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Entry-License Tax, Efficiency Gap and Social Efficiency in Free Entry Oligopoly

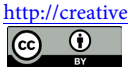
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Abstract

This paper applied an oligopoly market with asymmetric convex costs to analyze the influence of entry-license tax on the entry of inefficient firms under Cournot competition. We find that when the efficiency gap and market size are relatively large, and the number of efficient firms is relatively small, the excessive entry is less severe. The entry-license tax is needed to deter the low-efficiency firms from entering the market in an oligopoly market with asymmetric convex costs. We support the excessive entry argument with policy implication of anti-competitive entry regulation coupled with entry-license tax committed by the government authority.

Keywords

Cost Asymmetries, Efficiency Gap, Free Entry, Entry-License Tax, Social Efficiency

1. Introduction

Whether the free entry and exit of the market is in line with economic efficiency is an important question. Mankiw and Whinston (1986) showed that firms in the market are over-entered in a homogeneous oligopolistic market, due to the business stealing effect of entry. The welfare effects of entry also lead to a large interest in the literatures (see, Suzumura and Kiyono, 1987; Fudenberg and Tirole, 2000; Chen et al., 2019; González-Maestre and Granero, 2020, to name a few). Suzumura (2012) provided an excellent review of the *excess entry theorem* after 25 years since it was argued by Mankiw and Whinston (1986) and Suzumura and Kiyono (1987). Tsai et al. (2019) showed that the anti-competitive entry regulation policy suggested by the "excess-entry" theorem does not always hold with environmental policy.

Recently, Cato and Matsumura (2013) showed how the influence of horizontal mergers affect the optimal entry barrier (tax) in a Cournot model with constant marginal costs, they demonstrated that the government should raise the entry tax when a merger reduces the total number of firms entering. In newly-industrialized countries, the HHI for many service industries is low, for example, the large number of banking firms in Taiwan is being heavily criticized for lacking of competitiveness and excessive competition in domestic market because there are so many entrants since the liberalization of banking industry back to last century. The government in Taiwan is now mandating merger between selected banking firms aiming to reduce the excess entry problem, while the entry-license tax had not been executed couple with market liberalization. From the view point of policy activism, the entry-license tax should be seriously considered when the market is opening for the small-size and low efficiency firms. This real-world scenario motivates us to write this paper.

In the present paper, we develop an oligopoly market with asymmetric convex costs and aim to find the influence of entry-license tax on the entry of inefficient firms under Cournot competition. We demonstrate that the entry-license tax may be used to deter the low-efficiency firms from entering the market. The efficiency gap, market size and the number of efficient firms play an important role on the social efficiency.

The paper is organized as follow. The basic model is provided in Section 2. Base on the basic model, Section 3 provides the equilibrium analysis. A final section concludes.

2. The Model

The market inverse demand function is $p = a - Q$, where a, and p denote the market scale and market price, respectively. $Q = \sum_{i=1}^{m} q_i + \sum_{j=1}^{n} q_j$ is the total production of the market, where q_i and q_j are respectively, the output of the incumbents (efficient firms) and entrants (inefficient firms). In Cato and Matsumura (2013), the constant marginal costs are assumed for both types of firm and the incumbent firm incurring cost improving by Δ after the merger. Firms *i* is the incumbent in the market but firms *j* can enter the market by incurring an entry cost *F*. We assume that the cost function of incumbents and entrants are c_I and c_E, respectively; $c_I = \frac{q_i^2}{2}$ and $c_E = \frac{gq_j^2}{2}$, in which $g \geq 1$ means that there is an efficiency gap between the incumbents and entrants. The government levies the license fee T for the purpose of social welfare maximization.

The profit function of incumbents and entrants are respectively

$$\pi_i = \left(a - \sum_{i=1}^{m} q_i - \sum_{j=1}^{n} q_j\right) q_i - \frac{q_i^2}{2} - F - T \tag{1}$$

$$\pi_j = \left(a - \sum_{i=1}^{m} q_i - \sum_{j=1}^{n} q_j\right) q_j - \frac{gq_j^2}{2} - F - T \tag{2}$$

The social welfare function can be defined as

$$W = \frac{Q^2}{2} + \sum_{i=1}^{m} \pi_i + \sum_{j=1}^{n} \pi_j + (m+n) * T \tag{3}$$

We use a three-stage game to explore whether the entry-license fee is needed to rise for maximizing social welfare in asymmetric oligopoly at free entry. At Stage 1, the government determines the entry-license fee to maximize the social welfare; at Stage 2, the firms choose entry or not; at Stage 3, the firms are engaging in Cournot competition. The equilibrium of this game is solved by subgame perfection deduced through backward induction.

3. Equilibrium Analysis

Each firm in the market stage maximizes its own profit by choosing its output.

$$a - (m-1)q_i - 3q_i - q_j - (n-1)q_j = 0 \tag{4}$$

$$a - (m-1)q_i - q_i - 2q_j - gq_j - (n-1)q_j = 0 \tag{5}$$

From Equations (4) and (5), we have

$$q_i = \frac{a(1+g)}{2+m+g(2+m)+2n} \tag{6}$$

$$q_j = \frac{2a}{2+m+g(2+m)+2n} \tag{7}$$

The zero profit condition of each entrant is employed in the entry stage,

$$\frac{2a^2(2+g)}{(2+m+g(2+m)+2n)^2} - F - T = 0 \tag{8}$$

Substituting Equation (8) into Equations (6) and (7), the equilibrium outcomes are summarized as

$$q_i = \frac{a(1+g)}{2+m+g(2+m)+2n} \tag{9}$$

$$q_j = \frac{2a}{2+m+g(2+m)+2n} \tag{10}$$

$$n^E = \frac{a\sqrt{(2+g)(F+T)}}{\sqrt{2}(F+T)} - \frac{1}{2}(1+g)(2+m) \tag{11}$$

3.1. Optimal Number of Firms for Social Welfare Maximization

The optimal number of firms satisfies

$$\frac{\mathrm{d}W}{\mathrm{d}n} = \frac{-F(2+m+g(2+m)+2n)^3 + 2a^2(4+m+g(6+2g+m+2n))}{(2+m+g(2+m)+2n)^3} = 0. \tag{12}$$

Evaluating $\left.\frac{\mathrm{d}W}{\mathrm{d}n}\right|_{n^*=n^E, T=0}$, we have

$$\left.\frac{\mathrm{d}W}{\mathrm{d}n}\right|_{n^*=n^E,T=0}=\frac{a^2F^2\left(F\left(4(1+g)+\left(1-g^2\right)m\right)-2\sqrt{2}a\sqrt{F(2+g)}\right)}{\sqrt{2}\left(a^2F(2+g)\right)^{3/2}}<0,$$

if $a>\hat{a}\equiv\dfrac{F\left(4(1+g)+\left(1-g^2\right)m\right)}{2\sqrt{2}\sqrt{F(2+g)}}$.

Because W is strictly concave in n, and a is large enough even with efficiency gap, it follows that $n^*<n^E$, entry is socially excessive because the business stealing effect makes entry of inefficient firms more than socially warranted in the absence of entry-license tax.

Differentiating $\hat{a}$ with respect to *g*, we get

$$\frac{\mathrm{d}\hat{a}}{\mathrm{d}g}=\frac{F^2\left(12-m+g\left(4-(8+3g)m\right)\right)}{4\sqrt{2}\left(F(2+g)\right)^{3/2}}>0,\text{ if }\ m<\hat{m}\equiv\frac{4(3+g)}{1+g(8+3g)}$$

We can find that when the efficiency gap increases, the critical value of market size increases, indicating that the excessive entry is less severe, when the number of firms with efficiency is relatively low.

Differentiating $\hat{m}$ with respect to *g*, we get

$$\frac{\mathrm{d}\hat{m}}{\mathrm{d}g}=-\frac{4\left(23+3g(6+g)\right)}{\left(1+g(8+3g)\right)^2}<0$$

We can find that when the efficiency gap increases, the threshold for the number of efficient firms decreases, indicating that the under-entry situation becomes less severe.

Proposition 1. *When the efficient gap and market size are relatively large, and the number of efficient firms is relatively small, the excessive entry is less severe.*

3.2. Entry-License Tax at Free Entry Equilibrium

Now we evaluate T under $n=n^E$, the optimal license fee satisfies

$$\frac{\mathrm{d}W}{\mathrm{d}T}=\frac{(2F-gT)\sqrt{2}a\sqrt{(2+g)(F+T)}-\left[4g-g^2m+(4+m)\right](F+T)^2}{4(2+g)(F+T)^2}=0 \quad (13)$$

Note that

$$\left.\frac{\mathrm{d}W}{\mathrm{d}T}\right|_{T^*>0}=\frac{2\sqrt{2}\sqrt{a^2F(2+g)}-F(1+g)\left(4+(1-g)m\right)}{4F(2+g)}>0 \quad (14)$$

Proposition 2. *The entry-license tax is needed to deter the low-efficiency firms from entering the market in an oligopoly market with asymmetric convex costs.*

Simple but similar result is also obtained by Cato and Matsumura (2013), in the case of before merger with free entry of entrant, but no efficiency gap. From the strict concavity of *W*, Equation (14) infers that $T^*>0$. Due to that entry is socially excessive, the entry-license tax is needed to deter the low-efficiency firms entering the market. In Cato and Matsumura (2013), due to entry is socially ex-

cessive, the government needs to levy entry-license tax and raise entry barriers, resulting in a decrease in the number of entrants. The government should not attract new entrants by lowering the entry barriers, and need to raise the entry barrier for welfare-improving because after merger, because the reduction in the number of entering firms implies that the competition accelerating effect dominates the competition-reducing effect. We do not allow the merger of efficient firms with cost synergy in our current modelling and show the need of entry-license tax for welfare-improving is purely because excessive competition in product market after the free entry of production-inefficient firms and the larger output-substitution effect shifts from efficient to inefficient firms.

4. Conclusion

Mankiw and Whinston (1986) showed that due to the business stealing effect of entry, firms in the market are over-entered in a homogeneous oligopolistic market. In the present paper we developed an asymmetric oligopoly market with asymmetric convex costs and demonstrated that without having merger of efficient firms and cost saving, the entry of inefficient firms will definitely be socially excessive which calls for an entry tax to prevent the excessive entry of inefficient firms. We find that when the efficient gap and market size are relatively large, and the number of efficient firms is relatively small, the excessive entry is less severe. The entry-license tax is needed to deter the low-efficiency firms from entering the market in an oligopoly market with asymmetric convex costs. We support the excessive entry argument with policy implication of anti-competitive entry regulation coupled with entry-license tax committed by the government authority for correcting market distortion.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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