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Monopolistic Competition and Increasing Returns: Implications for Optimal Fiscal Policies and Over-entry

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Abstract

By separating monopolistic competition from increasing returns to fully disentangle their corresponding effects, this paper find that optimal tax rates on factor incomes are decreasing in the degree of increasing returns, but are independent of the degree of market power. Moreover, free entry may lead to over or too little entry relative to the social optimum, depending on the relative strengths of the effects from increasing returns, market power, and congestion. These conclusions are different from the recent study that uses the same parameter to characterize increasing returns and monopolistic competition.

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1. Introduction

Ever since the contribution of Dixit and Stiglitz (1977), considerable attention has been paid to issues concerned with whether free entry in a market with monopolistic competition leads to the over entry or too little entry of firms. Recently, researchers have further incorporated related issues with government policies to investigate optimal fiscal policies in the presence of distortions associated with imperfect competition. A notable contribution along this line of research is Chang et al. (2007) (hereafter, CHSL), who were the first to add monopolistic competition and increasing returns to specialization to a model where the government levies taxes on labor and capital incomes to provide congestible public inputs. They found that optimal tax rates on capital and labor incomes are decreasing in the degrees of monopolistic competition/market power and, more importantly, free entry always leads to over entry relative to the social optimum whenever the congestion is present. This latter conclusion is true even when the market is perfectly competitive.

While CHSL is quite insightful, they use the same parameter to characterize both market power and increasing returns to specialization. As pointed out by Benassy (1996), this type of setting is unable to distinguish the effects caused by monopolistic competition from those caused by increasing returns. The purpose of this paper is to separate monopolistic competition from increasing returns to fully disentangle their corresponding effects. In so doing, we derive conclusions that are significantly different from CHSL.

To be specific, we find that optimal tax rates on capital and labor incomes are independent of the degree of market power. This result is quite intuitive. To restore the social optimum, tax rates on capital and labor incomes must be able to correct distortions between factor incomes and their marginal products. While a higher degree of market power leads to a larger degree of distortions to the individual firm, it also attracts more firms to enter the market under free entry. An expansion in the number of firms, however, tends to ease distortions between factor incomes and marginal products. As a result, market power leads to two opposite effects on the distortion. As a whole, we find that the two effects cancel each other out so that market power has no effect on optimal tax rates.

With respect to the issue of over entry, we find that, depending on the relative strengths of market power, increasing returns, and congestion, free entry may lead to over or too little entry relative to the social optimum. When the market is perfectly competitive, free entry leads to over (too little) entry of firms, provided that the strengths of congestion are greater (less) than those of increasing returns. It is worth noting that increasing returns and market power possess equal strengths but opposite signs in determining whether free entry leads to over or too little entry. As a result, when increasing returns and market power are characterized by the same parameter, such a parameter will not have any effect on issues related to over entry. Hence, in CHSL, the only force that determines whether free entry leads to over entry is the congestion associated with public inputs.

2. Model

Consider an infinite-horizon production economy consisting of firms, households, and a government. There are two types of goods in the economy: a homogeneous final good and differentiated intermediate inputs. Each differentiated intermediate input is produced by a single firm indexed by $i = 1, ..., n_t$, where n_t is the total number of firms producing intermediate inputs at t. The final good is produced by competitive firms using the following production technology:

$$Y_t = [n_t^{\theta(1-\eta)-\eta} \int_0^{n_t} x_{it}^{1-\eta} di]^{\frac{1}{1-\eta}} \;\; \theta \in [0,1), \eta \in [0,1), \tag{1}$$

where x_{it} is the quantity of intermediate input i. Because intermediate inputs are not perfect substitutes in producing final goods, each intermediate-input producer faces a downward-sloping demand curve. This gives firm i some degree of market power and, as will be seen later, the parameter η measures the degree of market power.

Since intermediate-input firms are symmetric, each firm will produce the same amount of intermediate inputs in equilibrium (i.e., $x_{it} = x_t$). Using this result, the aggregate production function can be derived from eq. (1) as

$$Y_t = n_t^{1+\theta} x_t. \tag{2}$$

The technology in eq. (2), as in Ethier (1982) and Benassy (1996), displays aggregate increasing returns to specialization in the sense that the larger the number of intermediate inputs n_t, the higher the amount of final goods produced for a given amount of x_t. It is obvious that the parameter θ determines the degree of increasing returns to specialization.

From eqs. (1) and (2), the degree of market power is separated from the degree of increasing returns to specialization. In the CHSL model, the production function in eq. (1) is given as $Y_t = [\int_0^{n_t} x_{it}^{\rho} di]^{\frac{1}{\rho}}, \rho \in (0,1)$ and, under the symmetric equilibrium, $Y_t = n_t^{\frac{1}{\rho}} x_t$. Obviously, both market power and increasing returns to specialization are characterized by the same parameter ρ.

The producer of intermediate input i at t employs capital k_{it} and labor l_{it} to produce intermediate input x_{it} and sells it to final-good producers. Following CHSL, the technology for producing intermediate input i at t is given as

$$x_{it} = k_{it}^{\alpha} l_{it}^{\beta} G_{st}^{\gamma} - \phi, \;\; 0 < \alpha, \beta, \gamma < 1, \;\; \alpha + \beta + \gamma = 1, \tag{3}$$

where G_{st} is the amount of public inputs received by each firm and ϕ is the overhead/fixed cost associated with the production. Following Thompson (1974), Glomm and Ravikumar (1994), and Turnovsky (1996), public inputs are congestible and the amount of public inputs received by each firm is given as

$$G_{st} = \frac{G_t}{\Gamma(n_t, K_t)^{\sigma}}, \;\; \sigma > 0 \tag{4}$$

where G_t is the total amount of public inputs provided by the government and K_t is the aggregate private capital in the economy. The parameter σ is related to the degree of congestion. It is assumed that $G_t = gY_t$, with g being the ratio of government expenditure on public inputs. The function Γ is homogeneous of degree one in the number of firms n_t and the total amount of capital K_t, with $\Gamma_{n_t} > 0$ and $\Gamma_{K_t} > 0$. Because $k_{it} = k_t = K_t/n_t$ in a symmetric equilibrium, $\Gamma(n_t, K_t) = n_t\varphi(k_t)$. Defining ε as the elasticity of congestion with respect to per-firm capital k_t, we see that $\varepsilon = d\ln\Gamma(n_t, K_t)/d\ln k_t = k_t\varphi'/\varphi$, where $\varepsilon \in [0,1]$.

Households as a whole are endowed with one unit of labor at any point of time. They accumulate capital and provide labor to maximize the following lifetime utility function:[1]

$$\int_0^{\infty}[\ln C_t + \Lambda\ln(1-L_t)]e^{-\xi t}dt,\ \Lambda > 0, \xi > 0, \quad (5)$$

where C_t is total consumption (final goods) and L_t is total labor supplied to firms. By denoting w_t and r_t as the capital rental rate and the wage rate under the aggregate equilibrium at t, the households' budget constraint is given as[2]

$$\dot{K}_t = (1-\tau_l)w_tL_t + (1-\tau_k)(r_tK_t + \Pi_t) - C_t + T_t, \quad (6)$$

where Π_t is the total profits of firms, τ_k (τ_l) is the tax rate on capital income and profits (labor income), and T_t is a lump-sum transfer from the government. Note that $\Pi_t = \int_0^n \pi_{it}di$, where π_{it} is firm i's profit. In the symmetric equilibrium, households will equally supply their labor and capital to all firms; hence, $L_t = n_tl_t$ and $K_t = n_tk_t$.

The government finances public inputs G_t and lump-sum transfers T_t by taxing income from capital and labor as well as firms' profits. Hence, the government's budget constraint is given as

$$G_t + T_t = \tau_lw_tL_t + \tau_k(r_tK_t + \Pi_t). \quad (7)$$

3. Competitive Equilibrium

We now present the equilibrium consequences in which private agents make their own decisions by taking the market-determined wage and capital rental rates as well as tax rates as given. To solve the producers' maximization problems, we treat the final good as the numéraire and denote p_i as the price of intermediate input i (in terms of the final good).[3] Then, the representative final-good producer faces the following maximization problem:

$$\text{Max}_{x_i}[n^{\theta(1-\eta)-\eta}\int_0^n x_i^{1-\eta}di]^{\frac{1}{1-\eta}} - \int_0^n p_ix_idi \quad (8)$$

Taking the number of intermediate inputs n as well as p_i as given, the first-order condition for selecting x_i is derived as

$$p_i = (\frac{Y}{x_i})^{\eta}n^{\theta(1-\eta)-\theta} \quad (9)$$

Eq. (9) is the demand function for x_i. By taking logs on both sides of eq. (9), one can find

[1] To facilitate comparison with the centralized economy, we present the households' decision as a whole.
[2] For simplicity, there is no capital depreciation.
[3] To keep the notation simple, we eliminate time subscripts from now on.

that

$$-\frac{d\log x_i}{d\log p_i} = \frac{1}{\eta}.$$

Thus, the parameter η is the inverse of the elasticity of demand for x_i. When $\eta = 0$, the price elasticity is infinite, implying that intermediate inputs are perfect substitutes in producing final goods. In this case, the market for intermediate inputs is perfectly competitive. For $0 < \eta < 1$, the demand function for x_i is negatively sloped and in this case the intermediate-input firm can be exploited by manipulating prices. Moreover, a higher η corresponds to a higher degree of market power for the producer of intermediate input i.

Denote r_i and w_i as the capital rental and wage rates faced by firm i. Then, the intermediate-input firm i's profit can be written as

$$\pi_i = p_i x_i - r_i k_i - w_i l_i. \tag{10}$$

Taking r_i and w_i as given, the firm chooses k_i and l_i to maximize its profit, subject to eqs. (3), (4) and (9). The first-order conditions for selecting k_i and l_i are derived as

$$r_i = (1-\eta)\alpha(\frac{x_i + \phi}{k_i})p_i \tag{11}$$

$$w_i = (1-\eta)\beta(\frac{x_i + \phi}{l_i})p_i \tag{12}$$

Note that $\alpha(\frac{x_i+\phi}{k_i})p_i$ and $\beta(\frac{x_i+\phi}{l_i})p_i$ are the marginal products of capital and labor faced by firm i, respectively. Thus, the capital rental and wage rates are less than their corresponding marginal products in the case of imperfect competition (i.e., $1 > \eta > 0$). In response to this fact, households will accumulate less capital and provide less labor, leading to inefficiency in production compared with the case of perfect competition. This is consistent with Judd (1997) in the case where the number of firms is constant. In this model, the number of firms in equilibrium is endogenously determined by the free-entry condition. For this reason, the degree of market power leads to another effect on marginal products, as we will state below.

Under the symmetric equilibrium, $p_i = p$. Combining $p_i = p$, $k_i = k = K/n$, and $l_i = l$ with eqs. (2) and (9), we have

$$p = n^{\theta}. \tag{13}$$

In this model, new firms will enter the market and produce a new intermediate input in each period, until incumbent firms have zero profits. Substituting eqs. (11)-(13) into eq. (10) and setting $\pi_i = \pi = 0$, we derive

$$x_i = x = \frac{(1-\eta)(\alpha+\beta)\phi}{1-(1-\eta)(\alpha+\beta)}. \tag{14}$$

It is easy to verify that $\partial x / \partial \eta < 0$. By substituting eq. (14) into eq. (2), the equilibrium number of firms is determined as

$$n = [\frac{1-(1-\eta)(\alpha+\beta)}{(1-\eta)(\alpha+\beta)\phi} Y]^{\frac{1}{1+\theta}}. \tag{15}$$

Thus, a higher degree of market power will lead to a larger number of firms. Intuitively, a higher degree of market power raises the incumbent firm's profit and hence induces more new firms to enter the market. As shown in eq. (13), an expansion in the number of firms increases the price of the intermediate inputs and hence increases the marginal products of capital and labor (i.e., $\alpha(\frac{x_i+\phi}{k_i})p_i$ and $\beta(\frac{x_i+\phi}{l_i})p_i$). As a result, while market power η directly creates distortions between the capital rental and wage rates and the corresponding marginal products faced by each individual firm, free entry that leads to an expansion in the number of firms in the aggregate equilibrium raises the marginal product and thus eases these distortions. As a whole, these two opposite effects cancel each other out and hence market power has no effect on the distortions between the factor incomes and marginal products under the competitive equilibrium of the economy. To verify this, by substituting eqs. (13) and (14) into (11) and (12), we find that the capital rental and wage rates are given as

$$r = (\frac{\alpha}{\alpha+\beta})\frac{Y}{K} \tag{11'}$$

$$w = (\frac{\beta}{\alpha+\beta})\frac{Y}{L}, \tag{12'}$$

where $(\frac{\alpha}{\alpha+\beta})\frac{Y}{K}$ and $(\frac{\beta}{\alpha+\beta})\frac{Y}{L}$ are the marginal products under the aggregate equilibrium.

Households as a whole maximize their lifetime utility in eq. (5) subject to eq. (6). By denoting λ as the shadow price associated with the budget constraint $\dot{K}$ in eq. (6), the first-order conditions for the maximization are listed as follows:

$$\frac{1}{C} = \lambda \tag{16}$$

$$\frac{\Lambda}{1-L} = \lambda(1-\tau_l)w \tag{17}$$

$$\lambda(1-\tau_k)r = -\dot{\lambda} + \xi\lambda, \tag{18}$$

where r and w are given by eqs. (11') and (12').

4. Optimal Fiscal Policies and Entry

We next consider a centralized economy in which a social planner maximizes eq. (5), subject to the following aggregate production function for final goods:

$$Y^s = n^{1+\theta}[K^\alpha L^\beta G^\gamma \varphi(k)^{-\gamma\sigma} n^{-(\alpha+\beta+\gamma\sigma)} - \phi] \tag{19}$$

and aggregate resource constraint for the planner:

$$\dot{K} = Y - G - C. \tag{20}$$

Eq. (19) is derived by combining eq. (2) with (3), while eq. (20) is derived by substituting eqs. (10)-(13) into eq.(6) without the presence of tax rates and lump-sum transfers. Note that, by disentangling market power and increasing returns, the aggregate production function in eq. (19) is not directly related to market power η.

The social planner accomplishes his goal by selecting C, G, K, L, and n. By letting μ be the shadow price associated with the budget constraint $\dot{K}$ in eq. (20), the first-order conditions for the social planner's maximization are

$$\frac{1}{C} = \mu \tag{21}$$

$$\frac{\Lambda}{1-L} = \mu \underbrace{\beta\left(\frac{1+\theta}{\theta+\alpha+\beta+(1-\varepsilon)\gamma\sigma}\right)\frac{Y^s}{L}}_{MPL^s} \tag{22}$$

$$\underbrace{\mu(\alpha-\sigma\gamma\varepsilon)\left[\frac{1+\theta}{\theta+\alpha+\beta+(1-\varepsilon)\gamma\sigma}\right]\frac{Y^s}{K}}_{MPK^s} = -\dot{\mu}+\xi\mu \tag{23}$$

$$n^s = \left[\frac{[1-\alpha-\beta+\theta-(1-\varepsilon)\gamma\sigma]}{\phi[\alpha+\beta+(1-\varepsilon)\gamma\sigma]}Y^s\right]^{\frac{1}{1+\theta}} \tag{24}$$

$$\frac{G}{Y^s} = \frac{(1+\theta)\gamma}{\alpha+\beta+(1-\varepsilon)\gamma\sigma}, \tag{25}$$

where the superscript 's' represents the equilibrium values under the centralized economy.

There are three different types of distortions in the economy: imperfect competition, increasing returns, and the congestion of public inputs. In general, private agents in the decentralized economy make their decisions without taking these distortions into account. By contrast, the social planner takes these distortions into account and hence derives optimal conditions in eqs. (21)-(25). It is well known that the government in the competitive equilibrium (the decentralized economy) can induce private agents to behave like the social planner and restore the first-best outcome. To do so, the government in the decentralized economy sets up tax rates (τ_k and τ_l) and the ratio of expenditure g to equalize the decisions made by private agents (eqs. 16-18) and the social planner (eqs. 21-23). In so doing, the total output in the decentralized economy (i.e., Y) will be identical to that in the centralized economy (i.e., Y^s) under the equilibrium.[4] We then derive the following result.

Proposition 1. With the presence of an imperfect market, increasing returns to specialization, and congestion, the optimal tax rates and the fraction of government expenditure are given as

$$\tau_l = \frac{(1-\varepsilon)\gamma\sigma-\theta(\alpha+\beta)}{\alpha+\beta+(1-\varepsilon)\gamma\sigma} \tag{26}$$

$$\tau_k = \frac{(1-\varepsilon)\gamma\sigma+(\alpha+\beta)[(1+\theta)\frac{\gamma\sigma\varepsilon}{\alpha}-\theta]}{\alpha+\beta+(1-\varepsilon)\gamma\sigma} \tag{27}$$

$$g = \frac{(1+\theta)\gamma}{\alpha+\beta+(1-\varepsilon)\gamma\sigma}. \tag{28}$$

The striking result from Proposition 1 is that optimal policies are related to increasing

[4] λ is also equal to μ.

returns and congestion, but are independent of market power. This is significantly different from CHSL who find that optimal income tax rates on both labor and capital are decreasing in terms of market power. Intuitively, to restore the social optimum, fiscal policies must be able to correct any distortion in factor incomes and marginal products. As already stated, when the number of firms is endogenously determined by the free-entry condition, market power will not create distortions between factor incomes and marginal products in the aggregate equilibrium. As a result, optimal tax rates are independent of market power in our model. By contrast, when market power and increasing returns are characterized by the same parameter, the conclusion of CHSL may be misleading. Indeed, it is easy to see from eqs. (26) and (27) that optimal tax rates are decreasing in the degree of increasing returns. In other words, the conclusion of CHSL that optimal tax rates are decreasing in market power is, in fact, driven by the degree of increasing returns.

By equating eq. (15) with eq. (24), we have the following result:

Proposition 2. Free entry in the competitive economy leads to over (too little) entry relative to the social optimum when

$$\frac{1-(1-\eta)(\alpha+\beta)}{(1-\eta)(\alpha+\beta)} > (<) \frac{1+\theta-(\alpha+\beta)-(1-\varepsilon)\gamma\sigma}{\alpha+\beta+(1-\varepsilon)\gamma\sigma}.$$

Obviously, free entry in the competitive economy may lead to over or too little entry relative to the social optimum. This is also significantly different from CHSL who find that free entry always leads to over entry. In our model, a higher degree of market power leads to a higher number of firms; hence, market power tends to induce excessive entry. On the other hand, since private agents do not take increasing returns into account, the presence of increasing returns tends to result in too little entry. When market power and increasing returns are characterized by the same parameter, as in CHSL, both effects cancel each other out in determining whether free entry leads to over or too little entry. Hence, CHSL find that market power plays no role in determining the issue related to over entry.[5] By disentangling market power from increasing returns, we find that whether or not free entry leads to over or too little entry depends on the relative strengths of the effects of market power, increasing returns and congestion.

5. Conclusion

This paper extends Chang et al. (2007) by disentangling market power and increasing returns to specialization. In so doing, we arrive at conclusions that are significantly different from Chang et al. (2007). In particular, market power does not affect optimal tax rates and free entry may lead to over or too little entry even when the intermediate input market is perfectly competitive.

[5] From page 149 of CHSL, one can verify that the parameter ρ does not have an effect on whether $N_t^c > N_t^s$ or $N_t^c < N_t^s$ when optimal policies are implemented (and hence $Y_t^c = Y_t^s$).

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