Tax policy – is it a better alternative to patent policy?

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government, firms could be remunerated for innovation usi
patents. We show that under reasonable conditions (such th
customise the tax rate for each firm), patent protection is preferal
if the marginal costs of the imitators are sufficiently hig
Production inefficiency created by imitation is the reason fo
of the imitators are similar to that of the innovator, the autho
patent breadth to replicate the outcome of the tax/subsidy s
Cournot and Bertrand competition.

Key words: Patent; Tax; Welfare

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marginal costs of the imitators compared to the innovator. Patent system is preferable than a tax/subsidyscheme with no patent protection if the marginal costs of the imitators are

2.2. Tax/subsidy scheme to induce innovation

Now consider a situation with no patent protection, but the government imposes tax on profits and lumpsum tax on the consumers and uses the tax revenue to cover any loss of the innovator due to imitation. This can happen provided the sum of total gross industry profit and consumer surplus is higher than the cost of R&D, i.e., if welfare is positive.

If n firms (i.e., the innovator and $(n-1)$ imitators) produce like Cournot oligopolists, straightforward calculation gives the equilibrium output of the innovator and that of an imitator as $q_1^{NP,t} = \frac{1+(n-1)c}{n+1}$ and $q_i^{NP,t} = \frac{1-2c}{n+1}$, i = 2, …, n, respectively. We assume that –

Now compare welfare under “patent protection” and “no patent protection with tax/subsidy”.

We find that $W^{NP,t} \gtrless W^{P}$ if $\frac{(1+(n-1)c)^2}{(n+1)^2}+\frac{(n-1)(1-2c)^2}{(n+1)^2}+\frac{(n-c(n-1))^2}{2(n+1)^2}-\frac{3}{8} \gtrless 0$ or

$c \gtrless \frac{3+n}{10+6n} \equiv c^*$, where $c^* \in (0,\frac{1}{2})$.

Both the patent system and the tax/subsidy scheme induce innovation for $R \in (\frac{(1+(n-1)c)^2}{(n+1)^2},\frac{1}{4})$, and the patent system generates higher welfare and therefore, is preferable compared to the tax/subsidy scheme for $c \in (c^*,\frac{1}{2})$.

The reason for the above result is as follows. The tax/subsidy scheme increases competition but also creates production inefficiency in the industry if the marginal costs of the imitators are higher than that of the innovator. On one hand, hil'0

The tax/subsidy scheme creates higher welfare and therefore, is preferable compared to patent protection for $c \in (0, c^*)$. As discussed in the introduction, this result holds if the patent breadth is large enough to eliminate imitation. However, the authority can choose an appropriate patent breadth to replicate the outcome of the tax/subsidy scheme. Hence, for $c \in (0, c^*)$, the tax/subsidy scheme and the patent system with an appropriate patent breadth will create the same welfare.

The above discussion is summarised in the following proposition.

Proposition 1: Consider $R \in (\frac{(1+(n-1)c)^2}{(n+1)^2}, \frac{1}{4})$. The patent system preventing imitation is preferable than the tax/subsidy scheme for $(c^*, \frac{1}{2})$. If $c \in (0, c^*)$, the tax/subsidy scheme and the patent system with an appropriate patent breadth will generate the same welfare.

3. The case of Bertrand competition

The purpose of this section is to show that the result shown in the previous section under Cournot competition also holds under Bertrand competit

We assume in this section that the inverse demand function faced by the ith firm, i = 1, 2, …, n, is given by $P_i = 1 - kx_i - \gamma \sum_{j=1}^{n} x_j$, $i \neq j$, where $k = \left[1 + (n-1)(1-\gamma)\right]$. The corresponding demand function is given by

utility function $U = \sum_{i=1}^{n} x_i - \frac{1}{2}[k\sum_{i=1}^{n} x_i^2 - 2\gamma \sum_{i \neq j} x_i x_j]$. Under this utility function and the demand structure, the market size is not affected by the number of products.

respectively. The corresponding outputs are

$$q_1^{NP,t} = \frac{[(k+\gamma(n-2))(2k^2+\gamma^2(3+c(n-2)(n-1)-2n)+k\gamma(-5+c(n-1)+2n))]}{(k-\gamma)[2k+\gamma(n-3)][k+\gamma(n-1)][2k+\gamma(2n-3)]} \quad \text{and}$$

$$q_i^{NP,t} = \frac{[(k+\gamma(n-2))(2(1-c)k^2+\gamma^2(3+c(n-1)-2n)+k\gamma(-5-2c(n-2)+2n))]}{(k-\gamma)[2k+\gamma(n-3)][k+\gamma(n-1)][2k+\gamma(2n-3)]}, \; i = 2, \ldots, n.$$

We assume that $t < \frac{(k-\gamma)[2k+\gamma(2n-3)]}{2k^2+2k\gamma(n-2)-\gamma^2(n-1)}$.

The gross equilibrium profit of the innovator and the imitator are respectively

$$\pi_1^{NP,t} = \frac{(k+\gamma(n-2))[2k^2+\gamma^2(3+c(n-2)(n-1)-2n)+k\gamma(-5+c(n-1)+2n)]^2}{(k-\gamma)[2k+\gamma(n-3)]^2[k+\gamma(n-1)][2k+\gamma(2n-3)]^2} \quad \text{and}$$

$$\pi_i^{NP,t} = \frac{(k+\gamma(n-2))[2(1-c)k^2+\gamma^2(3+c(n-1)-2n)+k\gamma(-5-2c(n-2)+2n)]^2}{(k-\gamma)[2k+\gamma(n-3)]^2[k+\gamma(n-1)][2k+\gamma(2n-3)]^2}, \; i = 2, \ldots, n.^4$$

The government can raise a tax revenue equal to the cost of R&D and can use this tax revenue to subsidise the innovator for the cost of R&D provided the sum of total gross industry profit and consumer surplus is higher than the cost of R&D, i.e.,

(k (n 2))[2c(k)(3k (n 4))(n 1)(2k (2n 3))
(k)(3k (n 4))n(2k (2n 3))
c^2(n 1)(12k^4 28k^3 (n 2) k^2 ^{2} (89 (89 20 n))
^{4}(1)(6 (6)) 2 ^{3}(2)(13 (2 13)))]
2( )[2 (3)]^2[(1)][2 (

Welfare under the tax/subsidy scheme is

$$W^{NP,t} \quad \begin{array}{l} (k-\gamma(n-2))[2c(k-\gamma)(3k-\gamma(n-4))(n-1)(2k-\gamma(2n-3))^3 \\ (k-\gamma)(3k-\gamma(n-4))n(2k-\gamma(2n-3))^2 \\ c^2(n-1)(-12k^4-28k^3\gamma(n-2)-k^2\gamma^2(-89-(89-20)n)) \\ \gamma^4(n-1)(6-(n-6)n)-2k\gamma^3(n-2)(13-n(2n-13)))] \\ 2(\gamma-k)[2k-\gamma(n-3)]^2[k-\gamma(n-1)] \end{array}$$

Figure 1: $(W^{NP,t} - W^{P})$ for n = 2 and $\gamma = .5$

The above analysis shows that the results under Bertrand competition are similar to that of Cournot competition. The reasons for the results under Bertrand competition are similar to that of under Cournot competition.

The following proposition summarises the result under Bertrand competition.

Proposition 2: Consider $R \in (\Omega, \frac{1}{4})$. The patent system preventing imitation is preferable than the tax/subsidy scheme for sufficiently higher values of c. If c is not sufficiently high, the tax/subsidy scheme and the patent system with an appropriate patent ' ys@ðeult P pauB%Pt‡•s0¡ug

restricts output to increase profit. It is generally believed that patent protection is induced if the patent authorities and the innovators have similar information (Scotchmer, 1999).

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