# On monopolistic competition and optimal product diversity: a comment on cost structure and workers' rents*

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**Abstract**

In the Dixit-Stiglitz model of monopolistic competition, entry of firms is socially too small. Other authors have shown that excess entry is also a possibility with other preferences for diversity. We show that the cost structure and workers's rents can also explain excess entry.

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# 1 Introduction

Do firms offer too many varieties under monopolistic competition? Different strands of economic literature have answered this question. Contributions in industrial organization literature focus on partial equilibrium frameworks. For instance, Chamberlin (1950) considers the case of firms selling perfect substitutes and concludes that firms set production to the left of the point of their minimum average cost so that too many firms enter. Dixit and Stiglitz (1977) analyze the case of imperfect substitutes where firms set production levels larger than the (unconstrained) social optimum so that entry is below its social optimum. Generalizing this work, Benassy (1996) and Vives (1999, p.172) show that entry can be too large or too small according to the balance between consumers' preferences for variety and for individual consumption of each single variety. Other contributions have reconsidered Dixit and Stiglitz's (1977) model by allowing firms to behave strategically in a general equilibrium setting. In particular, d'Aspremont *et al.* (1989), Yang and Heijdra (1993) and d'Aspremont *et al.* (1996) consider that firms have non zero masses and use their ability to alter price indices and incomes in order to increase their own profits.[1] In such models, firms' strategic behavior may yield excess entry, which reverses the Dixit and Stiglitz' (1977) result.

In this paper we present a general equilibrium model with *imperfect labor markets* in which the Dixit and Stiglitz' (1977) prediction can also be reversed. The model includes a sector with constant returns to scale and a sector with increasing returns to scale, allowing workers of the latter to capture a rent (either because these workers are unionized - see McDonald and Solow, 1981 - or because of efficiency wage considerations - see Solow, 1979 and Akerlof and Yellen, 1990). Workers' positive rents raise firms' costs but also inflate the product demand and firms' revenues. The impact of rents on profits and entry then depends on how workers' rents translate to costs and to the demand. If rents are associated to fixed costs activities, they decrease profits on a one-to-one basis. The effect of rents on demand is then dominated by their effect on costs: profits and entry fall with higher rents. By contrast, rents associated to variable costs activities have a smaller impact on profits because firms are able to adapt their production levels. In this case, the effect of rents on demand can dominate their effect on costs: profits

[1] Such models give evidence of a 'Ford' effect, in reference to Henry Ford who firstly exploited the positive causality between wages and product demand.

rise with higher rents and more firms enter. We thus show that the response of entry to a change in workers' rents depends on the *structure of costs*.[2] Furthermore, the equilibrium number of firms can become larger than the social optimum.

# 2 The model

We consider a general equilibrium model under imperfect competition where $m$ individuals consume an homogenous good produced under constant returns to scale and a bundle of differentiated varieties produced under increasing returns to scale. Labor productivity is normalized to one in the production of the former good, which is taken as the numéraire. Individuals share the same preferences: $U = c_o^{1-\mu} * (\int_0^n c(i)^{1-1/\sigma} di)^{\mu\frac{\sigma}{\sigma-1}}$ where $c_o$ is the consumption of the numéraire and where $c(i)$ is the consumption of a differentiated variety $i \in [0, n]$. The share of revenue spent on the differentiated varieties is $\mu$ and the share of revenue spent on the numéraire is $1 - \mu$; the elasticity of substitution among differentiated varieties is constant and equal to $\sigma > 1$. Accordingly, consumers' demand for the differentiated variety $i$ is given by

$$c(i) = \left(\frac{p(i)}{P}\right)^{-\sigma} \frac{\mu E}{P} \text{ where } P \equiv \left(\int_0^n p(i)^{1-\sigma} di\right)^{\frac{1}{1-\sigma}} \quad (1)$$

where $E$ denotes the consumers' expenditure, $p(i)$ is the price of the differentiated variety $i$, and $P$ is the price index of the differentiated varieties.

Individuals work either in the constant returns to scale sector or in the increasing returns to scale sector. In the former sector, we assume unit labor productivity so that the wage is equal to one, i.e. the price of the numéraire. In the latter sector, there is a rent that can be bargained between employers and employees so that workers earn larger wages in that sector ($w > 1$). In the Appendix, we extend the simple bargaining framework that justifies such rigid wages higher than in the constant returns to scale sector (see also Picard and Toulemonde 2005). Larger wages can also result from incentives to effort as in efficiency models or from workers' investment in industry specific education.

[2] To our knowledge, no authors have analyzed the cost side effects on diversity. Gans (1997) develops a model with endogenous fixed costs to capture 'big push' effects, but offers no conclusion about diversity.

Firm $i$'s profit can be written as $\pi(i) \equiv [p(i) - v]\, x(i) - f$ where $v$ and $f$ denote variable and fixed costs respectively. Firms use two inputs: unionized labor and numeraire. The parameters $\alpha$ and $\beta \in [0,1]$ describe the shares of unionized labor in variable and fixed costs so that $v \equiv \alpha w + (1-\alpha)$ and $f \equiv \beta w + (1-\beta)$. Total expenditures in the economy are made of earnings of individuals working in the constant returns to scale sector, and wages of unionized workers[3]: $E = (m-l) + lw$ where $l$ is the total number of workers paid at the unionized wage $w$.

# 3 Monopolistic competition

Firm $i$ chooses the price $p(i)$ that maximizes its profits. Under monopolistic competition, each firm takes the index $P$ and the expenditures $E$ as given. Because the product demand is iso-elastic, firm $i$ sets its price as a markup over the variable costs: $p \equiv p(i) = v\sigma/(\sigma-1)$. Given the manufactured price index ($P = pn^{-1/(\sigma-1)}$) and the demand for each variety, output and profits are equal to

$$x = \frac{(\sigma-1)\,\mu E}{\sigma v n} \text{ and } \pi = \frac{\mu E}{\sigma n} - f \tag{2}$$

Under free entry, firms enter until their profits fall to zero. Wages may affect profits through their effects on fixed costs, on variable costs, and on expenditures. First, larger wages increase the fixed costs $f$, which clearly reduces the equilibrium number of firms. Second, larger wages increase the variable costs $v$, but this does not affect $\pi$, as seen in (2). Indeed, with iso-elastic demands, an increase in variable costs is automatically matched by a change in the production that leaves profits unaffected. Third, larger wages affect expenditures:

$$E = m + n\,(\alpha x + \beta)\,(w-1) = \frac{\sigma\,(m-n)\,(\sigma w + 1 - \alpha)}{\alpha\sigma\,(1-\mu)\,(w-1) + \sigma - \mu} \tag{3}$$

Whereas larger wages reduce the output (and the employment level) (see (2)), they also raise the earnings of unionized workers so that the net effect on expenditures $E$ is *a priori* unknown. From the second equality in the above expression, it is readily checked that an increase in wages raises the earnings, which promotes the entry of new firms.

[3] We assume that there is free entry so that profits fall to zero.

Under free entry, the equilibrium number of firms is given by

$$n_e = \frac{\mu m}{\sigma f (1-\mu) + \mu + \mu (\sigma - 1) f/v} \tag{4}$$

where

$$\frac{dn_e}{dw} > 0 \iff \frac{v\mu (\sigma - 1) + v^2 \sigma (1-\mu)}{\mu (\sigma - 1) + v^2 \sigma (1-\mu)} > f$$

where we used the definitions of $v$ and $f$ to substitute for $\beta$ and $\alpha$.

The novelty in this paper is the analysis of the effects that wages (costs) have on entry via the expenditures in a general equilibrium framework. Since under $w > 1$, $v$ is larger than one, it is readily verified that the left hand side of the last inequality has the following properties: (i) it is larger than one, (ii) it is larger than $f$ if $v > f$ (that is if $\alpha > \beta$), and (iii) it increases with $v$ - and thus with $\alpha$ - for reasonable values of union wage premium (i.e. for $w \in [1, 1 + \sqrt{(\sigma - \mu) / (\sigma (1-\mu))}]$ which includes $w \in [1, 2]$).

As a result of property (i), *an increase in wages always promotes entry if fixed costs are paid in terms of the numéraire ( $f = 1$ or $\beta = 0$ ).* As a consequence of property (ii), *the increase in wages also promotes entry if the share of unionized labor is proportionally larger in variable costs than in fixed costs.* Finally, because of property (iii) and because $f$ increases with $\beta$, the following proposition applies:

**Proposition 1** *An increase in unionized wages raises the number of varieties if the share of unionized workers in the variable costs ($\alpha$) is high enough or if their share in the fixed costs ($\beta$) is low enough.*

The natural next question is whether the economy operates with too much or too little entry.

# 4 Entry: too much or too little?

We compare the competitive equilibrium with the (unconstrained) social optimum where a planner is able to choose the values of $c_o$, $c(i)$ and $n$ that maximize utility under the resource constraint. In the constant returns to scale sector, the economy uses $c_o$ units of labor (for producing $c_o$) and $(1-\beta) n + (1-\alpha) \int_0^n c(i)di$ units of labor to produce the input for the other sector. The increasing returns to scale sector also uses $\beta n + \alpha \int_0^n c(i)di$ units of labor. The resource constraint is therefore $m = c_o + \int_0^n c(i)di + n$. Substituting $c_o$ from the constraint in the planner's objective, maximizing with respect to $c(i)$ and $n$, and using symmetry ($c(i) = c\ \forall i$ ) yields the first best levels of consumption and varieties: $c_o = \sigma - 1$ and $n_o = \mu m / (\sigma - 1 + \mu)$. Comparing $n_e$ to $n_o$ gives

$$n_e - n_o < 0 \iff \frac{(\sigma - 1)\, v}{\sigma (1 - \mu)\, v + \mu (\sigma - 1)} < f$$

If unionized workers do not manage to get larger wages than the workers from the constant returns to scale sector ($w = 1$), then $v = f = 1$ and the above inequality holds. This is the standard result according to which there is too little entry under perfect labor markets (Dixit and Stiglitz, 1977 and Vives, 1999). Now when unionized workers get larger wages, the expenditures $E$ increase with wages, which may promote entry and may result in over provision of varieties, particularly when wages have a strong effect on the number of firms $n_e$. Indeed, it can be checked that the left hand side of the condition increases in $v$, and thus in $\alpha$, whereas the right hand side increases with $\beta$. This gives the following proposition

**Proposition 2** *There is too much entry if the share of unionized workers in the variable costs ($\alpha$) is high enough or if their share in the fixed costs ($\beta$) is low enough. Otherwise, there is too little entry.*

This proposition readily applies to configurations where variable and fixed costs are made of a single type of workers, i.e. when $\alpha$ and $\beta$ are equal to 0 or 1. Then, one can check that *excess entry is supported only when the variable cost is paid in terms of unionized labor whereas the fixed cost is paid in terms of the numéraire ($\alpha = 1$, $\beta = 0$).* Two additional conditions are then required: the share of revenues spent on the differentiated varieties must be large enough ($\sigma\mu > 1$) and unionized wages must be large enough ($w > (\mu\sigma - \mu) / (\mu\sigma - 1)$). Because the right hand side of this last condition increases in $\sigma$ and decreases in $\mu$, we conclude that excess entry is more likely when varieties are lower substitutes (low $\sigma$) or when they are more intensely consumed (high $\mu$). In both cases, firms benefit from both larger market power and larger sales, which increases profits and attracts new firms that may enter in excess. Furthermore, excess entry is not inconsistent with reasonable values of economic parameters.[4]

[4] These two conditions are fulfilled for instance if $\sigma = 4$, $\mu = 0.75$ and $w \geq 1.125$, which are relevant values of parameters (see e.g. Hanson, 1998, Head and Mayer, 2004 for

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# 6 Appendix: Endogenous wages

In the paper we derived conditions for excess entry under exogenous wages. Still, one needs to be convinced that excess entry exists when wages are endogenous. We already know that if wages in the increasing returns to scale sector are determined on a perfectly competitive labor market ($w = 1$), then there is no excess entry. If labor markets are non competitive then labor market conditions link the wages to the number of firms by a relationship $w = F(n)$. The equilibrium wage and number of firms is obtained by solving this relationship with (4). In general, there is no closed form solution and numerical simulations are needed. Yet we are able to present a simple example of wage bargaining that yields excess entry. To simplify the analysis, we focus on the simplest case in which there can be excess entry: we assume that unionized workers contribute only to variable costs: $\alpha = 1$ and $\beta = 0$.

We assume a decentralized wage setting with one independent, utilitarian union per firm. First, the union and the firm bargain over wages. Then the firm chooses employment given wages (the firm has the right to manage). We consider the Nash solution, according to which wages maximize the following product

$$N \equiv \left[V(i) - \overline{V}\right]^{\phi} \left[\pi(i) - \bar{\pi}\right]^{1-\phi}$$

where $\phi$ is the union bargaining power, $V(i)$ is the union utility, $\pi(i)$ is the firm's profits, $\overline{V}$ and $\bar{\pi}$ are the fall-back utilities and profits.

Consider the firm $i$ and its associated union $i$ that bargain over the wage $w(i)$. On the one hand, union $i$ maximizes the sum of utility that its workers derive from the wages offered by the firm. With the Cobb-Douglas-CES utility specification, worker's utility is $w(i)/P_G$ where $P_G \equiv P^{\mu}\mu^{-\mu}(1-\mu)^{\mu-1}$. In case of persistent disagreement with the firm, workers go in the constant returns to scale sector where the wage is 1; they have a utility equal to $1/P_G$. Hence, union utility levels under agreement and disagreement are equal to $V(i) = w(i)l(i)/P_G$ and $\overline{V}(i) = l(i)/P_G$ where $l(i) = x(i)$ denotes the level of employment in firm $i$.

On the other hand, firm $i$ maximizes its profit $\pi(i) = (p(i) - w(i))\,x(i) - 1$. Under right-to-manage, the firm chooses its price $p(i)$ and consequently its output level $x(i)$. Maximization w.r.t. $p(i)$ yields the price and the output

$$p_e(i) = \frac{\sigma}{\sigma-1}w(i) \text{ and } x_e(i) = \mu\left(\frac{\sigma}{\sigma-1}\frac{w(i)}{P}\right)^{-\sigma}\frac{E}{P}$$

In case of persistent disagreement with the union, we assume that the firm still incurs the fixed cost ($\bar{\pi}(i) = -1$). This is also what is implicitly assumed in many models of wage bargaining in which the fixed cost is set equal to zero (see e.g. the seminal paper by McDonald and Solow, 1981). The firm's contribution to the Nash product is therefore

$$\pi(i) - \bar{\pi} = \left( \frac{\sigma}{\sigma - 1} \frac{w(i)}{P} \right)^{-(\sigma-1)} E/\sigma.$$

In a Nash bargaining, $w(i)$ maximizes the Nash product. Under monopolistic competition, there is a large number of firms and unions that consider the price index $P$, and the earnings $E$ as constants. The maximization gives

$$w(i) = w = 1 + \frac{\phi}{\sigma - 1}$$

for all firms $i$. Thus the wage is a fixed mark-up over the wage in the constant returns to scale sector and is independent of the number of firm. The analysis in Section 3 holds.

Finally we check whether excess entry can be supported by this simple model. Let us take the previous example with $\sigma = 4$ and $\mu = 0.75$. Then, we have that $w = 1 + \phi/3$ and excess entry occurs for $\phi \in [.375, 1]$.