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R&D subsidy policy of domestic firm considering foreign firm competition

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Abstract: Taking the advanced technology of the foreign firm into account, a mixed duopoly three-stage game model is established in the context of research and development (R&D) investment subsidies and product subsidies for domestic firms provided by the government, and the R&D subsidy policy of domestic firms in competition with foreign firms is analyzed. The equilibrium output, R&D investment of the domestic firm, social welfare and the value of government subsidies are derived, in the case of the two policies, R&D investment subsidies and product subsidies for domestic firms, provided by the government. The results show that, the equilibrium output and the optimal social welfare under the R&D investment subsidy policy are both less than those under the product subsidy policy; the optimal R&D investment under the R&D investment subsidy policy is less than that under the product subsidy policy; and the R&D product subsidy has a more obvious incentive effect on firm R&D investment. Under the background of the leading edge of technology of foreign firms, the product subsidy policy drawn up by the government to encourage R&D innovation of domestic firms is more effective than the R&D investment subsidy policy.

Key words: research and development (R&D) investment; investment subsidy; product subsidy; technology gap; foreign firm competition

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Many foreign firms have entered the Chinese market since China's accession to the WTO, which increases the domestic firms' competition in the market. Generally speaking, foreign firms in the domestic market have leading-edge technology, a lower marginal cost of the product, and high quality. In order to expand the market share, domestic firms must implement technology innovation to improve product quality and reduce marginal costs, increasing the domestic firms' competitive advantage. Therefore, it is quite important to study technology research and the development of domestic firms in competition with foreign firms. In order to encourage the research and development of domestic firms, the government may implement some incentive policies, such as the R&D subsidy and product subsidy policies for domestic firms, and thus, the domestic firms can take up more market share in the domestic market, and ultimately maximize the social welfare. In recent years, much research has been done in the analysis of the R&D subsidy policy. For example, Hinloopen[1-2] studied the influence of the subsidy policy of the enterprise R&D and furthermore extended his market structure to multi-oligarchs Cournot competition and Bertrand competitive markets. Matsumura[3] investigated Stackelberg mixed duopoly models, where a state-owned public firm and a foreign private firm compete, and implemented the strategy to be adopted under the social welfare maximization. Some other studies also considered R&D subsidies[4-11]. Tomaru[12] investigated the effects of trade with a foreign firm and privatization of the domestic public firm on an incentive for the domestic firm to reduce costs by undertaking R&D investment, and showed that the domestic public firm has less incentive to reduce its costs if the foreign private firm enters the domestic market. Matsumura et al.[13] extended the mixed oligopoly model of Anderson to a case with foreign competitors. They theorized that all firms have the same marginal cost and researched whether privatization is beneficial from the viewpoint of social welfare in a monopolistic competition model or not, and found that the social value of the public firm increases under the presence of foreign competitors in the short run. Wang et al.[14] established a mixed oligopoly competition model with foreign penetration, derived the equilibrium output and social welfare under Cournot competition market, and examined the impact of foreign penetration on privatization in a mixed oligopolistic market. There are other researchers who considered foreign enterprises. Elberfeld et al.[15-17] researched the strategy selection problem of the government with homogeneous duopoly Cournot competition under technical alliance. Wang[18] considered the market competition, corporate merger and bidding behavior of firms between one foreign firm and two domestic firms in the market, and investigated mergers and acquisitions and the bidding problem of state-owned enterprises over-

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seas. He also analyzed the impact on social welfare at the same time.

In this paper, we take into account the technological advantages of foreign firms (The products of foreign firms are usually more competitive than domestic firms due to their lower marginal costs), which disagrees with previous literature. In order to reduce the marginal cost of products and decrease the technology gap between domestic firms and foreign firms, the domestic firm shall implement R&D and innovation. It is an interesting direction to analyze the R&D subsidy policy of domestic firms considering foreign firm competition. However, to the best of our knowledge, there is no literature on this aspect at present. This fact gives the reason why efforts should be taken to bridge this gap.

1 Model Description

Suppose that an industry consists of two competing firms on the market, denoted by $i, j(i, j = 1, 2)$, that produce homogeneous goods, where Firm 1 is a private domestic firm, and Firm 2 is a foreign firm. The foreign firm is owned by the private sector which aims at maximizing the firm's profit. On the other hand, the domestic firm maximizes its own profit when the private sector owns it. The domestic firm is less efficient than the foreign firm (if the foreign firm is less efficient than the domestic firm, the foreign firm does not have a market share). In the domestic market, each firm faces the inverse demand functions: $p = p(Q) = a - Q = a - q_1 - q_2$, where q_1 and q_2 are the output of Firm 1 and Firm 2, respectively; Q is the total output, $Q = q_1 + q_2$; p is the price; and a is the largest market demand. Suppose that c_1 and c_2 are both positive constants, which represent their respective marginal production costs, and $c_1 > c_2$, $a > c_1 > c_2$. For tractability, we assume $c_1 = c$, and $c_2 = 0$ because the foreign firm has cost or technical advantages, where c also represents the technology gap and cost gap between the domestic firm and foreign firm, $0 < c < a$. However, due to the fact that the production efficiency of the domestic firm is lower than that of the foreign firm, the domestic firm can lower its marginal cost by conducting cost-reducing R&D investment, thus obtaining more profit. At the same time, the government encourages domestic firm innovation, and decides to provide a R&D subsidy policy for the domestic firm. Here, we assume that the R&D and innovation are successful. The R&D investment of Firm 1 is x, which denotes R&D investment's contribution to the marginal cost decline. After successful R&D, the marginal production cost of Firm 1 declines to $c - x, x \in (0, c]$, $c - x$ also represents the productive efficiency of firm 1, so x also reflects the firm's production efficiency. We denote by $\Gamma(x)$ a cost function for R&D investment. From Poyago-Theotoky et al.[6] and Tomaru[12], we assume that $\Gamma(x) = kx^2/2$, $k > 0$, where parameter k is the cost parameter of firm technology innovation. The smaller the k, the stronger the firm's innovation ability.

In order to ensure that the R&D output of domestic firm is positive and research and development have practical significance, we assume that $0 < c < 2a/3$. On the other hand, in order to maximize social welfare and profits, the government encourages the domestic firm to carry out research and development, and implements R&D subsidy policies for it. There are two forms of subsidy policies. One is R&D investment subsidies and the other is product subsidies. The former is subsidies for the firm's R&D investment in technological innovation to encourage firms to increase R&D investment. The latter is subsidies for firm product innovation, based on the new product sale of the firms or new product sale income. For the firm, obtaining subsidies is to achieve profit maximization, which is the market behavior criterion of the firm. For the government, providing subsidies is to maximize social welfare.

The goals of the two main bodies are inconsistent, which prompts us to scientifically compare and analyze two R&D subsidy policies, and this provides decision reference for the innovation behavior of the firms and the government. Since the production efficiency between firms is different, the output in the competition between firms is a common main means of competition. Hence, it is crucial to investigate the decisions under the Cournot competition. Here we establish a mixed duopoly three-stage game optimization model. In the first stage, the government chooses the optimal R&D subsidy to maximize social welfare. In the second stage, firms choose R&D investment to lower their marginal costs. In the third stage, firms engage in Cournot competition in the product market to maximize its per-period gross profits. Here, we use the backward induction of the game to solve the corresponding Cournot-Nash equilibrium solution.

2 Model Analysis

Under the condition of the government providing R&D investment subsidies and product subsidies for the domestic firm, we investigate the market equilibrium results, R&D investment of the domestic firm, social welfare and the value of government subsidies, when the domestic firm is faced with the cost advantage of the foreign firm. The case that the government provides R&D investment subsidies for the domestic firm is denoted by superscript A. The case that the government provides product subsidies for the domestic firm is denoted by superscript B.

2.1 Case 1: R&D competition analysis with R&D investment subsidies

In order to maximize social welfare and profits, the government encourages the domestic firm to carry out R&D and innovation, and provides R&D investment subsidies for it. In each unit of R&D investment, the govern-

ment gives R&D investment subsidies s. Therefore, the subsidies of Firm 1 is $S(x) = sx$[6], and the profit function of Firm 1 can be expressed as

$$\pi_1(q_1, q_2, x) = (a - q_1 - q_2)q_1 - (c - x)q_1 - \frac{1}{2}kx^2 + sx \tag{1}$$

The profit of Firm 2 is given by

$$\pi_2(q_1, q_2) = pq_2 \tag{2}$$

Domestic social welfare SW includes consumer surplus, the domestic Firm 1's profit and net R&D subsidies, which is given by[12]

$$\mathrm{SW}(q_1, q_2, x, s) = \int_0^Q p(z)\,\mathrm{d}z - p(Q)q_2 - pq_1 + \pi_1(q_1, q_2, x) - sx \tag{3}$$

Since Firm 1 and Firm 2 are private firms, they are to maximize the profit as their goal. In the third stage, firms engage in Cournot competition in the product market to maximize the per-period gross profits. Solving the first-order conditions (FOC henceforth) of the relevant maximization problems $\frac{\partial \pi_1}{\partial q_1} = 0$, $\frac{\partial \pi_2}{\partial q_2} = 0$ yields the following Cournot-Nash equilibrium quantities and price:

$$p^{\mathrm{A}} = \frac{a + c - x}{3},\quad q_1^{\mathrm{A}} = \frac{a - 2c + 2x}{3},\quad q_2^{\mathrm{A}} = \frac{a + c - x}{3} \tag{4}$$

In the second stage, firms choose R&D investment to lower their marginal cost. Firms select the level of R&D investment to maximize their profits. Substituting Eq. (4) into Eq. (3), and calculating partial derivative of Eq. (3) with respect to x, we obtain

$$\frac{\partial \pi_1}{\partial x} = \frac{2}{3}(a - c + x - q_2^{\mathrm{A}}) - kx + s = 0$$

Solving the above equation, we have

$$x^{\mathrm{A}} = \begin{cases} c & k < \dfrac{4a + 9s}{9c} \\ \dfrac{4a - 8c + 9s}{9k - 8} & \text{otherwise} \end{cases} \tag{5}$$

In the first stage, the government chooses the optimal R&D subsidy to maximum social welfare. Substituting Eq. (5) into Eq. (3), calculating the partial derivative of Eq. (3) with respect to s, and making it equal to zero, we derive the optimal R&D subsidy:

$$s^* = \frac{4a - 6ak + 3kc}{27(1 - k)} \tag{6}$$

Substituting Eq. (6) into (5), we have

$$\hat{x}^{\mathrm{A}} = x^{\mathrm{A}}(s^*) = \begin{cases} c & k < \dfrac{2a}{3c} \\ \dfrac{2a - 3c}{3(k - 1)} & \text{otherwise} \end{cases} \tag{7}$$

Substituting Eq. (7) into Eq. (4), we obtain the equilibrium output as follows:

$$\hat{q}_1^{\mathrm{A}} = q_1^{\mathrm{A}}(\hat{x}^{\mathrm{A}}) = \begin{cases} \dfrac{a}{3} & k < \dfrac{2a}{3c} \\ \dfrac{a + 3ak - 6kc}{9(k - 1)} & \text{otherwise} \end{cases} \tag{8}$$

$$\hat{q}_2^{\mathrm{A}} = q_2^{\mathrm{A}}(\hat{x}^{\mathrm{A}}) = \begin{cases} \dfrac{a}{3} & k < \dfrac{2a}{3c} \\ \dfrac{3k(a + c) - 5a}{9(k - 1)} & \text{otherwise} \end{cases} \tag{9}$$

Finally, substituting Eqs. (6) to (9) into Eq. (3), we obtain the social welfare

$$\mathrm{SW}^{\mathrm{A}} = \begin{cases} \dfrac{a^2}{3} - \dfrac{1}{2}kc^2 & k < \dfrac{2a}{3c} \\ \dfrac{2a^2(3k - 1) - 12akc + 9kc^2}{18(k - 1)2} & \text{otherwise} \end{cases}$$

2.2 Case 2: R&D competition analysis with product subsidies

To encourage the domestic firm to carry out R&D and innovation, the government can adopt another subsidy policy, i.e., providing product subsidies for the domestic firm. In each unit of output, the government gives the R&D subsidies e, and the subsidy of Firm 1 is $S(e) = eq_1$[17]. Then the profit function of Firm 1 is given by

$$\pi_1(q_1, q_2, e) = (a - q_1 - q_2 + e)q_1 - (c - x)q_1 - \frac{1}{2}kx^2 \tag{10}$$

The profit of Firm 2 can be expressed as

$$\pi_2(q_1, q_2) = pq_2$$

Domestic social welfare SW is the summation of the consumer surplus, the profit of domestic Firm 1 and net R&D subsidies are given by[12]

$$\mathrm{SW}(q_1, q_2, x, e) = \int_0^Q p(z)\,\mathrm{d}z - p(Q)q_2 - pq_1 + \pi_1(q_1, q_2, e) - eq_1 \tag{11}$$

Due to the fact that Firm 1 and Firm 2 are both private firms, they are to maximize profit as their goal. The third stage is the Cournot competition between firms in the product market. Calculating the partial derivative of Eq. (1) and Eq. (2), and making it equal to zero, $\frac{\partial \pi_1}{\partial q_1} = 0$, $\frac{\partial \pi_2}{\partial q_2} = 0$, we obtain the equilibrium outputs and price of Firm 1 and Firm 2.

$$p^{\mathrm{B}} = \frac{a + c - x - e}{3},\quad q_1^{\mathrm{B}} = \frac{a - 2c + 2x + 2e}{3}$$
$$q_2^{\mathrm{B}} = \frac{a + c - x - e}{3} \tag{12}$$

In the second stage, firms choose R&D investment to lower their marginal costs. Firms select the level of R&D

investment to maximize their profits. Substituting Eq. (12) into Eq. (10), and solving the first-order conditions of the relevant maximization problems, and making it equal to zero, we obtain the R&D investment

$$x^{\mathrm{B}}=\begin{cases}c & k<\dfrac{4(a+2e)}{9c}\\ \dfrac{4(a-2c+2e)}{9k-8} & \text{otherwise}\end{cases} \tag{13}$$

In the first stage, in order to encourage the domestic firm to carry out R&D and innovation, the government provides product subsidies for domestic firms, and the government chooses the optimal R&D subsidy to maximize social welfare. Substituting Eq. (13) into Eq. (11), and calculating the partial derivative of Eq. (3) with respect to e, and making it equal to zero, we obtain the optimal R&D subsidy in this case:

$$e^{*}=\begin{cases}a & k<\dfrac{4(a+2e)}{9c}\\ \dfrac{27k(a-c)+16c-20a}{27k-32} & \text{otherwise}\end{cases} \tag{14}$$

Substituting Eq. (14) into (13), we have

$$\hat{x}^{\mathrm{B}}=x^{\mathrm{B}}(e^{*})=\begin{cases}c & k<\dfrac{4(9a-4c)}{27c}\\ \dfrac{12(3a-4c)}{27k-32} & \text{otherwise}\end{cases} \tag{15}$$

Also, substituting (15) into(12), we obtain the equilibrium output

$$\hat{q}_1^{\mathrm{B}}=q_1^{\mathrm{B}}(\hat{x}^{\mathrm{B}})=\begin{cases}a & k<\dfrac{4(9a-4c)}{27c}\\ \dfrac{9k(3a-4c)}{27k-32} & \text{otherwise}\end{cases} \tag{16}$$

$$\hat{q}_2^{\mathrm{B}}=q_2^{\mathrm{B}}(\hat{x}^{\mathrm{B}})=\begin{cases}0 & k<\dfrac{4(9a-4c)}{27c}\\ \dfrac{2(9kc-8a)}{27k-32} & \text{otherwise}\end{cases} \tag{17}$$

Substituting Eqs. (14) to (17) into (11), we obtain the social welfare as

$$\mathrm{SW}^{\mathrm{B}}=\begin{cases}\dfrac{a^2-kc^2}{2} & k<\dfrac{4(9a-4c)}{27c}\\ \dfrac{a^2(27k-8)+18kc(2c-3a)}{2(27k-32)} & \text{otherwise}\end{cases}$$

Therefore, we can obtain the equilibrium output, R&D investment of domestic firm, social welfare and the value of government subsidies. In the case of the two cases, R&D investment subsidies and product subsidies for domestic firms are provided by government (see Tab. 1).

Proposition 1 For any $0<c<\dfrac{2}{3}a$ and $k>\dfrac{4(9a-4c)}{27c}$, there is $\hat{q}_1^{\mathrm{A}}<\hat{q}_1^{\mathrm{B}}$. The equilibrium output under the R&D investment subsidy policy is less than the equilibrium output under the product subsidy policy.

Proof From $k>\dfrac{4(9a-4c)}{27c}$, we have $k>\dfrac{4(9a-4c)}{27c}>\dfrac{2a}{3c}$, so

$$\hat{q}_1^{\mathrm{A}}-\hat{q}_1^{\mathrm{B}}=\frac{a+3ak-6kc}{9(k-1)}-\frac{9k(3a-4c)}{27k-32}=-\frac{2[81(a-c)k^2-3(29a-22c)k+16a]}{9(k-1)(27k-32)}$$

We assume that $f(k)=81(a-c)k^2-3(29a-22c)k+16a$, therefore $f'(k)=162(a-c)k-3(29a-22c)$. $k>\dfrac{4(9a-4c)}{27c}>\dfrac{2a}{3c}>\dfrac{3(29a-22c)}{162(a-c)}$ always holds if $k>\dfrac{4(9a-4c)}{27c}$, which can be concluded that if $k>\dfrac{2a}{3c}$, then $k>\dfrac{3(29a-22c)}{162(a-c)}$, thus $f'(k)>0$. Therefore, if $k>\dfrac{2a}{3c}$, $f(k)$ is monotonically increasing with k. Additionally, when $f\left(\dfrac{2a}{3c}\right)=\dfrac{2a(2a-3c)(9a-10c)}{c^2}>0$, $k>\dfrac{4(9a-4c)}{27c}>\dfrac{2a}{3c}$, we obtain $f\dfrac{4(9a-4c)}{27c}\Big)>f\left(\dfrac{2a}{3c}\right)>0$. Thus, we have $f(k)>0$ if $k>\dfrac{4(9a-4c)}{27c}$. Following the result, we have that if $k>\dfrac{4(9a-4c)}{27c}$, then $k-1>0$ and $27k-32>0$. Hence, $\hat{q}_1^{\mathrm{A}}-\hat{q}_1^{\mathrm{B}}<0$, $\hat{q}_1^{\mathrm{A}}<\hat{q}_1^{\mathrm{B}}$. The proof is completed.

Proposition 1 shows that, in the case of the domestic firm implementing R&D and innovation with foreign firm competition, the equilibrium output under the R&D investment subsidy policy is less than the equilibrium output under the product subsidy policy. That is to say, from the point of view of the government or social welfare maximi-

Tab. 1 The equilibrium values or the optimal value in the case of two cases

Variables	Case 1	Case 2
Output of firm 1	$\dfrac{a+3ak-6kc}{9(k-1)}$	$\dfrac{9k(3a-4c)}{27k-32}$
R&D investment of firm1	$\dfrac{2a-3c}{3(k-1)}$	$\dfrac{12(3a-4c)}{27k-32}$
Social welfare	$\dfrac{2a^2(3k-1)-12akc+9kc^2}{18(k-1)}$	$\dfrac{a^2(27k-8)+18kc(2c-3a)}{2(27k-32)}$
Government subsidies	$\dfrac{(6ak-4a-3kc)(2a-3c)}{81(k-1)^2}$	$\dfrac{9k(3a-4c)[27k(a-c)+16c-20a]}{(27k-32)^2}$

zation, in the process of the domestic firm carrying out R&D and innovation to reduce the marginal cost, the product subsidy policy is an optimal strategy.

Proposition 2 For any $0 < c < \frac{2}{3}a$ and $k > \frac{4(9a-4c)}{27c}$, $\hat{x}^A < \hat{x}^B$. The optimal R&D investment under the product subsidy policy is higher than that under the R&D investment subsidy policy.

Proof If $k > \frac{4(9a-4c)}{27c}$, we have $k > \frac{4(9a-4c)}{27c} > \frac{2a}{3c}$, and $\hat{x}^A - \hat{x}^B = \frac{2a-3c}{3(k-1)} - \frac{12(3a-4c)}{27k-32} = \frac{4(11a-12c)-9k(6a-7c)}{3(k-1)(27k-32)}$. We know that $\frac{9a-4c}{3c} > \frac{11a-12c}{6a-7c}$ for $0 < c < \frac{2}{3}a$, so $k > \frac{4(9a-4c)}{27c} > \frac{4(11a-12c)}{9(6a-7c)}$, $4(11a-12c)-9k(6a-7c) < 0$. Also, $k-1 > 0$ and $27k-32 > 0$ if $k > \frac{4(9a-4c)}{27c}$. Hence, $\hat{x}^A - \hat{x}^B < 0$, $\hat{x}^A < \hat{x}^B$. The proof is completed.

Proposition 3 For any $0 < c < \frac{2}{3}a$ and $k > \frac{4(9a-4c)}{27c}$, we find that $SW^A < SW^B$. When the domestic firm implements R&D and innovation in competition with the foreign firm, the optimal social welfare under the product subsidy policy is higher than that under the R&D investment subsidy policy.

Proof From $k > \frac{4(9a-4c)}{27c}$, we have $k > \frac{4(9a-4c)}{27c} > \frac{2a}{3c}$, and

$$SW^A - SW^B = \frac{2a^2(3k-1)-12akc+9kc^2}{18(k-1)} - \frac{a^2(27k-8)+18kc(2c-3a)}{2(27k-32)} = -\frac{81(a-c)^2k^2-3(23a^2-34ac+12c^2)k+8a^2}{18(k-1)(27k-32)}$$

We assume that $g(k) = 81(a-c)^2k^2 - 3(23a^2-34ac+12c^2)k + 8a^2$, then $g'(k) = 162(a-c)^2k - 3(23a^2-34ac+12c^2)$. $k > \frac{4(9a-4c)}{27c} > \frac{2a}{3c} > \frac{3(23a^2-34ac+12c^2)}{162(a-c)^2}$ always holds if $k > \frac{4(9a-4c)}{27c}$, thus $g'(k) > 0$.

Hence, if $k > \frac{4(9a-4c)}{27c} > \frac{2a}{3c}$, $g(k)$ is monotonically increasing with k,

$$g\left(\frac{2a}{3c}\right) = \frac{2a(2a-3c)(9a^2+4c^2-16ac)}{c^2} = \frac{2a(2a-3c)[(4-\sqrt{7})a-2c][(4+\sqrt{7})a-2c]}{c^2} > 0$$

then $g\left(\frac{4(9a-4c)}{27c}\right) > g\left(\frac{2a}{3c}\right) > 0$. If $k > \frac{4(9a-4c)}{27c}$, then $g(k) > 0$. Also, if $k > \frac{4(9a-4c)}{27c}$, then $k-1 > 0$, $27k-32 > 0$. Hence, $SW^A - SW^B < 0$, $SW^A < SW^B$. The proof is completed.

Proposition 2 and Proposition 3 show that, while the foreign firm with the leading-edge technology produces homogeneous goods and enters the domestic market, and the domestic firm implements R&D and innovation to reduce the marginal cost, the optimal R&D investment under the product subsidy policy is higher than that under the R&D investment subsidy policy. Moreover, the optimal social welfare under the R&D investment subsidy policy is both less than the social welfare under the product subsidy policy. According to Proposition 1, we reach the conclusion that the product subsidy policy is better than the R&D investment subsidy policy.

3 Numerical Analysis

Suppose that there are two competitive firms that produce homogeneous products in an industry, where Firm 1 is a private domestic firm, and Firm 2 is a foreign firm. The foreign firm is owned by the private sector which aims at maximizing the firm's profits. On the other hand, the domestic firm maximizes its own profit when the private sector owns it. The domestic firm is less efficient than the foreign firm. We assume that $a = 120$, $c = 50$ and analyze the equilibrium output, the R&D investment of the domestic firm, and the social welfare of the domestic firm under two cases, R&D investment subsidies and product subsidies for the domestic firm provided by the government (see Figs. 1 to 3).

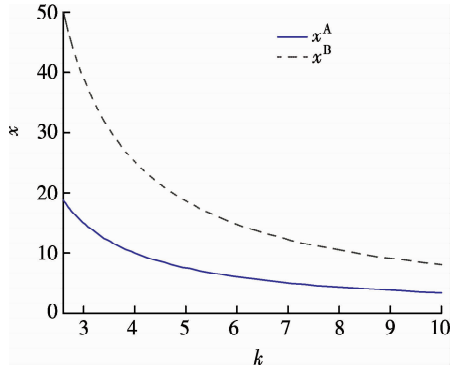

Fig. 1 R&D investment under two cases

Fig. 1 shows that the optimal R&D investment under the R&D investment subsidy policy is less than that under the product subsidy policy. Fig. 2 shows that the equilibrium output under the R&D investment subsidy policy is less than that under the product subsidy policy. According to Fig. 3, we find that the optimal social welfare under the product subsidy policy is higher than social welfare under the R&D investment subsidy policy.

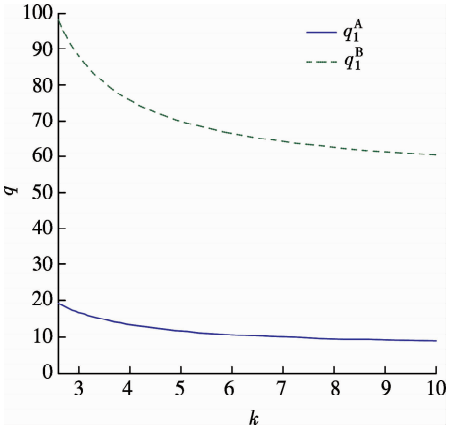

Fig. 2 Output under the two cases

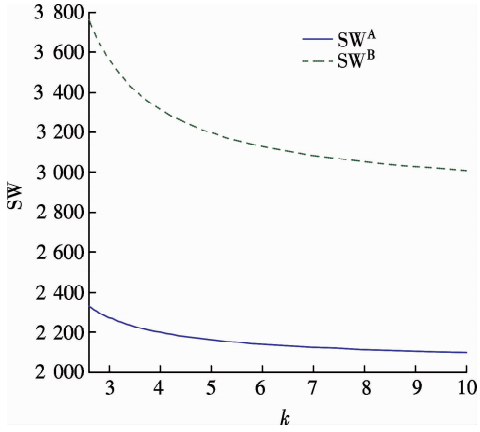

Fig. 3 Optimal social welfare under the two cases

4 Conclusion

Domestic firms should learn from foreign firms to innovate in the fierce market competition after foreign firms enter the domestic market, because foreign firms generally have advanced technology. Innovation is conducive to the development of domestic firms, which can improve the productivity of domestic firms indirectly and promote the development of society and economy. Hence, it is quite crucial to research the innovation and R&D in competition with foreign firms. In this paper, we investigate the problem that the domestic firm implements R&D and innovation, aim to reduce the marginal costs of domestic firm products and decrease the technology gap between domestic firms and foreign firms. The study shows that the equilibrium output, the optimal R&D investment and the optimal social welfare under the R&D investment subsidy policy are smaller than those under the product subsidy policy. Therefore, the product subsidy policy is better than the R&D investment subsidy policy.

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考虑国外企业竞争的国内企业研发补贴策略

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摘要:考虑到国外企业的技术领先优势,在政府给予国内企业研发投入补贴和产品补贴 2 种情形下,分别建立了混合双寡头三阶段博弈模型,分析了国外企业竞争下的国内企业研发补贴策略. 得出了在研发投入补贴与产品补贴情形时国内企业的均衡产出、研发投入、最优社会福利以及政府的补贴总额. 结果表明,研发投入补贴策略下的均衡产出和最优社会福利比产品补贴策略下的均衡产出和最优社会福利低;研发投入补贴策略下的最优研发投入低于产品补贴下的最优研发投入;研发产品补贴策略对企业研发投入具有更明显的激励效应. 在国外企业技术领先优势下,政府为激励国内企业研发创新提供产品补贴策略要优于研发投入补贴策略.

关键词:研发投入;投入补贴;产品补贴;技术差距;国外企业竞争
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