

Research On Manufacturer's Price and Service Strategy Under Gray Market Considering Government Supervision

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ABSTRACT

This paper considers a supply chain system consisting of a manufacturer with her authorized retailers, an unauthorized intermediary and the regional government. Aim at the problem of the manufacturer's price decision and service strategy in two markets under gray market, the demand function influenced by the consumer acceptance of gray goods and the manufacturer and the unauthorized intermediary's profit model are established. By analyzing and discussing the effects of government supervision on manufacturer's pricing decision and service strategy, this paper proposes the manufacturer's optimal price and service strategy. The results show that if the government increases supervision the manufacturer will benefit while products demand and profits of the unauthorized intermediary will decrease. Thus, the government will achieve the target of combating gray market transaction. Besides, the manufacturer's service level when the government does not provide any protection against the gray market is as same as the level when the government provides complete protection. The service level will be higher when the government provides incomplete protection. Furthermore the results are examined by numerical examples.

Keywords: *gray market; supply chain; pricing decision; service strategy*

1. INTRODUCTION

With the rapid development of economic globalization, enterprises' strategies of managing supply chain has been changed (Beamon, 2008; Msimangira & Tesha, 2014), while the difference strategies multinational enterprises adopt in different countries will lead to gray market. Gray market is goods produced genuinely under protection of a trademark, patent, or copyright, placed into circulation in one market, and then imported into a second market without the authorisation of the local owner of the intellectual property

right (Maskus, 2000). With the rapid development of economic globalization, the trade of gray market increases prominently, which cannot be ignored. It has been estimated that the losses of U.S. from the gray market amount to \$ 63 billion every year. The problem is more common in other counties (Kodak, 2011). The so-called "branded products" and "gray products" in the mobile phone market of mainland China exist because of the gray market. According to survey results published by the electronic digital industry consultancy iSuppli, the total shipments of the world's major handset makers to China reached 840 million units, while the gray shipments of unauthorized intermediaries occupied 220 million units (iSuppli, 2013). Gray market will decrease the company's profit level. Although the gray products are authentic, their after-sales service cannot be guaranteed. In the long term, it will decrease customer loyalty and satisfaction and even damage the company's reputation severely. Thus, it is of practical significance to study how the company develops strategies to fight against the gray market.

At present, the scholars mainly focus on the causes of gray market, the effects of gray markets on manufacturer and authorized retailers and the attitude of manufacturer and government to gray market. Regarding the causes of gray market, Myers (1999) found that the centralization of decision making, the degree of product standardization and the intensity of channel control were closely relevant to the gray market activity through empirical study. In other words, gray market activity was affected by internal control factors other than external control factors. As a usual form of gray market, parallel import and its causes also attracted scholars to do lots of researches. Richardson (2002) thought that the appearance of parallel imports mainly depended on the difference of the manufacturer's product price in different

countries and regions from which the unauthorized intermediary obtain interest. However, Maskus (2004) believed it was that the price difference was greater than trade cost. Regarding the effects of gray markets on manufacturer and authorized retailers, Ahmadi and Yang (2000) build a model that the number of parallel importers affected the manufacturer's pricing decision. They found that the more parallel importers, the smaller the price gap between the two markets. Lin (2006) detected the situation that the manufacturer's investments in cost-reducing research and development were affected by parallel import. The result showed that parallel import would not definitely decrease the manufacturer's profit. Xiao *et al.* (2011) studied the strategies that the manufacturer fight against gray market using simulation method and found that the channel structure had a great influence on the manufacturer's profit. Raff and Schmitt (2007) examined the situation that the authorized retailers traded unsold inventories through parallel import at the end of the sales season which would benefit the retailers. Hu *et al.* (2013) used the numerical method to study the effects of manufacturer's quantity discount contract and found that when the authorized retailer was offered all-unit quantity discounts, the higher inventory holding costs, the better for the retailer. With regard to the attitude of manufacturer and government to gray market, Antia *et al.* (2006) studied the manufacturer's defense strategy to gray trade using empirical method and concluded that either increasing the manufacturer's supervision effort or strengthening punishments would not decrease the gray trade and only combing the two methods can achieve the aim of preventing. Taking reimport as the background, Autrey and Bova (2012) illustrated that the optimal price for internal transfers was a function of the competitiveness of the upstream economy when a gray market competitor was present Dasu *et al.* (2012) shed light on the issue that gray goods had an adverse impact on manufacturer and imposed two mechanisms to decrease the impact, namely, buyback contracts and multiple replenishments. Roy and Saggi (2012) analyzed the effects of parallel import policies on price competition and the interdependence of national parallel import policies in a vertically differentiated duopoly.

To cope with challenges of gray market effectively, the manufacturer can not only use the methods of price control and channel contract, but also use the method of providing service to consumers to enhance its competitiveness. At the same time, the manufacturer should consider the effects of government supervision and consumer's buying behavior on its decisions. Chen (2009) set up a two-stage sub-game perfect equilibrium model and found that manufacturers against parallel import were likely to be those whose products had a low gray good penetration ratio, low price elasticity of demand, high cross-price elasticity of demand. Zheng and Huang (2010) build an econometric model to study a supply chain consist of a manufacturer and an unauthorized intermediary and analyze their pricing decisions separately. Except the Chen's study, we can also consider the impacts of consumer value evaluation or the consumer acceptance of the gray goods on manufacturer's product demand. As for Zheng's study, we could examine the effects of government supervision and manufacturer's service level. In reality, the manufacturer can provide consumer some product service to affect the demand of

branded products and then influence its pricing decision and profit level. The government has the right and responsibility to supervise the gray trade. And the manufacturer will do some adjustment and change of its pricing decision and service level according to the different government supervision policies.

In view of this, this paper intends to study the impact of government supervision on the manufacturer's pricing decision and profit by considering the influence of consumers' acceptance of the gray goods and taking service level into manufacturer's choice of strategy. Then we get the manufacturer's optimal pricing decision and service strategy and provide theoretical basis for enterprises' decision-making.

2. PROBLEM DESCRIPTION AND ASSUMPTIONS

There are a manufacturer (denoted by M, called she) and an unauthorized intermediary (denoted by A, called he) in the market, and the government (called it) supervises the unauthorized intermediary. The manufacturer sells her branded products through her authorized retailers to consumers in regional market 2 at the price of p_m . The unauthorized intermediary sells gray goods shipping form regional market 1 with a lower price to the consumers in regional market 2, at the price of p_a . The manufacturer provides after-sales service for consumers, we assume that the manufacturer's service cost of providing service level s is s^2 . The unauthorized intermediary doesn't provide any after-sales service for consumers. Meanwhile, in order to simply the analysis, we assume that there aren't other costs when the manufacturer selling branded products through her authorized retailers to consumers.

Although the gray goods are authentic, but they are different from the branded products in some product properties, such as product language supporting system, etc. These differences may affect consumer perceived value of products, these differences would be considered by consumers when they make consumption choice. We introduce consumer acceptance coefficient of gray goods θ to represent these differences, where $0 < \theta < 1$. The consumer acceptance coefficient of gray goods θ is greater indicates that consumer acceptance of gray goods is higher. The consumer acceptance coefficient of gray goods θ can also be thought as discount rate, which means that when consumers purchase gray goods, the consumers perceived value is discounted. Similar to Chiang *et al.* (2003), Bernstein *et al.* (2009), we assume that consumer perceived value of branded products is v , $[0, 1]$ uniform distribution.

$U(v)$ is consumer net utility of the product with perceived value v , it's equal to the difference between value evaluation minus price. Then consumers' perceived value of gray goods is θv . Consumer utility function in regional market 2 with value evaluation v is

$$U(v) = \begin{cases} v + s - p_m & \text{buying branded products} \\ \theta v - p_a & \text{buying gray goods} \\ 0 & \text{buying nothing} \end{cases} \quad (1)$$

Let v_2 represent the product value evaluation when consumers buy branded products or gray goods can obtain the same utility. From $v_2 + s - p_m = \theta v_2 - p_a$, we can get

$$v_2 = \frac{p_m - p_a - s}{1 - \theta}.$$

Let v_1 represent the product value evaluation when consumers buy gray goods or don't buy any products can obtain the same utility. From $\theta v_1 - p_a = 0$, we can get

$$v_1 = \frac{p_a}{\theta}.$$

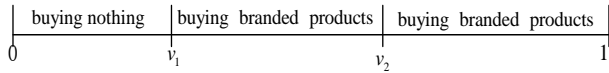


Figure 1. Consumers' purchase decision schematic diagram

Whether to buy the branded products or the gray goods depends on the size of consumers surplus. When consumers surplus is bigger than 0, consumers choose to buy products, and rational consumers will choose to buy the product with larger consumers surplus. Consumers' purchase decision is showed in **Figure 1**. The consumers with $[0, v_1]$ don't buy any products, the consumers with $[v_1, v_2]$ buy gray goods, the consumers with $[v_2, 1]$ buy branded products. Thus, the demand functions of branded products and gray goods are

$$D_m = \int_{v_2}^1 1dv = 1 - \frac{p_m - p_a - s}{1 - \theta} \quad (2)$$

$$D_a = \int_{v_1}^{v_2} 1dv = \frac{p_m - p_a - s}{1 - \theta} - \frac{p_a}{\theta} \quad (3)$$

The government bears the responsibility for supervising gray market transactions, it supervises the gray transaction of the unauthorized intermediary and imposes penalties on the gray goods selling behavior it found. We assume that the government supervision effort on unauthorized intermediaries is α ($0 \leq \alpha \leq 1$), which reflects the probability of unauthorized intermediary selling gray goods behavior found by the government. The greater α means that the government's supervision effort is larger, so the probability of the unauthorized intermediary selling gray goods behavior found by the government is larger. When unauthorized intermediary selling gray goods is found by the government, the government will penalize several multiples of gray goods value on the unauthorized intermediary. We assume that the valuation approach is calculated by the price of branded products, and in order to simply the analysis, we assume that the penalty multiple is 1. Thus unauthorized intermediary's expected penalties expenditure is $\alpha p_m D_a$. We don't consider the cost of the government supervision. On the one hand, the government is not involved in the game which means the α is an exogenous variable. On the other hand, the cost of the government supervision is the marginal increasing function of the α . It is impossible for the government to keep increasing its supervision effort blindly.

3. GAME MODELING AND ANALYSIS

According to the above problem description and assumptions, we can get the profit function of the manufacturer

$$\pi_m = (p_m - s^2)D_m = (p_m - s^2)\left(1 - \frac{p_m - p_a - s}{1 - \theta}\right) \quad (4)$$

and the profit function of the unauthorized intermediary

$$\pi_a = (1 - \alpha)p_a D_a - \alpha p_m D_a = ((1 - \alpha)p_a - \alpha p_m)\left(\frac{p_m - p_a - s}{1 - \theta} - \frac{p_a}{\theta}\right) \quad (5)$$

The game sequence among the manufacturer, the unauthorized intermediary and the government: firstly, under given the government's supervision effort α , the manufacturer choose an appropriate service level s and an appropriate price p_m ; then the unauthorized intermediary determine its gray goods price p_a according to the observed information.

3.1 The market equilibrium results

According to the game sequence, we use backward induction to solve the models.

Step 1: by seeking the first order condition of (5) for p_a , we can get

$$p_a = \frac{p_m}{2} \left(\theta + \frac{\alpha}{1 - \alpha} \right) \quad (6)$$

Step 2: by substituting (6) into (4) and seeking the first order condition for p_m , we can obtain

$$p_m = \frac{2 - 2\theta - 2\alpha + 2\theta\alpha - \theta s + \theta s\alpha + 2s - 2s\alpha + 2s^2 - 3s^2\alpha - s^2\theta + s^2\theta\alpha}{2(2 - 3\alpha - \theta + \theta\alpha)} \quad (7)$$

Step 3: by substituting the obtained p_a , p_m into (4), then seeking the first order condition for s , we can get

$$s = \frac{(2 - \theta)(1 - \alpha)}{2(2 - 3\alpha - \theta + \theta\alpha)} \quad (8)$$

According to the above process, we get the market equilibrium under the given government supervision effort α , which are

$$p_m^* = \frac{3(2 - \theta)^2(1 - \alpha)^2}{8(2 - 3\alpha - \theta + \theta\alpha)^2} + \frac{(1 - \theta)(1 - \alpha)}{2 - 3\alpha - \theta + \theta\alpha} \quad (9)$$

$$p_a^* = \frac{3(2 - \theta)^2(1 - \alpha)(\theta + \alpha - \theta\alpha)}{16(2 - 3\alpha - \theta + \theta\alpha)^2} + \frac{2(1 - \theta)\alpha - \theta^2(1 - \alpha)}{4(2 - 3\alpha - \theta + \theta\alpha)} \quad (10)$$

$$D_m^* = \frac{1}{2} + \frac{(2 - \theta)^2(1 - \alpha)}{16(1 - \theta)(2 - 3\alpha - \theta + \theta\alpha)} \quad (11)$$

$$D_a^* = \frac{3(2-\theta)^2(1-\alpha)(\theta-\alpha-\theta\alpha)}{16\theta(1-\theta)(2-3\alpha-\theta+\theta\alpha)^2} - \frac{2(1-\theta)\alpha+\theta^2(1-\alpha)}{4\theta(1-\theta)(2-3\alpha-\theta+\theta\alpha)} \quad (12)$$

$$\pi_m^* = \frac{(1-\alpha)\left((2-\theta)^2(1-\alpha)+8(1-\theta)(2-3\alpha-\theta+\theta\alpha)\right)^2}{128(1-\theta)(2-3\alpha-\theta+\theta\alpha)^3} \quad (13)$$

$$\pi_a^* = \frac{(1-\alpha)\left(3(2-\theta)^2(1-\alpha)(\theta-\alpha-\theta\alpha)-4(2-3\alpha-\theta+\theta\alpha)(2(1-\theta)\alpha+\theta^2(1-\alpha))\right)^2}{256(1-\theta)\theta(2-3\alpha-\theta+\theta\alpha)^4} \quad (14)$$

To ensure these results have practical significance, here we limit $2-3\alpha-\theta+\theta\alpha > 0$, i.e. $\alpha < \frac{2-\theta}{3-\theta}$.

By seeking the above results' derivatives of α , we can get proposition 1.

Proposition 1

1) $\frac{\partial s^*}{\partial \alpha} > 0$, $\frac{\partial^2 s^*}{\partial \alpha^2} > 0$. That is to say, the

manufacturer's equilibrium service level s^* is a concave function of the government's supervision effort α .

2) $\frac{\partial p_m^*}{\partial \alpha} > 0$, $\frac{\partial D_m^*}{\partial \alpha} > 0$, $\frac{\partial \pi_m^*}{\partial \alpha} > 0$. Namely,

when the government increases supervision effort, the manufacturer's equilibrium service level, price, product demand and profit will rise simultaneously. And we can get

$\frac{\partial s^*/\partial \alpha}{\partial p_m^*/\partial \alpha} < 1$, which means that the rising rate of the service level is less than the rising rate of the price.

3) $\frac{\partial p_a^*}{\partial \alpha} > 0$, $\frac{\partial D_a^*}{\partial \alpha} < 0$, $\frac{\partial \pi_a^*}{\partial \alpha} < 0$. When the

government increases supervision effort, the unauthorized intermediary's equilibrium price will rise, while his product demand and profit will decline.

Proposition 1 indicates that the manufacturer would benefit from the increasing government supervision effort. Because her profit increases, the manufacturer has incentive to improve service level, consumers are more willing to buy branded products, and then her market share and profit increase. At the same time, under the protection of the government, the manufacturer's profit will increase by rising price, but the improvement of service level will increase costs, so the rising rate of service level is less than the rising rate of price. For the unauthorized intermediary, when the government increases its supervision effort, the costs and risk for the unauthorized intermediary to sell gray goods increase, the price of gray goods increase, the unauthorized intermediary's market share declines. The unauthorized intermediary has to offer a higher gray goods price to consumers, thus the threshold for consumers to buy gray goods increases.

3.2 Boundary condition of the presence of gray goods

Because of $\frac{\partial D_a^*}{\partial \alpha} < 0$, when α increases to a certain

extent, the demand of the unauthorized intermediary will decline to 0, i.e. $D_a^* = 0$. Thus, we can get

$$\alpha = \frac{28-12\theta-33\theta^2+14\theta^3-\sqrt{784-2400\theta+2712\theta^2-1368\theta^3+273\theta^4}}{-26\theta^2+72+14\theta^3-64\theta} \quad (15)$$

Denoted by $\bar{\alpha}$, ($\bar{\alpha} < \frac{2-\theta}{3-\theta}$), therefore $\bar{\alpha}$ is the

maximum supervision effort the unauthorized intermediary can bear to survive, it's the minimum supervision effort the government must pay in order to make unauthorized intermediary withdraw from the market. Thus, we can get proposition 2.

Proposition 2 There exists $\bar{\alpha}$, when $\alpha \geq \bar{\alpha}$, the unauthorized intermediary withdraw from the market.

Proposition 2 indicates that the unauthorized intermediary exist when the government's supervision effort $\alpha < \bar{\alpha}$. Under this condition, the unauthorized intermediary and the manufacturer coexist in the market, the market equilibrium results are showed in (9)~(15). When $\alpha \geq \bar{\alpha}$, the unauthorized intermediary withdraws from the market, gray goods disappear and gray market transactions disappear, manufacturer monopolize the market. Proposition 2 also shows that the government's policy boundary that gray goods exist in the market, and this boundary condition depends on consumers' acceptance of gray goods. When the consumer acceptance of gray goods is higher, the threshold of banning gray goods is higher.

3.3 Manufacturer's service level decision under the government supervision policies

According to proposition 2, the range of government's supervision effort is $0 \leq \alpha \leq \bar{\alpha}$, i.e. $\alpha \in [0, \bar{\alpha}]$. Different α reflects the government's different supervision policies, or the government's different protection policies for branded products.

1) Non-protection policy: when $\alpha = 0$, the government doesn't implement any combat on unauthorized intermediary, let the market adjust by itself. In this case, the phenomenon that unauthorized intermediary sells gray goods may abound.

2) Complete protection policy: when $\alpha = \bar{\alpha}$, the government implements fully combat on unauthorized intermediary, that is the government provides compete protection for the manufacturer. Under this policy, unauthorized intermediary cannot survive, it withdraws the market.

3) Incomplete protection policy: when $0 < \alpha < \bar{\alpha}$, the government implements limited combat on unauthorized intermediary. In this case, branded products and gray goods coexist in the market, each accounted a certain market share.

3.3.1 Under the non-protection policy

When the government implements non-protection policy, by substituting $\alpha = 0$ into (8)~(16) we can get corollary 1.

Corollary 1 Under non-protection policy, the market equilibrium results are (denoted by superscript N)

$$s^N = \frac{1}{2}, p_m^N = \frac{14-11\theta}{8(2-\theta)}, D_m^N = \frac{10-9\theta}{16(1-\theta)}, \pi_m^N = \frac{(10-9\theta)^2}{128(1-\theta)(2-\theta)} \quad (16)$$

$$p_a^N = \frac{\theta(6-7\theta)}{16(2-\theta)}, D_a^N = \frac{6-7\theta}{16(1-\theta)(2-\theta)}, \pi_a^N = \frac{\theta(6-7\theta)^2}{256(1-\theta)(2-\theta)^2} \quad (17)$$

According to corollary 1, it's easy to find that under non-protection policy, the manufacturer's and the unauthorized intermediary's profit depend on the consumer acceptance of gray goods θ . When the consumer acceptance of gray goods is higher, the manufacturer's equilibrium price and profit are lower, while the manufacturer's equilibrium service level is less affected with respect to complete protection policy. When $\theta = \frac{6}{7}$, we have $D_a^N = 0$, the demand of the unauthorized intermediary's gray goods reduces to 0. Under non-protection policy, when consumers acceptance of gray goods reaches to $\frac{6}{7}$, the market will automatically clear the unauthorized intermediary.

3.3.2 Under complete protection policy

When the government implements complete protection policy, unauthorized intermediary exits from the market, the manufacturer monopolizes the market. In this case, consumers net utility is

$$U(v) = \begin{cases} v + s - p_m & \text{buying branded products} \\ 0 & \text{buying nothing} \end{cases} \quad (18)$$

Let v_0 represent the product value evaluation when consumers buy branded products or don't buy any products can obtain the same utility. From $v_0 + s - p_m = 0$, we can get $v_0 = p_m - s$. Thus, the demand functions of branded products is $D_m = \int_{v_0}^1 1dv = 1 - p_m + s$.

And we can get the profit function of the manufacturer is

$$\pi_m = (p_m - s^2)D_m = (p_m - s^2)(1 - p_m + s) \quad (19)$$

By seeking the first order condition of (19) for p_m and s , we can get (denoted by superscript N)

$$s^L = \frac{1}{2}, p_m^L = \frac{7}{8} \quad (20)$$

By substituting (20) into (19) and we can get

$$s^L = \frac{1}{2}, p_m^L = \frac{7}{8}, \pi_m^L = \frac{25}{64} \quad (21)$$

As shown in the above formula, $p_m^L = \frac{7}{8} > \frac{1}{4} = (s^L)^2$. It shows that the manufacturer would make the best of her capability of complete monopoly to set the price much higher than her marginal cost under government's complete protection.

When government provides complete protection, the manufacturer's service level is

$$s^L = \frac{1}{2}$$

3.3.3 Under incomplete protection policy

When government provides incomplete protection, namely, $0 < \alpha < \bar{\alpha}$. According to proposition 2, the manufacturer's service level is $s^* = \frac{(2-\theta)(1-\alpha)}{2(2-3\alpha-\theta+\theta\alpha)}$.

Comparing the the manufacturer's service level s^L , s^N and s^* under different government supervision policies, we can get

$$s^* - s^L = s^* - s^N = \frac{(2-\theta)(1-\alpha)}{2(2-3\alpha-\theta+\theta\alpha)} - \frac{1}{2} > 0 \quad (22)$$

Thus, we can get corollary 2.

Corollary 2 When $0 < \theta < 1$, $s^* > s^N = s^L$.

It indicates that providing more government supervision effort will promote the manufacturer to supply higher service level when $\alpha \in (0, \bar{\alpha})$. While $\alpha = 0$ or $\alpha = \bar{\alpha}$, the equilibrium service level is the same. On the one hand, the manufacturer gains the power of product monopoly when it is being completely protected and there is no need for the manufacturer to improve service to increase her product demand. On the other hand, the market will clearing the unauthorized intermediary automatically when the acceptance of gray goods of consumers reaches the critical value though the manufacturer don't receive any protection. Hence, the manufacturer has no willing to increase its service level. Only if there exists the unauthorized intermediary and government provides incomplete protection, the manufacturer would improve her service.

Under the incomplete protection policy, by seeking the first order condition of (8), (9), (11) and (15) for θ we can get

$$\frac{\partial s^*}{\partial \theta} > 0, \frac{\partial p_m^*}{\partial \theta} < 0, \frac{\partial D_m^*}{\partial \theta} < 0, \frac{\partial \pi_m^*}{\partial \theta} < 0 \quad (23)$$

This shows that the manufacturer's equilibrium service level improves and her equilibrium price, product demand and profit decrease simultaneously with the increasing consumer acceptance of gray goods when government supervision effort remains unchanged. The consumer acceptance of gray goods keeping increasing means that the utilities of branded products and gray goods becoming the same to consumers. The gray goods are more attractive to consumers, causing the manufacturer's product demand to decrease. To keep consumers, the manufacturer has to lower price and increase service level. Thus, the manufacturer's profit will reduce under the double impacts of less income and more cost.

4. NUMERICAL ANALYSIS

In the market under gray trade, let $\theta = \frac{1}{4}$, we analyze

the effects of government supervision effort α on the pricing decision and demand of the manufacturer's branded products and the manufacturer's profit. We get the **Figure 2**.

To analyze the effects of government supervision effort α on the pricing decision and demand of the manufacturer's branded products and the manufacturer's profit, we need to make the consumer acceptance coefficient of gray goods θ as a fixed value which range is between 0 and 1. Thus we let $\theta = \frac{1}{4}$ randomly. We get the **Figure 2**.

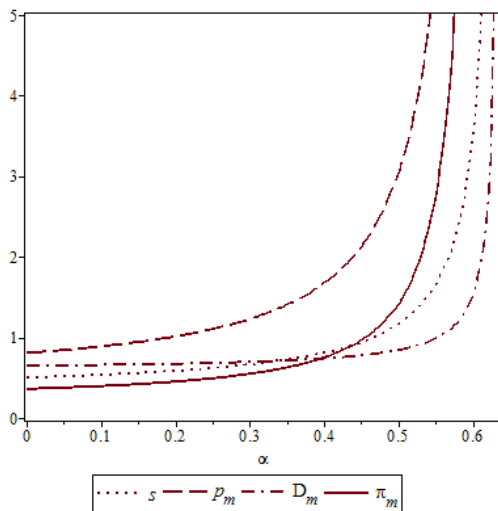


Figure 2. The influence of government's supervision policy on manufacture's price, demand and profit

As shown in **Figure 2**, the manufacturer's equilibrium service level, price, demand and profit simultaneously increase with the increasing government supervision effort. And the rising rate of service level is less than the rising rate of price. Notice that when $\alpha < 0.4$, both D_m and π_m increase slowly. However, when $\alpha > 0.4$, the π_m begins to rise sharply, and so does the D_m . That is to say, when government supervision effort is not enough, the gray goods still occupies a large market despite the increasing service level can attract a part of consumers. This will influence consumer's buying choice, resulting in unobvious increase of the branded products demand. When government supervision is strengthened, the unauthorized intermediary needs to raise price of gray goods to break even. On the other hand, the manufacturer's service level is rising, leading to more and more consumers willing to choose the branded products other than the gray good. Therefore, the manufacturer's product demand and profits will increase.

5. CONCLUSION

The unauthorized intermediary selling gray goods will influence the manufacturer's pricing decision of branded products, service level and profit level. And the government supervision policy will also make them different. By establishing the demand function influenced by the consumer acceptance of the gray goods and the profit

models of the manufacturer and unauthorized intermediary, this paper analyzes and discusses the effects of the government supervision on the manufacturer's pricing decision and service strategy. And the effects of the consumer acceptance of the gray goods on both the manufacturer and unauthorized intermediary are investigated. The results indicate that it's better for the manufacturer if the manufacturer do not clear the unauthorized intermediary outside the market completely and allow the unauthorized intermediary to conduct gray market transactions properly. The results also show that it is benefit for the manufacturer if the government increases supervision, while both the products demand and profits of the unauthorized intermediary will decrease. Thus, the government will achieve the target of combating gray market transaction. Besides, the manufacturer's service level when the government does not provide any protection against the gray market is as same as the level when the government provides complete protection. The manufacturer's service level will be higher when the government provides incomplete protection.

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