DE GRUYTER BE J. Econ. Anal. Policy 2022; 22(3): 601–610

Letter

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Social Efficiency of Market Entry Under Tax Policy

https://doi.org/10.1515/bejeap-2022-0012
Received January 7, 2022; accepted April 12, 2022

Abstract: We provide a new rationale for socially insufficient market entry. We show that if the shadow cost of public funds is sufficiently high, the number of firms under free entry can be socially insufficient if the tax policies are "time inconsistent", so that the governments cannot commit to the tax policies before market entry of firms. Hence, strategic tax policies may provide a reason why policymakers should engage in pro-competitive policies. Lump-sum subsidies to firms may be a way to achieve that goal.

Keywords: excessive market entry, insufficient market entry, tax policy

JEL Classifications: L13, L40

1 Introduction

The seminal paper by Mankiw and Whinston (1986), which shows that the number of firms under free entry is socially excessive in oligopolistic industries with scale economies, created huge interest to uncover the welfare effects of entry in imperfectly competitive markets.[1] This "excess-entry theorem" provides a rationale for anticompetitive entry regulation. While the literature examining social efficiency of market entry provided several important insights, they generally ignored the implications of some standard policies, such as tax policies.

1 Ghosh and Saha (2007) show excess entry in the absence of scale economies.

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It is well known that governments use tax policies to improve its welfare by reducing the distortion created by imperfectly competitive product market (see, Myles 1996; Hamilton 1999). It is also well documented in the literature that there can be a shadow cost of public funds (Chen et al. 2020; Collie 2000; Laffont and Pouyet 2004; Laffont and Tirole 1986, 1993; Lee and Wang 2018; Matsumura and Tomaru 2013, 2015; Meade 1944; Neary 1991, 1994; Olsen and Osmundsen 2001, to name a few), suggesting that social cost of taxation can vary significantly from its private cost and a pound may be significantly more valuable to the government compared to the firms and the consumers.

Given this background, we examine social efficiency of market entry in the presence of strategic tax policies. We show that if the shadow cost of public funds is sufficiently high, the number of firms under free entry can be socially insufficient if the tax policies are “time inconsistent”, so that the governments cannot commit to the tax policies before market entry of firms. Therefore, strategic tax policies may provide a reason why policymakers should engage in pro-competitive policies. Lump-sum subsidies to firms may be a way to achieve that goal.

The reason for our result is as follows. On one hand, a higher shadow cost reduces the incentives for market entry by increasing the tax rate. On the other hand, it increases the government’s incentive for having more firms by increasing the marginal welfare gain from higher competition. If the shadow cost is sufficiently high, the free entry equilibrium number of firms is lower than the welfare maximising number of firms, thus resulting in socially insufficient market entry. Otherwise, market entry is socially excessive.

The extant literature is showing that socially insufficient market entry may occur under strategic input price determination (De Pinto and Goerke 2020; Ghosh and Morita 2007a, 2007b), external economies of scale (Mukherjee 2010), return to scale technology (Basak and Mukherjee 2016; Cao and Wang 2020), market leadership (Mukherjee 2012a), strategic R&D investment (Mukherjee 2012b), foreign competition (Han, Haque, and Mukherjee 2021; Marjit and Mukherjee 2013), employee-controlled firms (Hamada, Ohkawa, and Okamura 2018), complementary industries and cost-reducing R&D investment in the presence of spillover (Chen, Li, and Qian 2020), network externalities (Basak and Petrakis 2021), and spatial product differentiation and product design (González-Maestre and Granero 2020; Gu and Wenzel 2009; Matsumura and Okamura 2006a, 2006b). We provide a different reason in this paper.

The remainder of the paper is organised as follows. Section 2 describes the model and derives the results. Section 3 concludes.

2 The Model and the Results

Assume that there is a large number of symmetric firms who want to enter a market. The firms produce homogeneous products at the constant marginal cost c. If a firm enters the market, it incurs an entry cost K and pays a per-unit tax t when selling its products.

Assume that the inverse market demand function is $P = P(Q)$, where P is price and Q is the total output, with $\frac{\partial P}{\partial Q} \equiv P_Q < 0$ and $P_{QQ} \leq 0$. We assume that $P(Q)$ is log-concave, which ensures that unique and symmetric Cournot equilibrium exists, as shown in Amir and Lambson (2000) and Cowan (2004), and considered in Amir, Castro, and Koutsougeras (2014).

We consider the following game. At stage 1, the firms decide whether to enter the market. At stage 2, the government determines the welfare maximising tax rate. At stage 3, the firms which entered the market compete in quantities à la Cournot. We solve the game through backward induction.

We are considering a situation where the government cannot commit to the tax rate before the entry decisions of the firms. This assumption may be motivated by the fact that government policies are often "time inconsistent", since governments with some degree of discretion in policy may have the incentive to deviate from their preannounced policies (Neary and Leahy 2000; Staiger and Tabellini 1987).

The timing of our entry-game is in line with Lee, Matsumura, and Sato (2018) where they examine how free entry of private firms affects the privatisation policy where the government cannot commit to the degree of privatisation before market entry of firms. We differ from Lee, Matsumura, and Sato (2018) by assuming that the firms are all private and the government adopts a tax policy.

If n firms entered the market, the ith firm maximises the following expression to determine its output in stage 3:

$$\underset{q^i}{\text{Max}}\, \pi^i = (P - c - t)\, q^i, \tag{1}$$

where the superscript i shows the firm-index i throughout the paper. We will use the subscripts to show the partial derivatives with respect to relevant variables.

The profit maximisation condition is given by

$$\frac{\partial \pi^i}{\partial q^i} = P - c - t + P_Q q^i = 0. \tag{2}$$

The second order condition for maximisation holds.

Since the firms are symmetric, solving n equations like (2) gives us the symmetric equilibrium outputs and profits of each firm, which entered the market, as q^* and $\pi^* = (P^* - c - t)\, q^* - K$, where $P^* = P(Q^*)$, $Q^* = n\, q^*$.

Differentiating (2) with respect to t and using the condition $Q^* = n\,q^*$, we get $Q_t^* = \frac{n}{n\,P_Q^* + P_Q^* + P_{QQ}^*\,Q^*} < 0$ and $q_t^* = \frac{Q_t^*}{n} < 0$.

At stage 2, the government maximises the following expression to determine the tax rate:

$$\begin{aligned} W &= \int_0^{nq^*} P(Q)\,\mathrm{d}Q - ncq^* - ntq^* + n\gamma tq^* - nK \\ &= \int_0^{nq^*} P(Q)\,\mathrm{d}Q - ncq^* + nt(\gamma - 1)\,q^* - nK, \end{aligned} \tag{3}$$

where γ (≥ 1) captures the shadow cost of public funds. The parameter γ reflects the distributional considerations, where a pound is significantly more valuable to the government compared to the firms and the consumers. It may happen since the government can use the tax revenue to support other sectors of the economy, thus reducing the burden of taxation in other sectors.

The equilibrium tax rate is determined by $\frac{\partial W}{\partial t} = 0$ which yields

$$t^* = -\frac{P - c}{\gamma - 1} - \frac{q^*}{q_t^*}. \tag{4}$$

The second order condition for welfare maximisation is assumed to hold. We get $t^* > (<)\,0$ for $-\frac{P-c}{\gamma-1} - \frac{q^*}{q_t^*} > (<) 0$.

Differentiating (4) with respect to γ and with $q_{tt}^* \leq 0$,[2] we get

$$t_\gamma^* = \frac{(P^* - c)\,q_t^{*2}}{2(\gamma - 1)^2 q_t^{*2} + (\gamma - 1)\,P_Q^* Q_t^* q_t^{*2} - (\gamma - 1)^2 q^* q_{tt}^*} > 0. \tag{5}$$

The equilibrium profits of the firms, which entered the market, is $\pi^* = (P^* - c - t^*)\,q^* - K$. Hence, the free entry equilibrium number of firms entering the market, which is denoted by n^*, is given by

$$\pi^* = (P^* - c - t^*)\,q^* - K = 0 \tag{6}$$

Now consider how welfare changes with respect to n. Following the literature, the social planner determines the welfare maximizing number of firms, while internalising its effect on the tax rate and firms' behaviour in the product market that follows Cournot competition. Even if the social planner may

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2 We get $q_{tt}^* = \frac{Q_{tt}^*}{n} \leq 0$ since $Q_{tt}^* = \frac{-n(n+2)P_{QQ}^*\,Q_t^*}{\left(n\,P_Q^* + P_Q^* + P_{QQ}^*\,Q^*\right)^2} \leq 0$, as $P_{QQ}^* \leq 0$, $Q_t^* < 0$ and assuming $P_{QQQ}^* = 0$.

control the number of domestic firms, it cannot control the type of product market competition.

Internalising that the welfare-maximising tax and the equilibrium outputs will be determined after the government's choice of n, we maximise the welfare expression (3) with respect to n, which gives:

$$\frac{\partial W}{\partial n} = P^* \left(q^* + nq_n^*\right) - \left(ncq_n^* + cq^*\right) + t^* (\gamma - 1) q^* + nt^* (\gamma - 1) q_n^* - K$$

$$= [(P^* - c - t^*) q^* - K] + [nP^* - nc + nt^* (\gamma - 1)] q_n^* + t^* \gamma q^*. \tag{7}$$

Evaluating (7) at the free entry equilibrium number of firms given by condition (6), we get

$$\left.\frac{\partial W}{\partial n}\right|_{n=n^*} = [nP^* - nc + nt^* (\gamma - 1)] q_n^* + t^* \gamma q^*. \tag{8}$$

By differentiating (2) with respect to n, we get $q_n^* = -\frac{q^*\left(P_Q^* + q^* P_{QQ}^*\right) - t_n^*}{(n+1)P_Q^* + n\, q^* P_{QQ}^*}$ and by differentiating (4) with respect to n, we get $t_n^* = -\frac{P_Q^* q_t^{*2}\left(q^* + nq_n^*\right)}{(\gamma-1)\left(q_t^{*2} - q_{tt}^*\right)} - \frac{q_n^* q_t^*}{\left(q_t^{*2} - q_{tt}^*\right)}$. Replacing t_n^* in q_n^*, we get $q_n^* = \frac{-q^*\left[\gamma P_Q^* + (\gamma-1) q^* P_{QQ}^*\right] q_t^{*2} + (\gamma-1) q^* \left(P_Q^* + q^* P_{QQ}^*\right) q_{tt}^*}{q_t^*(\gamma-1) + (\gamma-1)\left(P_Q^* + nq^* P_{QQ}^*\right) q_t^{*2} + q_t^{*2} \gamma n P_Q^* - (\gamma-1) n P_Q^* q_{tt}^*} < 0$.

It follows from (8) that $\left.\frac{\partial W}{\partial n}\right|_{n=n^*} > (<) 0$ for $t^* \gamma q^* > (<) [nP^* - nc + nt^* (\gamma - 1)] \left(-q_n^*\right)$. Hence, market entry is socially insufficient (excessive) for $t^* \gamma q^* > (<) [nP^* - nc + nt^* (\gamma - 1)] \left(-q_n^*\right)$.

The Mankiw and Whinston (1986) condition is a special case of $t^* \gamma q^* > (<) [nP^* - nc + nt^* (\gamma - 1)] \left(-q_n^*\right)$ where $t^* = 0$, implying that market entry is excessive in Mankiw and Whinston (1986) with no tax policy.

We get the following proposition from the above discussion.

Proposition 1. *Market entry is socially insufficient if and only if* $t^* > 0$ *and* $\gamma > \gamma^*$ *where* $\gamma^* = \frac{[nP^* - nc + nt^* (\gamma-1)]\left(-q_n^*\right)}{t^* q^*}$.

In line with Mankiw and Whinston (1986), an increase in the number of firms creates a *business stealing effect* by reducing the outputs of the incumbent firms. This tends to create socially excessive market entry by attracting new firms. However, the tax rate, which is affected by the shadow cost of public funds plays an important role in determining the social efficiency of market entry in our analysis.

If the shadow cost of public funds is sufficiently high, it creates a positive tax rate, and the tax rate increases with more firms, as increased competition encourages the government to raise the tax rate. Hence, on one hand, a higher shadow cost of public funds reduces the incentive for market entry by raising the tax rate, but on the other hand, a higher shadow cost of public funds increases the government's incentive for having more firms by increasing the marginal welfare gain from higher competition. If the shadow cost of public funds is sufficiently high, the welfare maximising number of firms gets higher than the free entry equilibrium of firms, thus creating socially insufficient market entry. Socially excessive market entry occurs if the effect of taxation is weak, which happens if the shadow cost of public funds is not very high.

2.1 An Example of Constant Marginal Cost

To get a clear exposition of the results, we consider an inverse demand function $P = a - Q$. Assume that the firms face a constant marginal cost, $c \in (0, a)$.

If n firms entered the market, the ith firm maximises $\pi^i = \left(a - \sum_{i=1}^{n} q^i - c\right) q^i - tq^i$ to determine its output. The symmetric equilibrium outputs and profits are $q^* = \frac{a-c-t}{1+n}$ and $\pi^* = \left(\frac{a-c-t}{1+n}\right)^2 - K$ respectively.

Consumer surplus, total industry profit, tax revenue and social welfare are respectively $\mathrm{CS} = \frac{n^2}{2}\left(\frac{a-c-t}{1+n}\right)^2$, $n\pi^* = n\left(\frac{a-c-t}{1+n}\right)^2$, $R = nt\gamma\left(\frac{a-c-t}{1+n}\right)$ and $W = \frac{n(a-c-t)[(2+n)(a-c-t)+2(1+n)t\gamma]}{2(1+n)^2}$.

The government maximises social welfare to determine the equilibrium tax rate. We obtain the equilibrium tax rate as $t^* = \frac{(a-c)(n\gamma+\gamma-n-2)}{n(2\gamma-1)+2(\gamma-1)}$.[3] The equilibrium tax rate is positive for $\gamma > \frac{2+n}{1+n}$, which is assumed to hold to warrant a positive tax rate.

Using the equilibrium tax rate, we find the equilibrium profit of the ith firm as $\pi^* = \frac{\gamma^2(a-c)^2}{[n(2\gamma-1)+2(\gamma-1)]^2} - K$. The free entry equilibrium number of firms, n^*, is given by $\pi^* = \frac{\gamma^2(a-c)^2}{[n(2\gamma-1)+2(\gamma-1)]^2} - K = 0$.

Substituting the value of the equilibrium tax rate, we get the social welfare as $W = \frac{n\gamma^2(a-c)^2}{2[n(2\gamma-1)+2(\gamma-1)]} - nK$. Maximising social welfare with respect to n, we get $\frac{\partial W}{\partial n} = \frac{\gamma^2(a-c)^2(\gamma-1)}{[n(2\gamma-1)+2(\gamma-1)]^2} - K$.[4] Evaluating $\frac{\partial W}{\partial n}$ at the free entry equilibrium number of firms, we get $\left.\frac{\partial W}{\partial n}\right|_{n=n^*} = \frac{\gamma^2(a-c)^2(\gamma-1)}{[n(2\gamma-1)+2(\gamma-1)]^2} - \frac{\gamma^2(a-c)^2}{[n(2\gamma-1)+2(\gamma-1)]^2} = \frac{\gamma^2(a-c)^2(\gamma-2)}{[n(2\gamma-1)+2(\gamma-1)]^2}$, suggesting that $\left.\frac{\partial W}{\partial n}\right|_{n=n^*} > (<) 0$, i.e., market entry is socially insufficient (excessive) for $\gamma > (<)\, 2 = \hat{\gamma}$.

3 We get $\frac{\partial^2 W}{\partial t^2} = -n\left[\frac{n(2\gamma-1)+2(\gamma-1)}{(1+n)^2}\right] < 0$.

4 We get $\frac{\partial^2 W}{\partial n^2} = -\frac{2\gamma^2(a-c)^2(\gamma-1)(2\gamma-1)}{[n(2\gamma-1)+2(\gamma-1)]^3} < 0$.

We summarise the above findings in the following proposition.[5]

Proposition 2. *Market entry is socially insufficient (excessive) if* $\gamma > (<)\, \hat{\gamma} = 2$.

2.2 An Example of Rising Marginal Cost

We considered constant marginal cost in the above analysis, and Proposition 2 shows that socially insufficient market entry occurs for $\gamma > 2$. However, this condition may change and socially insufficient market entry may occur for $\gamma < 2$ if, e.g., the marginal costs are increasing rather than constant.[6] To highlight this aspect, now we consider an example with convex costs, $c(q^i)^2$.[7]

If n firms entered the market, the ith firm maximises $\pi^i = \left(a - \sum_{i=1}^{n} q^i - cq^i\right) q^i - tq^i$ to determine its output. The symmetric equilibrium outputs and profits are $q^* = \frac{a-t}{1+n+2c}$ and $\pi^* = (1+c)\left(\frac{a-t}{1+n+2c}\right)^2 - K$ respectively.

Consumer surplus, total industry profit, tax revenue and social welfare are respectively $\mathrm{CS} = \frac{n^2(a-t)^2}{2(1+2c+n)^2}$, $n\pi^* = n(1+c)\left(\frac{a-t}{1+n+2c}\right)^2$, $R = \frac{nt\gamma(a-t)}{1+2c+n}$ and $W = \frac{n(a-t)[(2+2c+n)(a-t)+2(1+2c+n)t\gamma]}{2(1+2c+n)^2}$.

The government maximises social welfare to determine the equilibrium tax rate. We obtain the equilibrium tax rate as $t^* = \frac{a[2-\gamma-(2c+n)(\gamma-1)]}{2+2c+n-2(1+2c+n)\gamma}$.[8] The equilibrium tax rate is positive for $\gamma > \frac{2+n}{1+n}$, which is assumed to hold to warrant a positive tax rate.

Using the equilibrium tax rate, we find the equilibrium profit of the ith firm as $\pi^* = \frac{\gamma^2(a-c)^2}{[n(2\gamma-1)+2(\gamma-1)]^2} - K$. The free entry equilibrium number of firms, n^*, is given by $\pi^* = \frac{\gamma^2(a-c)^2}{[n(2\gamma-1)+2(\gamma-1)]^2} - K = 0$.

Substituting the value of the equilibrium tax rate, we get the social welfare as $W = \frac{n\gamma^2(a-c)^2}{2[n(2\gamma-1)+2(\gamma-1)]} - nK$. Maximising social welfare with respect to n, we get $\frac{\partial W}{\partial n} = \frac{\gamma^2(a-c)^2(\gamma-1)}{[n(2\gamma-1)+2(\gamma-1)]^2} - K$. Evaluating $\frac{\partial W}{\partial n}$ at the free entry equilibrium number of firms,

5 Our result is in line with Sato and Matsumura (2019), which examine the relationship between the optimal degree of privatization and the shadow cost of public funds. Like that paper, where the optimal policy depends on the shadow cost of public funds, social efficiency of market entry in our paper also depends on the shadow cost of public funds.

6 See, e.g., Auriol and Warlters (2012) and the references therein for the estimates of the marginal costs of public funds in different countries.

7 We thank an anonymous referee for highlighting this point.

8 We get $\frac{\partial^2 W}{\partial t^2} = -\frac{n[-2-2c-n+2(1+2c+n)\gamma]}{(1+2c+n)^2} < 0$.

we get $\frac{\partial W}{\partial n}\Big|_{n=n^*} = \frac{a^2\gamma^2(\gamma-1+c(2\gamma-1))}{(2+2c+n-2(1+2c+n)\gamma)^2} - \frac{a^2\gamma^2(1+c)}{(2+2c+n-2(1+2c+n)\gamma)^2} = \frac{\alpha^2\gamma^2(\gamma-2+2c(\gamma-1))}{(2+2c+n-2(1+2c+n)\gamma)^2}$, suggesting that $\frac{\partial W}{\partial n}\Big|_{n=n^*} > (<)0$, i.e., market entry is socially insufficient (excessive) for $\gamma > (<) \frac{2+2c+n}{1+2c+n} = \tilde{\gamma}$, where $\tilde{\gamma} = \frac{2+2c+n}{1+2c+n} < 2 = \hat{\gamma}$.

The following proposition is immediate from the above discussion.

Proposition 3. *Market entry is socially insufficient (excessive) if* $\gamma > (<) \tilde{\gamma} = \frac{2+2c+n}{1+2c+n}$, *where* $\tilde{\gamma} < \hat{\gamma} = 2$.

3 Conclusion

While the excessive-entry theorem gets significant attention in the academia and in the policy circle, it ignored tax policies, which is a common phenomenon in the real world. We show that if the shadow cost of public funds is significantly high, the number of firms under free entry can be socially insufficient rather than excessive if the government cannot commit to the tax policy before market entry of firms, which may happen since the government policies are often "time inconsistent". Hence, strategic tax policies may provide a reason why policymakers should engage in pro-competitive policies. Lump-sum subsidies to firms may be a way to achieve that goal.

Acknowledgment: We would like to thank an anonymous referee and the editor (Till Requate) of this journal for helpful comments and suggestions. The usual disclaimer applies.

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