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Market structure and welfare under monopolistic competition

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HIGHLIGHTS

- Non-monotonic link between market concentration and welfare under monopolistic competition.
- Differentiated impact of exogenous and endogenous sunk costs on welfare.
- Endogenous cross-product substitutability in a Dixit–Stiglitz model of monopolistic competition.

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ABSTRACT

This paper analyzes the relationship between market structure and welfare by developing a model of monopolistic competition in which exogenous entry costs and endogenous differentiation costs determine market concentration and market power. A non-monotonic link is identified between these costs and welfare under a decentralized equilibrium. These results detail new reasons why simple market concentration indicators are a misleading statistic for welfare evaluations.

1. Introduction

The interaction of horizontal and vertical product differentiation has been generally explored in growth and trade models (Peretto and Connolly, 2007; Di Comite et al., 2014). This paper introduces one new dimension to this approach by making cross-product substitutability endogenous. This is relevant in that price–demand elasticities depend on how closely spaced varieties are on the preference range. A new link is therefore created between sunk outlays incurred by firms, their price–cost margins and market power, providing added insights into the relation between market structure and welfare.

The theoretical framework proposed here builds upon the Dixit and Stiglitz (1977) interpretation of monopolistic competition, with love of variety embedded in additively separable preferences. The model allows for the possibility of differentiating investments aimed at increasing the willingness to pay of consumers, either by means of research or advertising efforts.[1] These, in turn, carry a direct effect over price elasticities of demand.

The results suggest that the impact of cost parameters on welfare is non-monotonic and different for exogenous (entry) and endogenous (differentiation) sunk costs. This outcome is driven by adjustments observed in product substitutability. When this is high, it becomes easier to trade-off a lower number of varieties against higher individual production scales, whereas lower substitutability makes this more difficult within the preference structure considered here.

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[1] This differentiation approach was introduced by Shaked and Sutton (1982) and developed in Sutton (1991). A diverse industrial organization literature on two-stage models, overviewed by Bolle (2011), is also characterized by first-stage investments (in research, for instance) followed by oligopolistic competition in quantity or price.

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2. The model

2.1. Households

The representative household maximizes

$$U = \ln C, \tag{1}$$

where C is a consumption aggregator defined over a continuum of goods as

$$C = \int_0^N C_i^{\theta(D_i)} di. \tag{2}$$

N is the mass of goods, C_i is the quantity purchased of each variety, and D_i is a differentiation index chosen by producer i. This captures investments carried by the firm in either advertising or research activities, aimed at influencing the willingness to pay of consumers. The function $\theta(D_i) : R_+ \to [0, 1]$ is continuous and twice differentiable. The rationale behind this aggregator is multifold. First, the exponential setup generates an intuitive link between differentiating outlays and price–cost margins. Second, additive separability simplifies the problem by making the choices of firms independent of each other.

The household maximizes (1) subject to

$$E = \int_0^N P_i C_i di, \tag{3}$$

where E is the household income and P_i is the price of good i.

The welfare optimization problem yields the individual demand schedule

$$C_i = \left[\frac{\theta(D_i)}{\lambda P_i}\right]^{\frac{1}{1-\theta(D_i)}}, \tag{4}$$

where λ is the marginal utility of income. The price elasticity of demand equals $[1 - \theta(D_i)]^{-1}$. The function $\theta(D_i)$ is subject to the general restrictions $\theta'(D_i) \leq 0$ and $\theta''(D_i) \geq 0$, with a strict inequality for any finite D_i. In this model, the decision to enter the market implies only access to elementary blueprints, upon which a standard product can be supplied. Advertising or research outlays are necessary to achieve differentiation. This affects the way households perceive goods to be related, decreasing the propensity to substitute them within the consumption bundle.

2.2. Producers

Each final good is produced by one monopolist according to

$$Y_i = L_i, \tag{5}$$

where L_i is labor used by firm i. Producers face entry costs identical to F, expressed in units of labor. There is also an endogenous cost, necessary to differentiate the good. This is again measured in units of labor as

$$L_{D_i} = \beta D_i^{\gamma}. \tag{6}$$

It is assumed that $\gamma > 1$, ruling out increasing returns in this activity. This is consistent with the setup proposed by Sutton (1991, ch. 3). Parameter $\beta > 0$ scales the marginal cost of differentiation.

Market clearing imposes $Y_i = LC_i$, where L measures the total labor force and proxies market size. Labor is the numeraire and wages are normalized to one. Using Eqs. (4) and (5), the profit function is

$$\pi_i = (P_i - 1) L \left[\frac{\theta(D_i)}{\lambda P_i}\right]^{\frac{1}{1-\theta(D_i)}} - \left(F + \beta D_i^{\gamma}\right). \tag{7}$$

Profit maximization is attained in two stages. Firms carry their differentiation activities first and next they engage in production, setting the optimal quantity and price. The first order condition over P_i implies

$$P_i = [\theta(D_i)]^{-1}. \tag{8}$$

Recall that $\theta'(D_i) < 0$. Hence, devising goods that reinforce the consumers' willingness to pay affords higher market power. Substituting this price into the profit Eq. (7), along with some algebraic manipulation, yields

$$\pi_i = [1 - \theta(D_i)] Y_i P_i - \left(F + \beta D_i^{\gamma}\right). \tag{9}$$

The differentiation equilibrium is derived evaluating this equation at the optimal quantity and price set in the production stage $\left(Y_i^* \text{ and } P_i^*\right)$. The implicit solution becomes

$$\theta'(D_i) Y_i^* P_i^* + \beta\gamma D_i^{\gamma-1} = 0. \tag{10}$$

Since the parameters associated with the differentiation technology are industry specific and the optimal price depends only on each firm's differentiation choice, producers adopt the same output level and choose a similar index D, facing the same price–demand elasticities. These choices are independent and simultaneous, yielding a symmetric outcome, so we ignore from now on individual subscripts.

Market clearing also implies

$$Y^* P^* = \frac{LE}{N}. \tag{11}$$

Entry and exit flows in each period lead to zero profits. Using (9) and (11), the number of producers is

$$N = \frac{[1 - \theta(D)] LE}{F + \beta D^{\gamma}}. \tag{12}$$

Finally, substituting (11) and (12) into (10), the implicit differentiation solution is

$$F = -\beta D^{\gamma-1}\left[D + \frac{1 - \theta(D)}{\theta'(D)}\gamma\right]. \tag{13}$$

This solution is unique, as shown in Appendix. The corresponding proof also establishes that larger entry costs (F) encourage differentiation investments. Since the number of producers declines, the market share for the remaining ones is increased, reinforcing the marginal benefits associated with larger margins. Higher costs (β) in stimulating a consumer's willingness to pay naturally decrease the level of differentiation and market power.

Labor resources devoted to production, entry costs and differentiation outlays are subject to the constraint

$$N\{L_i + F + \beta[D(\beta, \gamma, F)]^{\gamma}\} = L. \tag{14}$$

Using Eqs. (5), (8), (11) and (12) yields

$$L_i = \frac{\{F + \beta[D(\beta, \gamma, F)]^{\gamma}\}\theta[D(\beta, \gamma, F)]}{1 - \theta[D(\beta, \gamma, F)]}, \tag{15}$$

where $D(\cdot)$ is implicitly defined by (13).

After substituting this into Eq. (14), algebraic manipulation returns the equilibrium number of final producers as

$$N = \frac{-L\theta'[D(\beta, \gamma, F)]}{\beta\gamma[D(\beta, \gamma, F)]^{\gamma-1}}. \tag{16}$$

2.3. Welfare

Under symmetry, the consumption bundle in (2) may be simplified into

$$C = NC_i^{\theta[D(\beta,\gamma,F)]}. \tag{17}$$