years}$$

The number of years after which the total cost of owning both cars will be the same depends on the annual mileage. In the example above, with 15,000 km driven per year, it would take approximately 16.5 years for the total cost of the diesel car and the petrol car to be equal. If you drive a different number of kilometers per year, substitute that value into the formula to get the specific number of years.

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7. Example

We have calculated the total cost for both cars over 1, 5, 10, and 15 years for different annual mileage values (e.g., 10,000 km, 15,000 km, and 20,000 km).

7.1. Annual Mileage: 10,000 km

Table 1 Total cost of owning car diesel and petrol variants over 1, 5, 10, and 15 years with an annual mileage of 10,000 km

Years	Diesel Car Total Cost (Rs)	Petrol Car Total Cost (Rs)
1 Year	1401588 + (4.27 X 10000) + 15000 = 1459288	1247988 + (4.89 X 10000) + 15000 = 1310888
5 Years	1401588 + (4.27 X 10000 X 5) + (15000 X 5) = 1690088	1247988 + (4.89 X 10000 X 5) + (15000 X 5) = 1367488
10 Years	1401588 + (4.27 X 10000 X 10) + (15000 X 10) = 1978588	1247988 + (4.89 X 10000 X 10) + (15000 X 10) = 1886988
15 Years	1401588 + (4.27 X 10000 X 15) + (15000 X 15) = 2267088	1247988 + (4.89 X 10000 X 15) + (15000 X 15) = 2206488

7.2. Annual Mileage: 15,000 km

Table 2 Total cost of owning car diesel and petrol variants over 1, 5, 10, and 15 years with an annual mileage of 15,000 km

Years	Diesel Car Total Cost (Rs)	Petrol Car Total Cost (Rs)
1 Year	1401588 + (4.27 X15000) + 15000 = 1401588 + 64050 + 15000 = 1480638	1247988 + (4.89 X 15000) + 15000 = 1247988 + 73350 + 15000 = 1336338
5 Years	1401588 + (4.27 X 15000 X 5) + (15000 X 5) = 1401588 + 320250 + 75000 = 1796838	1247988 + (4.89 X 15000 X 5) + (15000 X 5) = 1247988 + 366750 + 75000 = 1689738
10 Years	1401588 + (4.27 X 15000 X 10) + (15000 X 10) = 1401588 + 640500 + 150000 = 2192088	1247988 + (4.89 X 15000 X 10) + (15000 X 10) = 1247988 + 733500 + 150000 = 2131488
15 Years	1401588 + (4.27 X 15000 X 15) + (15000 X 15) = 1401588 + 960750 + 225000 = 2587338	1247988 + (4.89 X 15000 X 15) + (15000 X 15) = 1247988 + 1100750 + 225000 = 2573738

7.3. Annual Mileage: 20,000 km

Table 3 Total cost of owning car diesel and petrol variants over 1, 5, 10, and 15 years with an annual mileage of 20,000 km

Years	Diesel Car Total Cost (Rs)	Petrol Car Total Cost (Rs)
1 Year	1401588 + (4.27 X 20000) + 15000 = 140588 + 85400 + 15000 = 1501988	1247988 + (4.89 X 20000) + 15000 = 1247988 + 97800 + 15000 = 1359788
5 Years	1401588 + (4.27 X 20000 X 5) + (15000 X 5) = 1401588 + 427000 + 75000 = 1903588	1247988 + (4.89 X 20000 X 5) + (15000 X 5) = 1247988 + 489000 + 75000 = 1797988
10 Years	1401588 + (4.27 X 20000 X 10) + (15000 X 10) = 1401588 + 854000 + 150000 = 2405588	1247988 + (4.89 X 20000 X 10) + (15000 X 10) = 1247988 + 978000 + 150000 = 2375988
15 Years	1401588 + (4.27 X 20000 X 15) + (15000 X 15) = 1401588 + 1281500 + 225000 = 2908088	1247988 + (4.89 X 20000 X15) + (15000 X 15) = 1247988 + 1462750 + 225000 = 2935738

8. Summary

The above tables provide a comparison of the total cost of owning a diesel and petrol car over different periods (1, 5, 10, and 15 years) and varying annual mileages (10,000 km, 15,000 km, and 20,000 km).

By reviewing the tables, you can determine the number of years after which the total costs of owning a diesel and a petrol car will be approximately equal, depending on the distance driven per year.

9. Comparison Table

Let's calculate the total cost over 1, 5, 10, and 15 years for three different annual mileages: 10,000 km.

Table 4 Annual Mileage: 10,000 km

| Variant	Years	Diesel Car Total Cost (Rs)	Petrol Car Total Cost (Rs)
NY2	1	1,401,588 + (4.27 X 10,000) + 15,000= 1,459,288	1,200,000 + (4.89 X 10,000) + 15,000 = 1,310,888
	5	1,401,588 + (4.27 X 10,000 X 5) + (15,000 X 5)= 1,690,088	1,200,000 + (4.89 X 10,000 X 5) + (15,000 X 5) = 1,367,738
	10	1,401,588 + (4.27 X 10,000 X 10)+ (15,000 X 10)= 1,978,588	1,200,000 + (4.89 X 10,000 X 10) + (15,000 X 10) = 1,886,988
	15	1,401,588 + (4.27 X 10,000 X 15) + (15,000 X 15)= 2,267,088	1,200,000 + (4.89 X 10,000 X 15) + (15,000 X 15) = 2,206,488
NY3	1	1,450,000 + (4.27 X 10,000) + 15,000= 1,507,700	1,250,000 + (4.89 X 10,000) + 15,000= 1,336,888
	5	1,450,000 + (4.27 X 10,000 X 5)+ (15,000 X 5)= 1,796,700	1,250,000 + (4.89 X 10,000 X 5)+ (15,000 X 5) = 1,689,738
	10	1,450,000 + (4.27 X 10,000 X 10)+ (15,000 X 10)= 2,192,700	1,250,000 + (4.89 X 10,000 X 10) + (15,000 X 10) = 2,131,488
	15	1,450,000 + (4.27 X 10,000 X 15) + (15,000 X 15)= 2,587,700	1,250,000 + (4.89 X 10,000 X 15)+ (15,000 X 15) = 2,573,738
X6	1	1,500,000 + (4.27 X 10,000) + 15,000= 1,557,700	1,300,000 + (4.89 X 10,000) + 15,000= 1,417,800
	5	1,500,000 + (4.27 X 10,000 X 5) + (15,000 X 5) = 1,903,70	1,300,000 + (4.89 X 10,000 X 5) + (15,000 X 5) = 1,797,800
	10	1,500,000 + (4.27 X 10,000 X 10)+ (15,000 X 10)= 2,405,700	1,300,000 + (4.89 X 10,000 X 10) + (15,000 X 10)= 2,375,800
	15	1,500,000 + (4.27 X 10,000 X 15)+ (15,000 X 15) = 2,908,700	1,300,000 +(4.89 X 10,000 X 15)+ (15,000 X 15) = 2,935,800
X8	1	1,550,000 + (4.27 X 10,000) + 15,000= 1,607,700	1,350,000 + (4.89 X 10,000)+ 15,000= 1,484,800
	5	1,550,000 + (4.27 X 10,000 X 5) + 15,000 X 5= 2,010,700	1,350,000 + (4.89 X 10,000 X 5) + (15,000 X 5) = 1,810,800
	10	1,550,000 + (4.27 X 10,000 X 10) + (15,000 X 10) = 2,605,700	1,350,000 + (4.89 X 10,000 X 10) + (15,000 X 10) = 2,335,800
	15	1,550,000 + (4.27 X 10,000 X 15)+ (15,000 X 15) = 3,200,700	1,350,000 + (4.89 X 10,000 X 15) + (15,000 X 15) = 2,860,800

X8 (O)	1	1,600,000 + (4.27 X 10,000) + 15,000= 1,657,700	1,400,000 + (4.89 X 10,000) + 15,000= 1,551,800
	5	1,600,000 + (4.27 X 10,000 X 5)+ (15,000 X 5) = 2,117,700	1,400,000 + (4.89 X 10,000 X 5) + (15,000 X 5) = 1,846,800
	10	1,600,000 + (4.27 X 10,000 X 10)+ (15,000 X 10) = 2,809,700	1,400,000 + (4.89 X 10,000 X 10) + (15,000 X 10) = 2,416,800
	15	1,600,000 + (4.27 X 10,000 X 15)+ (15,000 X 15) = 3,501,700	1,400,000 + (4.89 X 10,000 X 15) + (15,000 X 15) = 2,986,800
BY5	1	1,650,000 + (4.27 X 10,000) + 15,000= 1,707,700	1,450,000 + (4.89 X 10,000)+ 15,000= 1,618,800
	5	1,650,000 + (4.27 X 10,000 X 5) + (15,000 X 5)= 2,224,700	1,450,000 + (4.89 X 10,000 X 5) + (15,000 X 5) = 1,883,800
	10	1,650,000 + (4.27 X 10,000 X 10)+ (15,000 X 10) = 2,839,700	1,450,000 + (4.89 X 10,000 X 10) + (15,000 X 10) = 2,429,800
	15	1,650,000 + (4.27 X 10,000 X 15) + (15,000 X 15) = 3,454,700	1,450,000 + (4.89 X 10,000 X 15)+ (15,000 X 15) = 2,975,800
BY5L	1	1,700,000 + (4.27 X 10,000) + 15,000= 1,757,700	1,500,000 + (4.89 X 10,000) + 15,000= 1,685,800
	5	1,700,000 + (4.27 X 10,000 X 5) + (15,000 X 5) = 2,331,700	1,500,000 + (4.89 X 10,000 X 5) + (15,000 X 5)= 2,021,800
	10	1,700,000 + (4.27 X 10,000 X 10) + (15,000 X 10) = 3,069,700	1,500,000 + (4.89 X 10,000 X 10) + (15,000 X 10) = 2,633,800
	15	1,700,000 + (4.27 X 10,000 X 15)+ (15,000 X 15) = 3,807,700	1,500,000 + (4.89 X 10,000 X 15)+ (15,000 X 15) = 3,245,800

9.1. Summary

The table compares the total cost of owning each variant of the car (diesel and petrol) over different periods and annual mileages. You can adjust the annual service costs and fuel prices based on the actual data for more accurate comparisons. This will help you determine the total cost and compare which variant is more cost-effective over time.
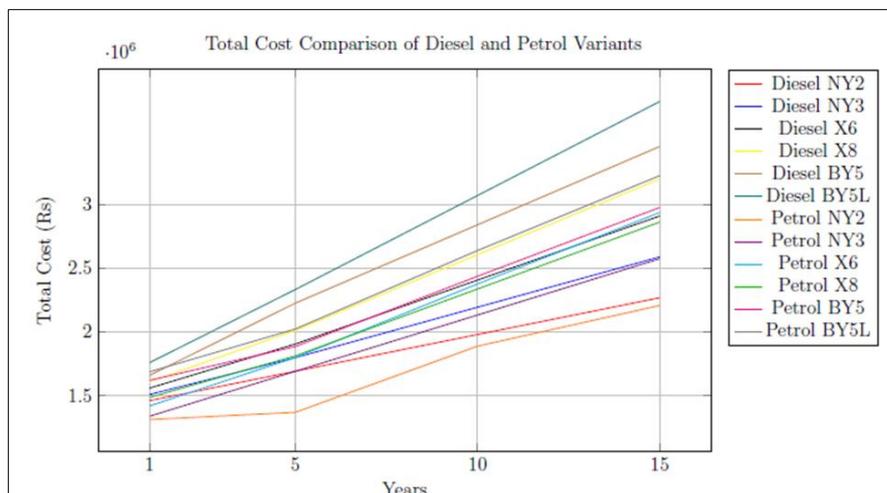
Figure 1 Comparison of Total Cost for Diesel and Petrol Cars over Different Years
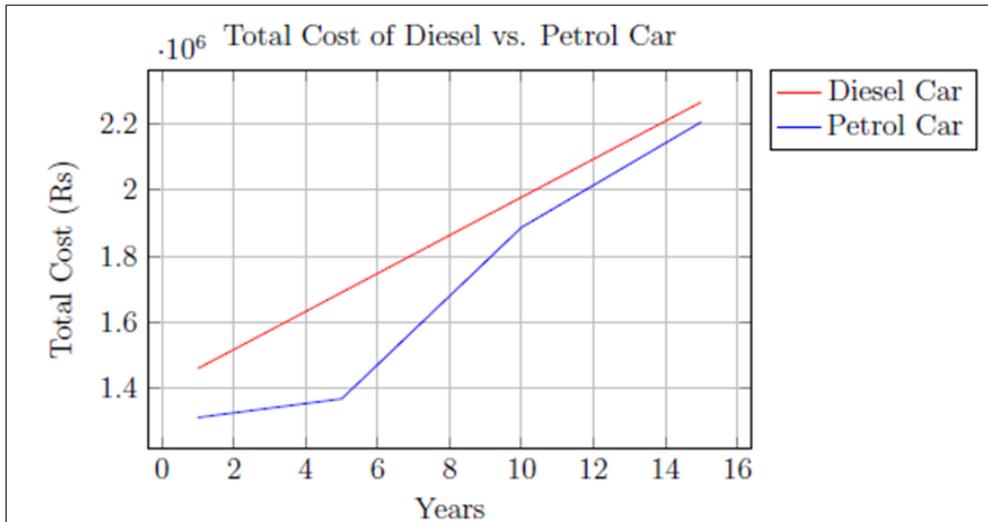
Figure 2 Comparison of Total Costs for Diesel and Petrol Variants of car Over Different Years

10. Conclusion

This research paper has provided a comprehensive analysis of the total cost of ownership (TCO) for various car variants, comparing diesel and petrol models over multiple time horizons (1, 5, 10, and 15 years). By incorporating factors such as initial purchase price, fuel efficiency, fuel costs, and annual maintenance expenses, the study offers valuable insights into the financial implications of choosing between diesel and petrol variants.

Key findings from the analysis indicate that while diesel vehicles typically incur higher initial purchase costs, their superior fuel efficiency often leads to lower fuel expenses over time. This results in a lower total cost of ownership for diesel variants compared to petrol models, especially over extended ownership periods. The higher upfront cost of diesel vehicles is offset by their better mileage, making them more cost-effective in the long run. Conversely, petrol vehicles, despite their lower initial purchase price and generally lower maintenance costs, tend to have higher operational costs due to reduced fuel efficiency.

The results underscore the importance of considering both short-term and long-term financial aspects when making a vehicle purchase decision. For consumers who drive frequently or plan to keep their vehicle for several years, the diesel variant of the car may offer a more economical choice. On the other hand, those with lower annual mileage or a preference for lower initial investment may find petrol variants more suitable.

Moreover, this study highlights the broader implications of vehicle choice on personal finances and environmental impact. As fuel prices and maintenance costs continue to evolve, the financial advantages of diesel versus petrol vehicles may shift. Consumers should regularly reassess their vehicle options in light of changing economic conditions and personal driving habits.

In summary, the findings of this research provide a valuable framework for prospective car buyers to evaluate the total cost of ownership of diesel and petrol variants of the car. By carefully analyzing their individual needs and financial situation, consumers can make more informed decisions that align with their budgetary constraints and long-term goals.

Remark : All the data used in this paper is hypothetical.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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