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PRICE-COST MARGINS AND FIRM SIZE UNDER MONOPOLISTIC COMPETITION: THE CASE OF IES PREFERENCES[ℵ]

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ABSTRACT

We introduce a class of "increasing elasticity of substitution" preferences in a monopolistic competition setting à la Dixit and Stiglitz (1977). Contrary to the standard view, we find that a market which is widening, as a result of, for example, international trade, increases price-cost margins and reduces firm sizes. However, even if prices are higher (with constant marginal costs), consumers benefit from the market expansion because of higher product diversity (the free-entry equilibrium has a sub-optimal number of varieties). Our results might contribute to explain the puzzle posed by the movements of mark-ups following globalisation. They could also help explaining the cyclical behaviour of prices.

Keywords: monopolistic competition, endogenous mark-up, firm size, elasticity of substitution

JEL Classification: D11, D43, F12, L11.

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1 Introduction

This paper reconsiders the relationship between market outcomes and competition in the standard framework introduced by Dixit and Stiglitz (1977) to model Chamberlin's "monopolistic competition". Dixit and Stiglitz (1977: section I) popularised a version of their model (henceforth DS) where preferences are constant-elasticity-of-substitution (CES) and the number of firms is large enough so that the price index is independent of the individual price changes. They showed that in such a setting the market equilibrium would indeed reach "a sort of ideal", as previously informally suggested by Chamberlin (see e.g. Anderson, 2008). The DS model has had a large influence on many fields, such as international trade theory (see e.g. Helpman and Krugman, 1985: section III), growth theory (see e.g. Romer, 1987), economic geography (see e.g. Krugman and Venables, 1995) and monetary economics (see e.g. Blanchard and Kiyotaki, 1987).

The DS model is extremely tractable. However its tractability is based on rather peculiar assumptions, hardly plausible as a description of many real markets. In particular, these assumptions imply constant demand elasticities. These in turn result in constant mark-ups along the business cycle, a possibly unpleasant feature: see e.g. Colciago and Etro (2007). The DS assumptions also deliver the counterintuitive result that firm size is not affected by the globalisation process: see e.g. Eckel (2008). Many authors consider those results unsatisfactory and counter-factual (see e.g. Neary, 2002: section 4), and the literature has investigated different ways to make the relevant demand elasticities endogenous by modifying the two DS main assumptions: the price index independence and CES preferences.

The first approach actually departs from the monopolistic competition setting, where the number of firms is assumed to be large enough to make the representative consumer's marginal utility of income independent of individual prices. This stream of literature has either assumed a price-index effect of individual pricing (as suggested by Yang and Heijdra, 1993), or considered a full-fledged oligopoly version of the same setting (see e.g. Beath and Katsoulacos, 1991: chapter 3). In both settings the mark-up becomes endogenous, as (in the symmetric equilibrium) it inversely depends on the number of active firms. This approach has been applied to some specific fields, such as real business cycle and international trade, showing remarkable effects if the number of firms is indeed not very large: see e.g. Colciago and Etro (2007) and Eckel (2008).

The second approach changes the assumption on consumer preferences within the monopolistic competition setting. Dixit and Stiglitz (1977: section II) themselves showed that different preferences (allowing for different commodity substitutability) would deliver different results. In this line, while studying the impact of international trade under monopolistic competition, Krugman

(1979) made specific assumptions on preferences in order to generate a pro-cyclical mark-up and an increase in the firm size as a response to an expansion in market demand. However, as Neary (2004: section 4.2) noted, no alternative preference specification has proven to be tractable, and most scholars have then retained the CES one. Indeed, Krugman (1980) himself returned to a standard DS structure with its strong implication that neither mark-ups nor firm sizes are affected by trade policy. In fact, an explicit functional form for the Krugman's (1979) type of preferences has only recently been proposed by Bertoletti (1998 and 2006) and Behrens and Murata (2007): see Appendix 1.

In this paper, we introduce an alternative class of (non-homothetic) preferences characterised by non-constant demand elasticities. In particular, we define a new class of well-behaved consumer preferences, called *Increasing Elasticity of Substitution* (IES) preferences, and show that an increase in the number of firms/varieties results in an increase in the equilibrium price (with a constant marginal cost). Given the consumers' taste for variety, the possibility that they might pay more for a richer set of products should not come as a complete surprise. Moreover, the higher price does not harm consumers in that they are more than compensated by the rise of product variety available for consumption: with IES preferences, higher prices are therefore associated with higher consumer welfare. As proved in Appendix 2, price-increasing competition can also arise in a Cournot oligopoly version of our setting, that is, under the assumption of strategic interaction among firms.

The intuition for our results is the following. A rise in the number of firms shifts the residual demand curve downwards and, given the representative consumer's disposable income, reduces the equilibrium consumption of each variety. The overall effect on prices is contingent on how demand elasticity changes according to the scale of consumption. It turns out that, in a monopolistic competition setting, demand elasticity only depends on the functional form chosen to model consumers' preferences. In particular, in a symmetric equilibrium, the elasticity of demand (in absolute value) coincides with the elasticity of substitution between any two varieties.

The main issue is then how the scale of consumption affects commodity substitutability. CES preferences (see e.g. the DS model used in Krugman, 1980) give rise to isoelastic residual demands. Under these preferences, competition does not affect demand elasticity and the equilibrium price (with constant marginal costs). However, consumers benefit from an increase in the number of firms through higher product diversity.

In the somewhat less known case of varieties with a decreasing (with respect to the scale of consumption) elasticity of substitution (see the papers by Krugman, 1979, Bertoletti, 2006 and Behrens and Murata, 2007 quoted above), more competition enhances consumer welfare through a wider product variety and a lower equilibrium price.

In contrast, the class of (symmetric) preferences that we introduce in this paper is characterised by an increasing elasticity of substitution with respect to the level of (symmetric) consumption. Therefore, the lower the scale of consumption of each variety, the lower (in absolute value) the residual demand elasticity that each firm faces. It is worth adding that, in principle, results similar to our own would also arise with any kind of other preferences based on a "decreasing relative risk aversion" sub-utility function for the consumption of a single variety.

We regard the contribution of this paper as being threefold. Firstly, it proposes an unexplored variation of the Dixit and Stiglitz (1977) monopolistic-competition model, stressing the relevance of consumer preferences for equilibrium behaviour. Secondly, it adds to the literature on price-increasing competition under product differentiation. Hollander (1987) provided an early investigation of this issue in a Cournot setting with differentiated products.[1] More recently, the possibility that competition could raise prices has been explored in a few papers by Chen and Riordan (2006) and (2008) and Cowan and Yin (2008). These papers show that, in discrete choice models of product differentiation, entry can increase the symmetric oligopoly price.[2] Our results are derived in a setting which is not encompassed by any of the abovementioned models and do complement the findings of this literature.

Finally, by providing an endogenous countercyclical mark-up, we contribute to the applied literature (mostly macroeconomic and international trade models) that has adopted the monopolistic competition setting. In particular, our paper directly relates to the many contributions that followed Krugman (1979) in discussing the possibly pro-competitive effects of international trade: see Boulhol (2006) for a recent example. According to the standard view, globalisation: widens the number of varieties available to consumers; reduces the total number of firms while increasing their size, allowing for a better exploitation of the scale economies; and reduces the firm mark-up. By using a mark-up which is negatively dependent on the number of firms and specific cost conditions, Eckel (2008) shows that international trade can even lower the number of varieties while sharply increasing the firm size. Our model suggests that, on the contrary, globalisation may result in a larger number of smaller firms with higher mark-ups. Namely, the raise in the number of competitors brought about by international trade decreases the individual consumption of each variety. The per-capita consumption reduction decreases the demand elasticity and increases the price-cost margin (in contrast with the results of Krugman, 1979). The price increase reduces the firm size and allows the coverage of the higher average costs in order to satisfy the free-entry zero-profit condition.

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[1] Hollander assumes an inverse demand system $p_i = D(q_i, \Sigma_{j \neq i} q_j)$, $i,j = 1, \ldots, n$. Note that the demands generated by IES preferences have not this functional form (see equation A2.1 in Appendix 2).

[2] These results appear to have been somehow anticipated in a passage by Wicksell (1901: pp. 87-8).

Our setting might also be interesting for the real business cycle literature on "endogenous market structure", which considers oligopoly versions of the DS model: see e.g. Colciago and Etro (2007). Differently from this literature, which uses the change in the number of active firms which follows a shock to account for the mark-up modifications, in our setting the mark-up endogeneity comes from the type of preferences. This should imply a different time path of shocks' effects from the usually postulated one, due to time-to-build and entry costs considerations.

The paper is organised as follows: section 2 introduces the model and discusses the price-increasing competition result. Section 3 considers the free-entry equilibrium and studies the welfare implications. Section 4 summarises the results. Appendix 1 illustrates the cases of monopolistic competition with the alternative CES and CARA preferences. Appendix 2 deals with the case of Cournotian competition under IES preferences.

2 The model

Following Dixit and Stiglitz (1977) and Krugman (1979), we consider a market with n identical firms, each producing a different variety of a particular commodity. Let x_i be the quantity of variety i, produced by firm i with a (positive) marginal cost c. If variety i is actually sold, its market price is p_i. Assume that the representative consumer has the utility function $U(\boldsymbol{x}) = \Sigma_i u(x_i)$ (that is, her preferences are symmetric and *additive*[3]), defined over a large number $N > n$ of potential varieties ($i = 1, ..., N$). It is also assumed that $u(\cdot)$ is a well-behaved (sub-utility) function with $u(0) = 0$ and $u''(\cdot) < 0 < u'(\cdot)$.[4] Let Y denote the disposable income of the representative agent. Then her budget constraint in any *symmetric* equilibrium (i.e., in any equilibrium in which the price of varieties, p, is the same and hence also the quantity, x, is the same) can be written as:

$$p = \frac{Y}{nx}. \tag{1}$$

The other equilibrium condition is given by firms' profit maximization. In order to compute that, we first have to consider the FOCs for the maximization of the representative consumer's utility:

$$p_i = \frac{u'(x_i)}{\lambda}, \tag{2}$$

[3] See e.g. Deaton & Muellbauer, 1980: section 5.3.

[4] Note that, being strictly concave with respect to $\boldsymbol{x}$ and increasing with respect to n, $U(\cdot)$ embodies a Chamberlinian "taste for variety". Moreover, it is well defined over the positive orthant of the relevant Euclidean space: according to standard results, this implies regular and well-behaved demand functions for (strictly) positive prices and income.

for $i = 1, ..., n$, where $\lambda > 0$ is her marginal utility of income.

One can prove that, if prices are not disproportionate, the elasticity of λ with respect to each price is of the same order of magnitude as $1/n$ (see e.g. Deaton and Muellbauer, 1980: section 5.3). Thus, under the assumption of many varieties (i.e., if n is large enough), one can assume that each firm ignores the price interaction with the others, that is, each firm considers λ as a constant (this is the *monopolistic competition hypothesis* popularised by Dixit and Stiglitz, 1977). Accordingly, the inverse demand function for variety i is given by $p_i(x_i) = u'(x_i)/\lambda$. Therefore, demand elasticity can be written as:

$$\varepsilon_i(x_i) = \frac{p_i(x_i)}{p_i'(x_i)x_i} = \frac{u'(x_i)}{u''(x_i)x_i} . \tag{3}$$

Note that $\varepsilon_i(\cdot)$ does not depend on λ, and that it equals the reciprocal of the elasticity of the marginal utility $u'(\cdot)$, i.e. minus the so-called "coefficient of relative risk aversion" of $u(\cdot)$. It can be shown that, in any symmetric equilibrium (thanks to the properties of symmetric additive preferences), $\varepsilon_{ji} = -u'(x)/(nxu''(x)) = -\varepsilon_{ii}/(n-1)$, where ε_{ii} and ε_{ji} are respectively the direct and cross elasticities of the "compensated" (Hicksian) demand for variety i. It follows that, for a symmetric consumption, demand elasticity (hereafter, we omit the suffixes), $\varepsilon(\cdot)$, equals in absolute terms the (partial) elasticity of substitution between any two varieties $\sigma(\cdot)$, i.e., $\varepsilon(x) = -\sigma(x)$.[5]

The profit-maximising first and second order conditions for each firm under monopolistic competition can be written as follows:

$$p = \frac{\varepsilon(x)}{1+\varepsilon(x)} c = m(x)c , \tag{4}$$

$$u'''(x)x + 2u''(x) < 0 . \tag{5}$$

The symmetric equilibrium is then given by a couple (p, x), such that equations (1), (4) and (5) are simultaneously met. Equation (1) – the budget constraint – is an equilateral hyperbola in the space (p, x), whose distance from the origin depends on the *disposable income per variety* Y/n. Equation (4) – the profit maximising FOC – depends only on $\varepsilon(\cdot)$ (it requires $|\varepsilon(x)| > 1$, i.e. $u''(x)x + u'(x) >$

[5] More precisely, it can be showed that the so-called "Morishima" elasticity of substitution between varieties i and j, $\sigma_{ij} = \varepsilon_{ji} - \varepsilon_{ii}$, is equal to $-u'(x_i)/(u''(x_i)x_i)$ whenever $p_i = p_j$ and then $x_i = x_j$ (on the different partial elasticity of substitution measures see Blackorby and Russell, 1989).

0), that is on the elasticity of the marginal utility $u'(\cdot)$. Equation (5) – the profit maximising SOC – is just a decreasing marginal revenue condition which must be satisfied in our setting.

In order to study the effect of an increase in competition, we consider an *exogenous* decrease in the disposable income per variety, *Y/n* (see next section for the characterization of the free-entry equilibrium with an endogenous number of firms). This affects only equation (1): from a graphical point of view, the equilateral hyperbola simply shifts towards the origin. In economic terms, this implies that the revenues of each active firm, *px*, must decrease. Since (5) implies that $m(x)x = [u'(x)x]/[u''(x)x + u'(x)]$ is an increasing function, in this setting also *x* must get smaller. However, *p* might increase or decrease depending on the properties of $\varepsilon(\cdot)$. Figure 1 provides a graphical representation of how the effects of a rise in competition might differ according to the slope of $m(x)$, which in turn depends on the characteristics of $\varepsilon(\cdot)$.

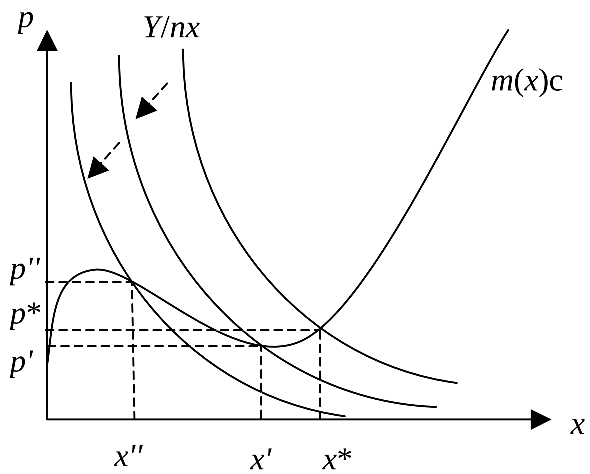

Figure 1: A non-monotonic elasticity case

In Appendix 1 we illustrate the alternative cases of CARA (Constant Absolute Risk Aversion: see Bertoletti, 2006 and Behrens and Murata, 2007) and CES preferences (see e.g Krugman, 1980), leading respectively to a result of price decrease and of no change in price after an increase in competition.

On the contrary, the condition for demand elasticity to grow (locally) is easily derived as:

$$\frac{1}{u'(x)} - \frac{1}{u''(x)x} < \frac{u'''(x)}{u''(x)^2}. \tag{6}$$

Inequality (6) requires $u''' > 0$ in the relevant interval, i.e., a convex individual demand curve for the single firm under monopolistic competition. Condition (6) can be written in several forms, but it is basically a condition of "decreasing relative risk aversion", which would be satisfied for instance by an appropriately chosen Hyperbolic Absolute Risk Aversion (HARA: see e.g. Merton, 1971) sub-utility function $u(\cdot)$. To satisfy (5) and (6), we assume that preferences can be described by a functional form for $u(\cdot)$ in the class:

$$u(x_i) = \frac{x_i^\rho}{\rho} + \frac{x_i^\gamma}{\gamma}, \tag{7}$$

where $0 < \rho < \gamma \leq 1$, or

$$u(x_i) = \ln x_i + \frac{x_i^\gamma}{\gamma}, \tag{8}$$

where $0 < \gamma < 1$, for $i = 1, ..., N$. We call the preferences represented by $U(\cdot)$ under (7) or (8) "Increasing Elasticity of Substitution" (IES) preferences. Note that if $\rho = \gamma$ in (7) preferences would be CES: indeed (7) and (8) are combinations of two "CES expressions", respectively with elasticity of substitution $1/(1 - \rho)$ and $1/(1 - \gamma)$ ($\ln x$ in (8) corresponds to the "Cobb-Douglas case" with $\rho = 0$ and unit elasticity of substitution). In what follows, without loss of generality, to illustrate the case of IES preferences we use (7) and assume $\gamma = 1$: i.e.:

$$u(x_i) = \frac{x_i^\rho}{\rho} + x_i, \tag{9}$$

for $i = 1, ..., N$.

Under (9), we obtain:

$$p_i(x_i) = \frac{1 + x_i^{\rho-1}}{\lambda}, \quad \varepsilon(x) = \frac{1 + x^{1-\rho}}{\rho - 1}, \quad m(x) = \frac{1 + x^{1-\rho}}{\rho + x^{1-\rho}}. \tag{10}$$

Note that the elasticity of substitution $\sigma(x) = - \varepsilon(x)$ increases with respect to the scale of consumption, with:

$$\sigma(0) = \frac{1}{1-\rho}, \quad \lim_{x\to\infty} \sigma(x) = \infty. \tag{11}$$

Whenever the representative consumer has IES preferences, an increase in the number of firms/varieties (for a given disposable income Y), makes it less elastic for any given price by shifting down the residual demand of each variety. This, in turn, implies an increase in the equilibrium price $p(n)$. Conversely, when the number of firms (varieties) decreases (assuming that it is still large enough to validate the "monopolistic competition hypothesis" implicit in equation (3)), the scale of consumption increases and the market price tends to marginal cost. i.e., $p'(n) > 0$ and:[6]

$$m(0)=\frac{1}{\rho}, \quad \lim_{x\to\infty} m(x)=1. \tag{12}$$

Are the equilibrium values unique and can they be given an explicit expression? The equilibrium value $x(n)$ is implicitly given by the condition:

$$\frac{Y}{nc} = m(x)x = \frac{x + x^{2-\rho}}{\rho + x^{1-\rho}}, \tag{13}$$

and it is easily proved to be unique since the function in (1) is steeper than the one given by (4) at any point such that (13) is satisfied (i.e., the equilibrium *loci* (1) and (4) only cross once under IES preferences). The situation is described in Figure 2.

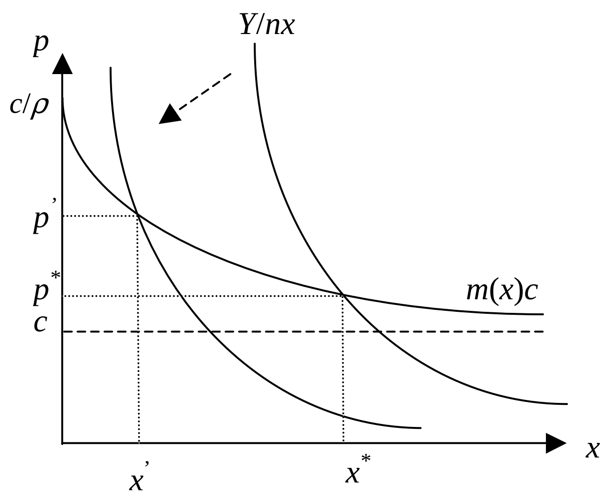

Figure 2: the IES case

Accordingly, an increase in the number of competitors does increase the equilibrium price, while it decreases each firm's revenue and profit, and the consumption of each variety. The latter fact implies a decrease in the equilibrium elasticity of substitution between any two varieties, which provides a rationale for the result. What happens to consumers' welfare is not obvious, since consumers pay higher prices but also enjoy a higher product variety, and it is investigated in next section. Interestingly, price-increasing competition under IES preferences for the representative consumer can also be extended to an oligopoly (*à la* Cournot) version of the previous setting, in

[6] More generally: under preferences given by (7), one finds that as x tends to infinity σ tends to $1/(1 - \gamma)$ and m tends to $1/\gamma$, while under preferences (8) $\sigma(0) = 1$ and m tends to infinity as x tends to zero.

which the number of competitors directly affects the mark-up. The proof of this result is outlined in Appendix 2.

One could wonder how realistic IES preferences are as a description of consumer attitudes towards product variety. Here we propose the following exercise of introspection. Consider you own some units of a given commodity in different varieties (the same number of units for each variety). With IES preferences you would regard any two units of different varieties to be closer substitutes when you have many of them than when you have a few. With CES preferences the substitutability across varieties does not change with the number of units of each variety, while according to Krugman's (1979) preferences as the number of units goes up varieties become less substitutable. Which assumption does appear more consistent with your own preferences?

Notice that (10) shows that, interestingly, if firms had different (constant) marginal costs (i.e., with $c_j \neq c_i$), IES preferences would result in more efficient firms having smaller mark-ups and larger sizes. This prediction is in sharp contrast with the implications both of the DS and Krugman's (1979) models, and in principle offers a way to test empirically the IES hypothesis. It is worthy to note that it also differs from what is implied by traditional (asymmetric) Cournot equilibria.

3 Free-entry equilibrium and welfare implications

Following Dixit and Stiglitz (1977: section II), we can compare the (long-run) equilibrium that would arise in our setting under market free entry if the production of each potential variety also involves some fixed set-up cost $F > 0$, with a constrained (no lump-sum transfers) social optimum. The market equilibrium must satisfy the zero-profit condition:

$$p = c + \frac{F}{x}. \tag{14}$$

Together with (1) this gives the condition:

$$m(x^e) = \frac{cx^e + F}{cx^e}, \tag{15}$$

which characterises the free entry market equilibrium. The latter has to be compared with the social optimum which maximises $U = nu(x)$, under the constraint that $Y = ncx + nF$. The FOCs for the stated problem imply:

$$\frac{1}{\phi(x^c)} = \frac{cx^c + F}{cx^c}, \quad (16)$$

where $\phi(x) = u'(x)x/u(x)$ is the elasticity of utility $u(\cdot)$.

Given that under IES preferences $m(x) < \phi(x)^{-1}$, it can be easily proved that (15) and (16) uniquely define x^e and x^c, with $x^e > x^c$. Accordingly, by (14), under the free entry hypothesis the number of varieties (n^e) and their price (p^e) are lower than in the social optimum (n^c and p^c). Therefore, a social planner would introduce more varieties, expand less their production and price them higher with respect to the free entry market equilibrium.

An intuition for these results can be grasped by looking at the sign of $\phi'(\cdot)$, as suggested by Dixit and Stiglitz (1977: pp. 303-4). As defined above, $\phi(x)$ is the ratio between $u'(x)x$ and $u(x)$. The numerator is proportional to each firm's revenue, while the denominator measures the contribution of each variety to consumer welfare: accordingly, ϕ is a sort of "appropriability ratio". Therefore, if $\phi'(\cdot) > 0$, at the margin each firm finds it profitable to produce more than the social optimum. This is indeed the case under IES preferences, since

$$\frac{\phi'(x)x}{\phi(x)} = \frac{1}{m(x)} - \phi(x). \quad (17)$$

This result is coherent with Dixit and Stiglitz's (1977) suggestion that the free market equilibrium might well involve fewer and bigger firms with respect to the (constrained) social optimum. However, Dixit and Stiglitz (1977: p. 304) based their presumption on the expectation of a positive correlation between $\phi(\cdot)$ and $|\varepsilon(\cdot)^{-1}|$. We show that under IES preferences the free entry market equilibrium has too little product diversity even if $\phi(\cdot)$ and $|\varepsilon(\cdot)^{-1}|$ are not positively related.

To compare our result with the case of CES preferences, notice that, as shown by Mankiw and Whinston (1986), with product diversity entry always entails two kinds of externalities: a "non-appropriation of consumer surplus" effect and a "business stealing" effect. The former deters entry, since firms do not internalise all the surplus entry creates, while the latter encourages too many firms to enter, since they are not affected by the reduction of other firms' profit. For the CES case, these two forces exactly cancel out, and the free entry equilibrium is a second-best optimum: see e.g. Anderson (2008). With IES preferences, the "non-appropriation of consumer surplus" effect dominates and the equilibrium number of firm is socially insufficient.

This welfare result also suggests that the entry of a new competitor (out of the free-entry equilibrium) can raise consumer welfare, even if associated with a price increase. This is what actually happens under IES preferences. Indeed, by using (1) and (4) it is easily computed that:

$$\frac{x'(n)n}{x(n)} = -\frac{m(x(n))}{m'(x(n))x(n) + m(x(n))}. \tag{18}$$

It follows that an increase in the number of competitors increases consumer welfare $nu(x(n))$ if and only if:

$$\frac{1}{\phi(x(n))} > \frac{m(x(n))}{m'(x(n))x(n) + m(x(n))}. \tag{19}$$

Given that profit maximisation, even under price-increasing competition, implies that an increase in the number of competitors reduces firm's profits, the following condition must hold:

$$m'(x(n))x(n) + m(x(n)) > 1. \tag{20}$$

Thus $\phi' > 0$ is a *sufficient* condition for more monopolistic competition to deliver a consumer welfare improvement.

Finally, to complete the comparison among the monopolistic competition cases of CES, CARA and IES preferences, consider the benchmark (partial equilibrium) case of two identical markets which join (for example due to the opening of international trade). If the number of firms is allowed to adjust to its free-entry equilibrium value, it is easy to see[7] that prices and the (total) number of firms respectively keep constant, decrease or raise (while the size of each firm keeps constant, increases or decreases) in the CES, CARA and IES cases, in principle providing further empirically testable implications of the different models.

4 Conclusions

In this paper we have introduced IES preferences in the monopolistic competition framework of Dixit and Stiglitz (1977) and shown that in such a case (with a constant marginal cost): (a) more monopolistic competition results in a price increase; (b) despite the price increase, consumers are better off thanks to higher product diversity; (c) the constrained Pareto optimum has more varieties, higher prices and smaller quantities than the market long-run equilibrium of free entry.

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[7] By redefining x as the quantity of each variety consumed by any "individual", which is now half of the production of each firm, one can still use equations (1), (4) and (modified) (14) to analyze the market equilibrium.

Accordingly, globalisation may beneficially affect an industry through an increase in the number of firms accompanied by a raise in the mark-up and a size reduction. It remains an open question whether, under a different class of preferences, an increase in the number of firms leading to a price increase could actually make consumers worse-off in a monopolistic competition setting.[8] We have also shown that, under IES preferences, a case for price-increasing competition can be made also in an oligopoly setting *à la* Cournot.

Our results add to the small set of papers (Hollander, 1987, Chen and Riordan, 2006 and 2008, and Cowan and Yin, 2008) which have considered the case for price-increasing competition in models with differentiated products. However, our setting differs from theirs on two grounds. Firstly, we use symmetric "non-address" product differentiation; secondly, since we adopt a Chamberlinian model of monopolistic competition, firms compete non-strategically. Thus, our results complement and strengthen the previous findings in the literature.

We suggested in the Introduction that, by proposing an explicit (and simple) micro-foundation for a countercyclical mark-up based on consumer preferences, our setting should be of some interest for the many applications of the monopolistic competition framework, in particular for the "endogenous market structure" literature. Our results might for example provide useful insights on the empirical puzzle posed by non-decreasing price-cost margins following globalisation and market reforms (usual explanations are based on supply-side factors: see e.g. Griffith, Harrison and Simpson (2006), Boulhol (2006) and (2008)).

Finally, we noticed in section 2 that the key to generate price-increasing results in a monopolistic competition setting is a condition of "decreasing relative risk aversion" of the sub-utility function $u(\cdot)$, which implies an increasing elasticity of substitution with respect to the scale of consumption. Dixit and Stiglitz (1977: p. 304) write: "*… we would normally expect that as the number of commodities produced increases, the elasticity of substitution between any pair of them should increase. In the symmetric equilibrium, this is just the inverse of the elasticity of marginal utility. Then a higher x would correspond to a lower n, and therefore a lower elasticity of substitution …*". As discussed above, this suggestion is seemingly taken up by Krugman (1979), who assumes a decreasing elasticity of substitution and comments this way: "... [*this assumption*] *seems to be necessary if this model is to yield reasonable results, and I make the assumption without apology*." (Krugman, 1979: p. 476). However, the previous intuition seems misplaced. As a matter of fact, due to *additive* symmetric preferences, in a symmetric equilibrium of monopolistic competition the elasticity of substitution between any two varieties does *not* depend *directly* on the number of

[8] As Dixit & Stiglitz (1977: p. 304) argued, there is no a necessary relation between the signs of $\phi'(\cdot)$ and $m'(\cdot)$.

varieties actually consumed.[9] The relevant question is rather how the elasticity of substitution might change according to the scale of consumption. We have argued that, to describe consumers tastes concerning a differentiated industry, IES preferences are not a priori less plausible than the popular CES ones, deserve to be investigated and should be empirically easily testable. Indeed, this paper shows that the assumption of a non-increasing elasticity of substitution is not necessary for monopolistic competition to yield "reasonable results".

Appendix 1: Examples of different monopolistic competition effects on prices

In this Appendix we show two examples of utility functional forms leading, within the monopolistic-competition framework *à la* Dixit-Stiglitz (1977), respectively to no change and a decrease in the equilibrium price after an increase in the number of monopolistic competitors.

1. The CES case (Dixit and Stiglitz, 1977, and Krugman, 1980)

Suppose that:

$$u(x_i) = \frac{x_i^{\rho}}{\rho} \qquad \text{(A1.1)}$$

for $i = 1, ..., N$, with $0 < \rho < 1$: i.e., $u(\cdot)$ is a "constant relative risk aversion" (sub-)utility function. Preferences are CES, and demand elasticity is constant and given by $\varepsilon = 1/(\rho - 1)$, with $m = 1/\rho$. Figure 1 shows the effect of an increase in the number of varieties:

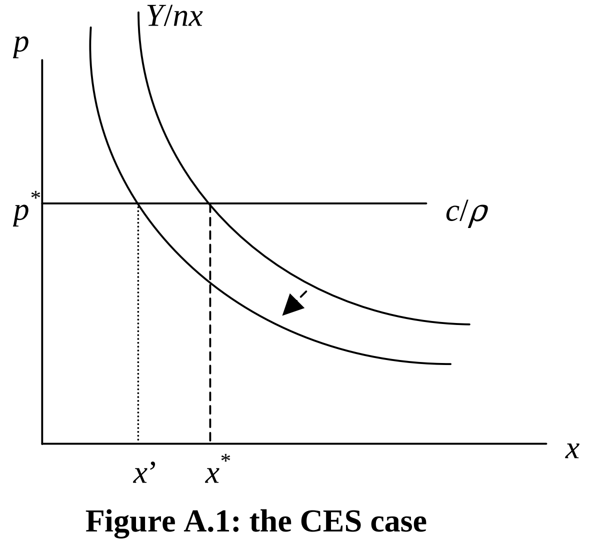

Figure A.1: the CES case

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[9] This was first noticed by Pettengill (1979: p. 960), and acknowledged by Dixit & Stiglitz (1979: pp. 962-3) while pointing out that, in their setting, an increase in the number of commodities/firms does not increase the degree of crowding in the commodity space.

Note that in Figure A.1, an increase in the number of firms/varieties for a given level of nominal income decreases the amount of each of them, but leaves the equilibrium price unchanged. The obvious reason is that the optimal mark-up does not depend, in such a case, on the amount that is to be produced. Since the equilibrium values can be easily computed, the CES case has been tremendously popular in applications (especially in international trade and macroeconomic models).

2. The CARA case (Bertoletti, 1998 and 2006 and Behrens and Murata, 2007)

Assume that

$$u(x_i) = -\frac{e^{-\alpha x_i}}{\alpha}, \qquad \text{(A1.2)}$$

for $i = 1, ..., N$, with $\alpha > 0$. Therefore, $u(\cdot)$ is a "constant absolute risk aversion" (sub-)utility function, preferences are quasi-homothetic and $\varepsilon(x) = -1/(\alpha x)$, with $m(x) = 1/(1 - \alpha x)$ (this requires that α is small enough with respect to x). Demand elasticity increases along a given individual demand curve (the elasticity of marginal utility $u'(\cdot)$ is decreasing) and a smaller consumption is associated with lower prices in a symmetric equilibrium. The situation can be graphically represented as follows:

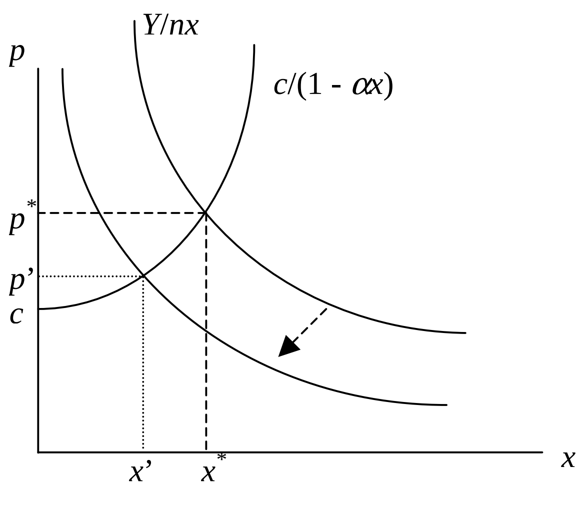

Figure A.2: the CARA case

Note that an increase in the number of varieties reduces both the consumption level of the single variety and its equilibrium price. The mark-up varies "procyclically", so that an increase in competition also benefits consumers through lower prices

Appendix 2: The case of price-increasing Cournot competition

In this Appendix we show that, under IES preferences, price-increasing competition can also arise in an oligopoly (*à la* Cournot) version of our setting. By using (1) and (2) one can easily derive the complete *inverse* demand function of the representative consumer:

$$p_i(\mathbf{x}) = \frac{u'(x_i)Y}{\sum_j u'(x_i)x_j}, \tag{A2.1}$$

which is decreasing with respect to x_i. Given (A2.1), it is straightforward to compute that the FOC for Cournot profit maximization is given by (it requires $u''(x)x + u'(x) > 0$):

$$\frac{\partial R_i(\mathbf{x})}{\partial x_i} = Y \frac{[u''(x_i)x_i + u'(x_i)](\sum_{j\neq i} u'(x_j)x_j)}{(\sum_j u'(x_j)x_j)^2} = c, \tag{A2.2}$$

and that the (global) satisfaction of (5) ensures that the "marginal revenue" $\partial R_i/\partial x_i$ is decreasing with respect to x_i..

It follows that in any *symmetric* equilibrium *à la* Cournot for which (A2.2) holds it must be that:

$$x = \frac{(n-1)[u''(x)x + u'(x)]}{n^2 u'(x)c} Y = \frac{(n-1)}{n^2 m(x)c} Y, \tag{A2.3}$$

with

$$p = \frac{n}{(n-1)} m(x)c. \tag{A2.4}$$

Thus, by using (1), the symmetric oligopoly equilibrium quantity $x_o(n)$ is defined by:

$$\frac{(n-1)Y}{n^2 c} = m(x)x. \tag{A2.5}$$

Since the left-hand-side of (A2.5) does not increase with respect to n if $n \geq 2$, and the right-hand-side is increasing with respect to x, it follows that an increase in the number of competitors/varieties decreases $x_o(n)$. Such an increase in competition also raises the equilibrium price p_o if and only if it decreases nx, i.e., if and only if the elasticity of $x_o(n)$ is less than – 1. Since:

$$\frac{x_o'(n)n}{x_o(n)} = \frac{2-n}{n-1} \frac{m(x_o(n))}{m'(x_o(n))x_o(n) + m(x_o(n))}, \tag{A2.6}$$

the condition for price-increasing oligopoly competition is equivalent to:

$$-\frac{m'(x_o(n))x_o(n)}{m(x_o(n))} > \frac{1}{n-1}. \tag{A2.7}$$

Condition (A2.7) is not obviously satisfied in any case of IES preferences (for any value of *Y*/*n*); however, consider the (limiting) case of (8). Computation shows that, under (8):

$$m(x) = \frac{1+x^{\gamma}}{\gamma x^{\gamma}}; \tag{A2.8}$$

and

$$\frac{m'(x)x}{m(x)} = -\frac{\gamma}{1+x^{\gamma}}. \tag{A2.9}$$

Accordingly, under (8), (A2.7) is equivalent to:

$$(n-1)\gamma - 1 > x_0(n)^{\gamma}, \tag{A2.10}$$

which must hold when *n* is large enough.

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