The Research of Oil Enterprise Behavior Based on Environmental Taxation and Subsidies of Oil Product Upgrade

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Abstract. Oil is a special commodity which has three attributes of consumption, industry and society, which is related to the development of national economy and ecological environment. The formation cause of the crisis of the atmosphere was discussed briefly, and we got the conclusion that the main influential factor is the lower quality of oil products. First the paper analyzed the current situation that the standards of gasoline and diesel in China are lower and the impact on the environment on the basis of foreign comparison. Then based on the knowledge of petroleum products and oil enterprise, we analyzed the influential factors of the quality upgrade of oil products. Finally by building oil enterprise profit model based on environmental taxation and the subsidies of product upgrade and studying the behavior of oil enterprise, we got the conclusion that the government can promote product upgrades by raising environmental taxation and subsidies and also regulate the prices of petroleum products indirectly to achieve optimal equilibrium by adjusting the tax rate and subsidies.

Introduction

The previous analysis of major urban sources in China indicates that the tail gas from motor vehicles has an important contribution to PM2.5 through primary emission and secondary generation [1], while nitrogen oxides (NOx) and volatile organic compounds (VOCs) emitted by motor vehicles are the key precursors of ozone [2]. Studies have shown that it is the most effective and straightforward approach for the control of tail gas pollution to improve the quality of oil products and reduce the air pollution caused by automotive fuels besides improving vehicle performance through advanced technologies of optimizing engine design and installing tail gas converters [3].

Based on comparisons of key technical indicators of motor gasoline standards among the international fuel specifications, the EU, Japan and China, the quality gap of motor gasoline in China with the advanced areas has grown smaller. The sulfur content in standards of state-V gasoline and diesel has dropped to 10ppm, lower than that of the U.S. standards and equal to that of Japan and Europe. The motor gasoline will develop in the direction of decreasing the content of sulfur, aromatics and benzene, increasing the amount of octane, reducing metal adding amount, shortening the vapor pressure and distillation range, controlling the density in the future [4]. Compared with Europe, the U.S. and Japan, motor diesel standards in china lag behind, The main factors affecting the quality upgrading of diesel are the heavy mass and deterioration of crude oil processed, the low production capacity and the lack of catalyst competitiveness [5]. The latest research shows that the standards upgrading of China’s gasoline and diesel accelerates, while parts of critical indicators of the state-V motor gasoline and diesel equal to the world advanced level in recent years. But the smooth application of the new standard is the basic insurance of implementation effect of the standard, needing a co-operative effort of the government, oil refining enterprises, the automotive industry, the communities [6].

For the promotion of oil products upgrading, the research conducted by Xia Xiaojian and Sun Yingjun based on game theory points out there’s a prisoner’s dilemma between local government and enterprises on this issue[7]. This paper studies the behaviors of enterprises by constructing a profit model of oil enterprises based on environmental taxation and the subsidies of oil product
upgrading, finding that enterprises could be encouraged to upgrade oil products by increasing environmental tax and subsidies, and that the cost of oil products upgrading could be shared by enterprises, the government and consumers through adjusting the environmental tax rate and subsidies to control the price of oil products, which maximizes the overall interests.

Factors Affecting Quality Upgrading of Oil Products

To analyze the problem of oil products upgrading, it’s necessary to have a certain understanding of the oil and oil enterprises.

The Economic Attribute of Oil

Compared with the general commodities, oil has two notable economic features: one is scarcity, corresponding to the commodity properties of petroleum products. The other is strategy, corresponding to the industrial properties of petroleum products.

Commodity property is the most fundamental attribute of oil, following the market mechanism to a certain extent, the price of which determined by the supply and demand. The industrial properties of oil affect the development of modern society, and the core responsibility of China's oil companies is to stabilize the energy supply and ensure other products run stably and orderly.

The Social Attribute of Petroleum Enterprises

For the particularity and strategy of petroleum enterprises, the author applies stakeholder theory to state the social responsibilities that petroleum enterprises should bear from three aspects according to the general definition of corporate social responsibility:

Firstly, China's oil companies have the absolute right to control petroleum Enterprises that shoulder the guarantee of energy security and stable supply, steady market order. Secondly, as the “Economic Man”, the development of China's oil companies cannot be separated from the internal support, that is, the internal social responsibility of enterprises. Finally, all enterprises have the dual attribute of “economic man” and “social man”. The enterprises find it essential to attach importance to the external stakeholders, that is, the external social responsibility of enterprises.

Prerequisites of Oil Products Upgrading

Essential technology. The motor gasoline will develop in the direction of decreasing the content of sulfur, olefin, aromatics and benzene, increasing the amount of octane, reducing metal adding amount, shortening the vapor pressure and distillation range, controlling the density in the future. The main factors affecting the quality upgrading of diesel are the heavy mass and deterioration of crude oil processed, the low production capacity and the lack of catalyst competitiveness.

Enough funds. It is estimated that China's major oil companies will at least cost more than 50 billion to upgrade the gasoline and diesel to the "state-four" standard, the cost of oil per liter increasing ¥ 0.12 or ¥ 0.15. But the parties have different opinions about who should pay the cost of oil products upgrading.

Decision-making of Petroleum Enterprises Based on Social Responsibility

Core responsibility. When energy crisis occurs, the oil companies should not be oriented towards economic interests, but should meet the overall economic interests of society first to achieve the overall social welfare.

Internal social responsibility. It includes the responsibility for the interests of employees and shareholders. In order to better fulfill the social responsibility, the most important thing is to expand the financial resources, improve financial performance and maintain a high profit.

External social responsibility. The social responsibility for consumers is to provide a variety of high-quality oil products and services for different consumption demand. In addition, the oil companies should take the social popularity and public status into account when making decision to upgrade oil products, which is of some significance to the survival and development of oil companies.
Studies have found that the technology and capital investment of oil quality upgrading are already available, the Government has developed a plan for new standards of oil products upgrading, and the society is also calling for upgrading oil quality and controlling air pollution.

The biggest obstacle now lies in the inconsistency of interests between enterprises and the public. As oil products upgrading can lead to substantial capital investment, rising production costs, compressing profit margins, and unpredictable demand for high-quality products also brings great risks, which will affect the interests of enterprises.

Therefore it may a viable way to keep interests of enterprises consistent with those of the public and the government by adjusting the policy.

**Game Analysis of Government and Petroleum Enterprises**

**Model Building**

Assume that the demand function is:

\[ q = Q - bp \]

- \( p \) - Commodity price, \( Q \) - total market demand, \( q \) - demand for goods
- \( b \) - Fixed coefficient, \( q_1 \) - Oil market demand before oil quality upgrading
- \( q_2 \) - Oil market demand after oil quality upgrading
- \( C \) - Unit manufacturing cost, increasing with the upgrade of oil
- \( C_1 \) - Unit manufacturing cost before oil quality upgrading
- \( C_2 \) - Unit manufacturing cost after oil quality upgrading
- \( D \) - Unit pollution of the reduced oil quality, and the higher the oil, the more the amount of pollution is reduced
- \( d_1 \) - Reduced unit pollution before oil quality upgrading
- \( d_2 \) - Reduced unit pollution after oil quality upgrading
- \( \pi \) - Gross profit, \( \pi_1 \) - Gross profit before oil quality upgrading
- \( \pi_2 \) - Gross profit after oil quality upgrading

**Profit function:**

\[ \pi_1 = [P_1 - C_1 - t](a - d_2)]q_1 \]

\[ \pi_2 = [P_2 - C_2 - t](a - d_2) + s]q_2 \]

Plug demand function in Profit function and eliminate \( q \):

\[ \pi_1 = [P_1 - C_1 - t](a - d_2)](Q - bP_1) \] (1)

\[ \pi_2 = [P_2 - C_2 - t](a - d_2) + s](Q - bP_2) \] (2)

- \( a \) - Total pollution; \( t \) - Environmental tax rate; \( s \) - Subsidies per unit of product after oil quality upgrading, \( t \) and \( s \) stand for government regulated

**Model Analysis**

**Condition of Oil Quality Upgrading.** When \( \pi_2 - \pi_1 > 0 \), the oil companies have incentives for oil upgrades. Through (2) we can see that Enterprise profit is proportional to \( s \) and \( d \), but inversely proportional to \( t \).

When the government increases the environmental tax rate \( t \) and the Oil upgrade subsidy \( s \), \( \pi_1 \) will be reduced and \( \pi_2 \) will rise, so \( \pi_2 - \pi_1 \) will also rise. At this time, the enterprise will carry on the oil quality upgrading in time to achieve the purpose of reducing the loss and increasing the profit.

**Optimal Price.** The first order partial derivative of \( P \) on the formula (2):

\[ \frac{\partial \pi_2}{\partial P_2} = Q - 2P_2b + C_2b + t \alpha b + tgbd_2 - sb \]
When \( Q - 2p_2 b + c_2 b + tab + tbd_2 - sb = 0 \), the profit reaches its maximum. The optimal price is

\[
P_2 = \frac{Q + c_2 b + tab - tbd_2 - sb}{2b}
\]  

(3)

The optimal price is mainly affected by the environmental tax rate \( T \), the oil upgrading subsides.

**Similarities and Differences between Existing Researches**

Xia Xiaojian and Sun Yingjun advocate the coordination of government and enterprises and guiding public opinion to promote enterprises to take action, the essence of which is mutual concessions and application of external force. In contrast, it is the more effective way to focus on the interests of enterprises and guide business behaviors to maximize their own benefits while maximizing the interests of public and government.

Some scholars have conducted research on corporate behavior of taxation and R & D subsidies, however neglected that the reason for the difficulty of promoting oil products upgrading is not that the research is not deep, but the distribution of loss and benefits is unfair. In contrast, the subsidy for unit upgraded petroleum products meets the actual situation better.

**Conclusions**

This paper constructs a profit model of oil enterprises based on environmental taxation and the subsidies of oil product upgrading, studies the impacts of environmental tax policy and oil subsidy incentive policy on the behaviors of oil enterprises under the equal external environment, and further discusses the optimal policies combination from which the government can choose to solve the problem of oil quality upgrading. Analyzing the model, the following important conclusions are drawn:

1. Increasing the environmental taxes and oil upgrading subsidies can encourage oil companies to upgrade oil products.
2. Applying the environmental tax rate and the subsidy amount can get the best price based on the best interests.
3. The environmental tax rate is positive correlated with the price, and negative correlated with the output. While the subsidy of oil products upgrading is the other way round.

Therefore the upgrading of oil quality can be promoted, the government, enterprises and consumers could reach the “win-win” of maximizing the interests as well through adjusting the environmental tax rate and the subsidy amount.

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**References**


