

Pricing Analysis and Optimization Strategies Based on the Marginal Cost of New Energy Vehicles

Qingyun Dong

*Shenzhen Foreign Languages School (Group) GBA Academy, Shenzhen, China
stevendong2027@slis.net.cn*

Abstract. The new energy vehicles people talk about today are mostly cars that don't use fossil fuels for power. Instead, they use energy that can be replaced and is more sustainable and renewable, such as electricity or natural gas. This study addresses the critical need for sustainable sales solutions in the new energy vehicle (NEV) industry. The research is significant for its multifaceted contributions to environmental protection, industrial sustainability, and corporate profitability. A case analysis illustrates how key factors, including consumer behavior and market competition, influence pricing dynamics. The findings highlight major advantages, such as enhanced profitability, alongside critical challenges including raw material cost volatility, brand trust erosion, and the potential for price wars, all of which pose significant threats to industry development. To mitigate these challenges, the study proposes strategic recommendations, including forming long-term supplier partnerships and pursuing product value differentiation. Collectively, this research provides an actionable framework for NEV firms to navigate market complexities, offering both theoretical insights and practical strategies for achieving sustainable growth.

Keywords: Marginal Cost Pricing, New Energy Vehicles, Pricing Optimization, Supply Chain Volatility, Sustainable Industry

1. Introduction

The new energy vehicles that consumers are discussing today are basically vehicles that do not use fossil fuels to provide energy but instead use replaceable, more sustainable, and renewable energy, such as electricity and natural gas.

Nowadays, there are two major problems with cars. The first problem lies in the effects of climate change, which is brought about by factors like burning fossil fuels. Therefore, in order to decrease the deterioration of the climate, the car industry needs other energy sources that can replace fossil fuels and be sustainable and renewable. That's why new energy vehicles have been invented [1]. The second problem is that fossil fuels are non-renewable energy sources. Fossil fuels will constantly decrease until one day, there's no fossil fuel left [2]. Consequently, the discovery and adoption of sustainable and renewable energy sources have become an imperative for the future of transportation.

To address these challenges, particularly in making NEVs affordable and competitive, it is essential to apply robust economic principles. Marginal cost analysis provides a foundational tool

for this purpose. Theoretically, marginal cost is the extra cost for producing one extra unit of product or service. It represents the total cost change for every extra unit produced. The formula for calculation is: $\text{Marginal cost} = \text{Change in total cost} / \text{Change in quantity}$. As an example, producing 1 unit costs \$1 and 2 units costs \$2, then the marginal cost will be equal to \$1 for 2 units. Pricing analysis and optimization are important factors that usually appear in business and economic areas at the same time. Pricing analysis is basically the process of assessing and evaluating how to price products or services in order to understand how the prices can affect different factors, such as sales, revenues, and profit margins. The optimization of pricing is the process of finding the best way to price products or services to find the maximum profits that the product or service can bring while also considering real-life factors such as market demand and cost structure. Finding out pricing analysis and optimization is important since businesses can understand costs and prices optimally through reliable data and analysis. By considering marginal costs with pricing, businesses are able to make sure that the prices are higher than the additional costs, and this prevents losses and can be used for the long-term running of businesses. What's more, businesses can set their price based on the interval of marginal cost, so that while businesses can change their products' price flexibly to ensure that their profits are higher than their costs, they can also either attract consumers' attention or maximize their profits.

For example, after calculating the extra unit's marginal cost, the answer "\$1 for 2 units" is obtained, and the company can set the price for this unit between \$1.1 and \$1.5, for instance, since the price is higher than the cost, and it's acceptable for the customers [3]. In this case, when the company is requiring consumers' attention, or if the company is facing some difficulties, such as COVID-19 that's affecting the sales volume, the company can lower the price to \$1.1 so that more consumers will be likely to buy the product. Similarly, if the sales volume is high and many consumers want to buy the product, the company can increase the price to \$1.5 so that the company is able to maximize the profit. In the context of NEVs, this principle applies to the cost of battery packs, software features, or autonomous driving capabilities. For instance, if the marginal cost of adding a longer-range battery is \$2,000, the manufacturer can price that option within a range that both covers the cost and aligns with consumer willingness to pay, thereby optimizing profitability and adoption [4]. Effective, accurate pricing can have a good impact on factors such as market penetration, profit margins, supply chain efficiency, and market growth.

There are two main benefits of researching this topic: commercial value and social value. While companies can enhance their income and make their business more sustainable, which is for the commercial value, companies can also enhance the accessibility of new energy vehicles to the public, making it more affordable, and can help protect the environment, which is a fitting social value.

2. Case description

Nowadays, the pricing conditions for new energy vehicles are both rising and decreasing. Overall, five factors are influencing the fluctuation of pricing conditions.

The first factor is a strategy called Price Discrimination Based on Purchase History, which means that new energy vehicle companies usually collect and utilize customers' historical purchases to decide whether they need to raise or lower prices. For example, when companies figure out that a customer is a repeat buyer, they might decrease the price a little: over the cost a lot, but lower than the price shown to customers.

Second, due to the intense competition between fuel-burning vehicles and new energy vehicles, the companies will change the price based on the customers' attention to the purchasing

environment. If the customers are focusing more on fuel vehicles, then to sell the new energy vehicles, companies will choose to lower the price to attract customers' attention. Similarly, if customers are interested in new energy vehicles, companies might increase the price a bit to reach maximum profit.

Third, since customers are increasingly more focused on environmental problems, new energy vehicles will appear to be more attractive to customers, which can contribute to an increase in prices. While people are focusing more on new energy vehicles, there'll be less attention focused on fuel vehicles, and this, in turn, contributes to the second factor, making the profit even more.

Fourth, considering wholesale and retail prices, the companies will raise or lower the price. Wholesale prices are commonly lower than retail prices, but companies can capture more willingness to consume through retail. This pricing stratification allows manufacturers to maximize volume through bulk sales to fleet operators (e.g., rental car companies, ride-hailing services) at wholesale prices while simultaneously capturing higher margins from individual consumers through retail channels.

Fifth, "green innovation" fundamentally reshapes pricing strategies by altering the product's cost structure and value proposition. For instance, innovations in battery technology can significantly reduce the marginal cost of production—the most important factor for pricing decisions. This lower cost base provides companies with greater flexibility: they can either pass on savings to consumers through lower prices to stimulate adoption, or maintain higher profit margins. Additionally, unique technological features (e.g., superior autonomous driving capabilities) enhance product differentiation, allowing companies to justify premium pricing strategies by increasing the perceived value of the vehicle beyond mere transportation.

3. Analysis of the problem

3.1. Positive influences of pricing analysis and optimization strategies based on the marginal cost of new energy vehicles

Marginal cost pricing, when coupled with advanced data analytics, offers several key advantages for NEV manufacturers operating in dynamic markets. The primary advantage is the potential for enhanced profitability. Conducting rigorous pricing analysis and optimization is critical, as it enables firms to ensure costs and prices are optimized through reliable data and analysis figures collected by artificial intelligence [5]. They can determine an optimal price elasticity range, and they can change their prices flexibly since they are taking different factors into account. Therefore, while companies can make sure that their price set are larger than the cost considering marginal cost, they can also prevent their companies from losses and can extensively maximize their profits. Furthermore, this can be used in the long-term running of businesses due to the sustainability of this method. For instance, if a company's analysis reveals that the marginal cost of producing an additional NEV is X , it can set a price within a range above this cost (e.g., $(X+Y)$ to $\$(X+Z)$), where Y and Z represent the variable profit margin [6].

When consumers are not putting much focus on new energy vehicles, or if there's a low point of purchases, the companies can lower the price between the interval prices. For example, it should be lower to 115,000 so that while the company can attract more customers to buy the vehicles, it can also attract more consumers' attention in order to contribute to the sustainable development of the industry. In this case, stable customers can be attained while the company is earning, ensuring that the company can keep doing business. And in other cases, when consumers are putting greater attention on new energy vehicles, the company can increase the price. For example, up to 145,000,

so that the company can extensively maximize the profit earned, so that while the company and employees can earn more, motivating the employees' and industry's positivity on selling, the company can also make the business sustain longer.

3.2. Problem identified analysis on pricing analysis and optimization strategies based on the marginal cost of new energy vehicles

Though this strategy brings many advantages, there are still some disadvantages.

3.2.1. Supply chain volatility and its implications

The first problem lies in the market volatility of raw material costs of new energy vehicles. Because this type of vehicle is relatively new compared to fuel vehicles, the raw materials are constantly being updated, invented, and innovated. Consequently, raw material prices experience severe and constant fluctuations. In this case, two questions are obvious: the business needs to change the price persistently, and the manufacturers and businesses can't keep a stable profit. This volatility necessitates frequent price adjustments [7]. However, from a consumer perspective, these changes—especially if implemented through dynamic pricing algorithms—can be perceived as opaque and unpredictable. This perception erodes consumer trust in the brand, as customers may feel the pricing is arbitrary or exploitative, rather than a fair reflection of value.

Compared to what was mentioned before for the advantage, “changing the price based on the customer environment can benefit the business”, this fluctuation in price is having a negative impact because it's a passive change in price. Changes based on customer conditions will probably appear among all companies, but this passive, separated fluctuation, especially dynamic pricing, will confuse customers about the company's condition, and the customers will therefore decrease their trust in the brand. Besides, manufacturers and businesses will struggle to earn and keep the business stable since they can't have a stable profit or income. Thus, external supply chain volatility translates directly into internal brand perception challenges, creating a dual threat to both profitability and brand equity.

3.2.2. Price war potential

The second problem is that some aggressive and constantly fluctuating price settings might lead to a price war among manufacturers and businesses, which in turn damages the profitability across the entire industry. As an example, if company B is setting the price of \$100,000 for one type of vehicle, and company C is setting the price of \$105,000 for the same type of vehicle, the customer would like to buy the vehicle in company B for sure because it's cheaper, unless the customer is an old customer for company C or the customer thinks that the quality of vehicle in company C is being more reliable. In this case, customers will swarm into company B, and company C will therefore have no choice but to lower the price, for example, to \$95,000. Now, the condition changes. Lots of customers would like to purchase from company C, and company B will decrease the price again [8]. This will ultimately lead to a persistent decrease in price, making the selling price only a little higher, or even lower than the original cost, having a negative impact on employees, business, and even the economic depression of the whole industry. This scenario illustrates a classic 'prisoner's dilemma' in game theory: although all firms would benefit from maintaining stable prices, the incentive for any single firm to undercut the competition leads to an outcome that is worse for everyone. Marginal cost pricing provides a clear, rational basis for each firm to set prices

individually. However, when all firms do this simultaneously in a competitive market, it creates a feedback loop that pushes prices toward marginal cost, eroding industry-wide profits. Marginal cost pricing, while rational for an individual firm in a static environment, can accelerate this race to the bottom if not managed within a broader strategic context.

4. Suggestions

4.1. Mitigating supply chain volatility and brand erosion

In fact, several solutions can decrease the effect that this problem is bringing, but this problem can't be totally solved or avoided because it's impossible to always maintain the price of the raw materials. Here are some solutions:

4.1.1. Establishing long-term supplier partnerships

The first solution, which is widely used among companies, is to set up long-term partnerships with the raw material suppliers in order to stabilize the price of raw materials. With a more detailed explanation, negotiating fixed prices or price ceilings will probably be the most beneficial and convenient method for the businesses [9]. In this case, sudden increases in prices can be avoided, and there're likely to be long-term cooperations among businesses. What's more, with the basis of this contract, businesses are more likely to develop more cooperation over time. Nevertheless, businesses need to consider whether it is beneficial for them to have this contract. This is because not all businesses are focusing on long-term new energy vehicle sales. However, long-term contracts carry inherent risks. If market prices fall below the contracted rate, the firm becomes locked into an uncompetitive cost structure, potentially threatening its viability. Besides, if the price is set relatively high, then the businesses are benefiting more; if the price is set relatively low, then the raw material suppliers are benefiting more. Therefore, businesses need to discuss and negotiate an appropriate price, which contains a little gambling factor in it.

4.1.2. Implementing comprehensive market intelligence systems

The second solution is to make a constant and detailed marginal cost analysis in the market. In other words, businesses can form a comprehensive analysis of all factors that are able to affect marginal costs, such as raw materials, labor, and overhead. This is important because they are affecting each other [10]. For example, if the labor force decreases one day, the raw materials' prices might increase due to the lack of labor and increased difficulties in creating the raw materials. Since the prices of raw materials have increased, marginal costs will surely be affected, and this will finally affect the new energy vehicle industry. Therefore, since they're all related to each other, businesses can make comprehensive research on all the factors so that when there're possibilities that raw materials' price is going to be fluctuant, the businesses can either try to deal with the problem in the early stage or try to conform to the condition gradually predicted so that there won't be a huge change. This involves deploying predictive analytics tools and AI models to monitor leading indicators (e.g., commodity futures, labor market trends, geopolitical events) that signal future cost pressures. A good thing in this case is that businesses can also see changes in other factors by using the same method to deal with them. However, businesses need to be aware that this constant and comprehensive analysis and research needs to be based on a good relationship among businesses and frequent investigation so that the prediction can be updated and accurate.

4.2. Avoiding destructive price competition

4.2.1. Pursuing value-based differentiation

The first solution is to differentiate the company's value from that of other companies. In simpler words, companies can focus on their products' unique features, high quality, and reliable customer service, but not only on competing prices. Some attractive factors, such as innovation and sustainability, can also attract customers' attention. Furthermore, making a vision and mission statement can be helpful in advertising the company and its product. That's why consumers can usually see that people are willing to buy more expensive products. It's not because they didn't see cheaper ones, it's because the company or its features attract them, or it's because they think that the company or its products are more reliable. In this case, the price war potential will decrease since the businesses are not only focusing on prices for sale. This strategy carries relatively lower direct financial risk compared to price competition but requires significant investment in branding and R&D to be effective. However, this condition is not likely to happen.

4.2.2. Forming industry-wide pricing covenants

This is a straightforward but efficient solution. Through setting up agreements among businesses, a price war is not likely to happen. The agreements can contain limited prices and limited fluctuation of prices, and the agreements can also be mutually beneficial to businesses. In this case, businesses and this industry will be more stable, and aggressive and inappropriate fluctuations of price will be blocked. However, such agreements must be carefully structured to avoid violating antitrust and competition laws, which often prohibit explicit price-fixing collusion. A more feasible approach may be implicit coordination through industry benchmarking or following a price leader.

5. Conclusion

5.1. Key findings

This study elucidates the advantages, limitations, and strategic implications of marginal cost-based pricing analysis and optimization for new energy vehicles (NEVs). The analysis reveals that the primary benefit is enhanced profitability, while the principal challenges include raw material cost volatility, associated brand trust erosion, and the potential for destructive price wars. These challenges significantly undermine firm profitability, hinder the sustainable development of the NEV industry, and negatively impact broader economic growth. To address these issues, several strategies are proposed: establishing long-term supplier partnerships (e.g., through fixed-price contracts) to stabilize costs; conducting detailed market analysis to inform value differentiation through quality and unique features; and fostering industry collaboration to mitigate the risk of price wars. In these cases, companies can maintain and constantly improve their profit while they can also gain customers.

5.2. Research significance

This paper is important because it extends beyond an academic perspective and over to business, economy, and social aspects. Through motivating pricing optimization strategies that are efficient and useful, the economy and sustainability of new energy vehicles can be enhanced. Furthermore, by promoting the adoption of NEVs, which reduce greenhouse gas emissions compared to internal

combustion engines, these strategies contribute to environmental sustainability by helping to mitigate climate change. In another aspect, businesses can increase their profits. All in all, this research contributes to the acceleration of the new energy industry. Thus, the study provides a holistic framework that aligns corporate strategy with economic and environmental objectives, supporting the transition to a more sustainable transportation ecosystem.

5.3. Limitations

Although there are many good points in this paper, the research still has limitations. As an example, this paper focuses only on secondary sources. Although the paper provides reasonable and valuable information from reliable sources, the condition of the real-world market may not be fully observed and described since there are no primary sources. Consequently, the conclusions, while theoretically sound, lack robust empirical validation from real-world industry applications. This paper could be strengthened by incorporating primary research, such as surveys and interviews with industry practitioners, to validate the proposed models and gain deeper insights into implementation challenges, so that there will be a deeper understanding and more comprehensive analyses of the topic.

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