THE EFFECTS OF THE SECOND-HAND CAR MARKET ON THE FIRM’S DYNAMIC PRICING AND NEW PRODUCT INTRODUCTION STRATEGIES

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ABSTRACT

In recent years, as China’s rapid economic development, the automobile consumption has been developing rapidly, including the used car distribution industry, which is growing rapidly at double-digit rates no matter from the number of transactions, or the transaction amount. Data shows that in the early 21st century, China’s second-hand car circulation industry has stepped into a golden era of high speed and sustainable development. As the development prospects of the secondary markets are so widely that many luxury car manufactures are all beginning to sell their own second-hand products, at the same time, as the secondary market may influence the new car market essentially, it’s becoming much more important for the manufactures to develop a scientific and reasonable pricing strategy and the introduction of new products. Therefore this article try to study the influence of these second-hand car markets make on the auto industries’ dynamic pricing and the new product strategy, and it has important significance.

Through the establishment of a two-cycle dynamic supply chain model, the article try to analysis the consumers’ strategy selection under the conditions of whether the used car markets exist and the car manufacturers’ corresponding selecting behavior, in order to make a clear direction for the automotive industries’ further development.

Keywords: Automotive second-hand market, Dynamic pricing, New product strategy

1. INTRODUCTION

With the rapid development of China’s automobile industry, the trading volume and the size of the used car market growing, its huge development potential and market space gradually exposed. A set of data [11] released by the China Automobile Dealers Association show, from January to October in 2014, the national second-hand car trading volume was up to 491900, increasing by 16.78% compared to the same period in 2013, the turnover is up to 294.478 billion yuan, increasing by 27.08% compared to the same period in 2013. In the first 11 months of 2014, China’s new car sales rose 6% over the same period in last year, was 2100000. The growth rate of secondary car was nearly three times to new cars. Among them, the basic passenger car sales is 2851900, increasing by 16.18%, the transaction amounted to 181.651 billion yuan; the passenger car sales is 739300, an increase of 19.14%, the transaction amounted to 35.364 billion yuan; the sales of trucks is 62.79 million, an increase of 14.48%, the transaction amounted to 26.974 billion yuan; SUV sales up to 160100, an increase of 20.52%, the transaction amounted to 23.133 billion yuan.

The second-hand car market is growing so rapidly in recent years that more and more attentions are took to the market research, many scholars at home and abroad carried out extensive research for its secondary market price and its development. For example, Jonathan R. Peterson and Henry S. Schneider[6] analyzed the adverse selection of consumers in the secondary market in the case of information by symmetry and asymmetry. In addition, HaoZhao and Sharan Jagpal[7] analyzed the effect of secondhand markets for durable goods on the firm’s dynamic pricing and new product introduction strategies, they got that all the prices, including the second-hand and upgrade prices increase when the market is growing. In addition, Sun Xiaobing[8] in Shanghai Jiao Tong University concluded that the brand used-car business could promote the sales of new cars and it could provide effective support for the car rental by the analysis in the importance of used car residuals and the impact factors. Nevertheless, the academic research that the used car market for new car pricing and policy are still less in its infancy, which has not yet formed a relatively mature theoretical system.

This article mainly analyzed the following issues by game theory and optimality conditions: whether the presence of the used car market has an impact on new car market price, how the degree of influence is; what influence the second-hand car market will make to the monopoly manufacturers’ profits; in this regard, what kind of measures should be taken, and how to develop new product introduction strategies for the vendor.
2. THE MODEL ASSUMPTION AND MODEL STRUCTURE

Provide \( W \) to be the willing of the \( W \) type consumers to buy a new car, while the consumers are rational assumptions, in the two-cycle supply chain model, we set up the market size of the first cycle and the second cycle to be 1, we analysis the manufacturer’s different behavioral choice under consumer purchasing decision in the first period without second-hand car market as well as the second period with it.

In this model, the willingness of the buyer to purchase a new car in the first cycle is \( W \), and they could obtain the utility \( W - P_i + \delta \cdot W \), wherein, the first period \( P_i \) car prices, \( \delta \) automotive durability, but in the second period, consumers continue to use the new car to get the utility \( \delta \cdot W \), where \( 0 < \delta < 1 \). It’s based on consumer utility theory, if \( W - P_i + \delta \cdot W > 0 \), namely critical condition \( W_i = \frac{P_i}{1 + \delta} \), then the consumers with the willing to pay more than \( W_i \) are all willing to buy a new car in the first period.

After entering the second period, the consumers are divided into two parts, including the purchaser of the first period, and the second cycle of new consumer into the market, for the new entrants in the second cycle, there are two kinds of options:

- If \( \delta \cdot W - P_i > 0 \), the critical condition is \( W_{s2} = \frac{P_i}{\delta} \), then they would buy a used car in the second-hand market, of which, \( W_{s2} \) the willingness to buy used cars, \( P_i \) for the price of used cars; If \( \Delta \cdot W - P_2 > \delta \cdot W - P_i \), that is when \( W_{s2} > \frac{P_i - P_2}{\Delta - \delta} \), the new consumer is willing to buy a new car in the second phase.

Similarly, the first period consumer into the second period has two choices:

- They continue to use their old cars to obtain the utility \( \delta \cdot W \),
- Due to the pursuit of high-tech innovative products, they are more inclined to sell the old cars to buy a new car in the second period, then they could get the utility \( \Delta \cdot W - P_i + C \), of which, \( C \) represents the recovery price of the used car in the second-hand market. If \( \Delta \cdot W - P_2 + C > \delta \cdot W \), namely \( W_{s1} > \frac{P_2 - C}{\Delta - \delta} \), then they purchase the second-generation car, otherwise, they continue to use the old car, of which, \( W_{s1} \) stands for the willingness to buy a second-generation new car. The consumer type distribution are in the following figure:
According to the relationship between consumer demand and the buying willingness, we can get:

The demand of the purchaser purchasing a new car in the first period is:

\[ Q_1 = 1 - W_1 = 1 - \frac{P_1}{1 + \delta} \]  
(1)

The demand of the first cycle buyer to purchase a new car in the second period is:

\[ Q_{n1} = 1 - W_{n1} = 1 - \frac{P_{n1} - C}{\Delta - \delta} \]  
(2)

The demand of the new entrants to buy a new car in the second cycle is:

\[ Q_{n2} = 1 - W_{n2} = 1 - \frac{P_{n2} - P_1}{\Delta - \delta} \]  
(3)

The demand of the second cycle consumer to buy a used car in the second-hand market is:

\[ Q_s = W_{s2} - W_{s1} = \frac{P_2 - P_1}{\Delta - \delta} - \frac{2P_1}{\delta} \]  
(4)

First, make judgments about the choosing behavior of car manufacturers under the condition of without second-hand market in the first cycle. Their goal is to maximize the profit, set its profit \[ \Pi \] , then

\[ \Pi = P_1 \cdot Q_1 = P_1 \cdot (1 - W_1) = P_1 \left(1 - \frac{P_1}{1 + \delta}\right) \]

The derivation of \[ P_1 \] is:

\[ \frac{\partial \Pi}{\partial P_1} = 1 - 2 \cdot \frac{P_1}{1 + \delta} \]

As

\[ \frac{\partial^2 \Pi}{\partial P_1^2} = - \frac{2}{1 + \delta} \]

we can get that its profit function is convex, the critical value of the price is:

\[ P_1 = \frac{1 + \delta}{2} \]

Manufacturers can improve the car’s price within a certain range to obtain high profits, simultaneously, we can see in the absence of second-hand car market, basically, the manufacturers just need to ensure high quality and durability of cars, they can get a greater degree of consumer recognition.
In the analysis of the sellers decision-making in the second-hand market of the second cycle, in order to ensure the supply of no less than balance, namely to ensure the existence of second-hand automobile market, we need to let \(Q_{n1} \geq Q_n\), that is \(1 - W_{n1} \geq W_{n1} - W_{n2}\), we can get that \(P > \frac{2P_2 \cdot \delta - \Delta \cdot \delta + \delta^2 - C \cdot \delta}{2\Delta - \delta}\). Because of the second-hand market, the vendors must ensure the maximization of their income when they make new product pricing in the second period,

\[
\Pi = P_2 \cdot (1 - W_{n1} + 1 - W_{n2}) = 2P_2 - \frac{P_2 - C}{\Delta - \delta} \cdot P_2 - \frac{P_2 - P_1}{\Delta - \delta} \cdot P_2,
\]

the derivation of \(P_2\) is:

\[
\frac{\partial \Pi}{\partial P_2} = 2 - \frac{2P_2 - C}{\Delta - \delta} - \frac{4P_2}{2\Delta - \delta} + \frac{1}{2\Delta - \delta} \cdot \frac{2\delta P_2 - \Delta \cdot \delta + \delta^2 - C \cdot \delta}{2\Delta - \delta},
\]

of which, \(\frac{\partial P_1}{\partial \Delta} = \frac{2\delta}{2\Delta - \delta}\), let it be equal to 0, we can get:

\[
P_2 = \frac{4\Delta^2 + \delta^2 - 5\Delta \cdot \delta + 2C \cdot \Delta}{4\delta},
\]

so \(\frac{\partial P_2}{\partial \Delta} = \frac{8\Delta - 5\delta + 2C}{4\delta} > 0\), \(\frac{\partial P_2}{\partial \delta} = \frac{\delta^2 - 4\Delta^2 - 2C \cdot \Delta}{4\delta^2}\).

If \(\frac{\partial P_2}{\partial \delta} > 0\), then \(\delta > 4\Delta^2 + 2C \cdot \Delta\), \(\delta > \sqrt{4\Delta^2 + 2C \cdot \Delta}\), as \(0 < \delta < 1\), reject it.

If \(\frac{\partial P_2}{\partial \delta} < 0\), then \(0 < \delta < \sqrt{4\Delta^2 + 2C \cdot \Delta}\),

because \(\Delta > 1\), so \(\delta\) can take any value in the domain of definition, namely \(\frac{\partial P_2}{\partial \delta} < 0\) is constantly founded.

3. RESULT ANALYSIS

3.1 In The Absence Of Second-hand Car Market

By \(\frac{\partial P}{\partial \Delta} > 0\), it’s described that the first generation of automobile sales price increases with its durability increasing, while the car profits will also increase with the price, therefore, as the durability of the car increases, the consumers will love it more, then the amount of car users increase, as well as the car demand, so the car manufacturers will raise price to obtain higher profits. On the other hand, the automobile durability increase, then the cost of producing a car will increase, which will force manufacturers to raise prices, the reason why the price of the same level of German cars is higher than that of Japanese cars is partly that the German car is technical hard, durable and advocating maintainability and reliability. Therefore, as car manufacturers, consumers maximize utility should be took into account, produce high-quality cars so as to better open up their own markets.

3.2 In The Presence Of Second-hand Market

By \(\frac{\partial P}{\partial \Delta} < 0\), it’s described that the second-generation car price reduces with the improving of the first-generation car durability, it’s easy to see, for the first phase buyers, due to the high durability of the first-generation car, it can be used a long time, even when the new car appears, consumers are still willing to keep their old cars, which makes the new car demand reduction, supply exceeds demand, manufacturers have to stimulate consumer demand by lowering price, in addition, for the second phase of new consumers into the market, because the durability of the first generation cars is improved, they are more inclined to buy a used car in the secondary market, meanwhile, in alternative aspects of the product, the first generation of automotive durability is good, in the minds of consumers has been formed a good reputation, even the second-generation car propaganda is not enough, for consumer, they are not willing to take risk to spend a higher price to buy a car that they don’t understand each aspect, to attract consumers, the new car manufacturers will reduce price to drive car sales.

By \(\frac{\partial P}{\partial \Delta} > 0\), it indicates that as the second-generation of new car quality improve, the first generation of buyer is more inclined to buy a new car due to the pursuit of high-tech product, so the manufacturers should continue to...
strengthen the innovation, innovation is the soul of a company to survive and make progress, the importance of high-tech development is self-evident.

4. CONCLUSION
Through the establishment of a two-cycle dynamic model, this article analyzed the vendor’s selection behavior in the cases of both the presence and absence of the secondary market, the second-hand market will encourage manufacturers to improve new vehicle price, but the model is a oligopolistic market game, so it can be expanded, for example, the demand externalities of manufacturers can be taken into account, in addition, in the second cycle, the consumer group can be set other parameters to analyze instead of 1.

5. REFERENCES


[9].Tong, J. Risk Research and Game Analysis of Second-hand Vehicle Trade.[C].2010.5
