Endogenizing monopolistic competition*

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Abstract

We show that a market involving a handful of large-scale firms and a myriad of small-scale businesses may give rise to different types of market structure, ranging from monopoly or oligopoly to monopolistic competition through new types of market structure. In particular, we find condition under which the free entry and exit of small firms incentivizes the big firms to sell their varieties at the monopolistically competitive prices, as if they were to behave like multi-divisionalized firms. The structure of preferences is the main driving factor for a specific market structure to emerge as an equilibrium outcome.

Keywords: dominant firms, competitive fringe, monopolistic competition, contestability.

JEL Classification: D43, F12 and L13.

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1 Introduction

According to Bruce D. Henderson, the founder of the Boston Consulting Group, "a stable competitive market never has more than three significant competitors." Using a sample of more than 160 U.S. industries, two base-time periods, and numerous performance measures, Uslay et al. (2010) find that most industries consist of three large generalists and numerous small and specialized producers, which succeed if they are able to operate in a niche market. However controversial the so-called "Rule of Three," it seems unquestionable that many industries are dominated by a handful of big firms, which share the market with many small firms. Using a sample of 50,000 U.S. firms, Hottman et al. (2014) observe almost 90 percent of sales in a product group are produced by 10 percent of firms, while 98 percent of firms have market shares smaller than 2 percent. These authors conclude their analysis as follows: "We find that most firms charge markups close to the monopolistic competition benchmark of constant markups, because most firms have trivial market shares, and hence are unable to exploit their market power. However, the largest firms that account for up to around 25 percent of sales within sectors charge markups between 32 and 120 percent higher than the median firm."

In this paper, we acknowledge that in many markets big and small firms compete for the same customers. To study such markets, we build on Aumann (1964) and combine two *kinds* of firms: a discrete number of atomic players, which represent the big firms, and a continuum of nonatomic players, which represent the fringe. The continuum assumption made to describe the fringe distinguishes monopolistic competition from other market structures in that it is the formal counterpart of the basic idea that a firm's action has no impact on the others. Our setting thus blends oligopolistic and monopolistically competitive firms, which all produce different varieties of a differentiated product. Formally, a big firm supplies a positive measure range of varieties, whereas a small firm supplies a single variety. Owing to their product scope difference, it is reasonable to believe that firms adopt different attitudes toward competition. In this paper, we assume that the big firms understand that they can strategically manipulate the entire market, whereas the small firms, which are each negligible to the market, choose their outputs (or prices) while accurately treating market conditions as given.

In the wake of general equilibrium models with imperfect competition (Gabszewicz and Vial, 1972; Hart, 1985), we assume that big firms are aware that their choices affect both consumers' income and the size of the competitive fringe. For this reason, we find it natural to describe the market process as a two-stage game. In the first stage, the big firms choose their outputs (or prices), anticipating the reactions of the small firms. In the second stage, the small businesses choose their outputs (or prices), treating the big firms' choices parametrically. In other words, the small firms may enter or exit the market, whereas the big firms always stay in business. Although somewhat extreme, this difference in entry behavior aims to fit a fairly robust empirical fact, i.e. the survival probability of a firm is positively correlated with its size. This staging is similar to the one used in the dominant firm model in which one big firm chooses its sale price while anticipating the reactions of a large number of small firms that treat this price as a given (Markham, 1951). Note, however, the difference between this model, where the mass of small firms is exogenous, and ours, where it is endogenous. We will see that allowing the mass of small firms to vary through free entry and exit has several unsuspected consequences.

Our main findings may be summarized as follows. In Section 2, we start by revisiting Dixit (1979) and ask when an incumbent selling a differentiated product chooses to deter or to accommodate the entry of a monopolistically competitive fringe. Like in Dixit and many others, consumers are endowed with quadratic preferences, but here these preferences are defined over a continuum of varieties (Ottaviano et al., 2002). The scope of the incumbent is given by the range of varieties it supplies. Not surprisingly, when this range is wide enough relative to the market size, entry in blockaded and the incumbent remains an unconstrained monopolist. When the market size rises, the incumbent chooses to deter entry by selling a bigger quantity of each of its varieties. Last, entry is accommodated when the size of the market is sufficiently large. These results echo those obtained by Dixit (1979). The novelty lies in the behavior of the incumbent when entry is accommodated.

Since the incumbent moves first by committing to a certain production capacity, the demand for each of its varieties must account for the reaction of the monopolistically competitive fringe. Every small firm being negligible to the market, it rationally chooses its output as a monopolist maximizing its profit on its residual demand. Conditional upon this, the small firms react to the big's firm behavior only by entering or exiting the market. Although the incumbent can manipulate the total output available on the market through its own output, hence the entry or exit of small firms, it realizes that the mass of small firms varies in a way such that the equilibrium aggregate output is the same regardless of its own behavior. In other words, *the fringe acts as a buffer that stabilizes competition* by making the aggregate output constant. As a consequence, when it chooses its output the incumbent accurately treats this aggregate as a parameter.

This has a far-reaching implication for the big firm: the "residual" inverse demand for each of its varieties now depends *only* upon the quantity at which it sells this particular variety. Therefore, the big firm may be broken down into horizontal profit-maximizing divisions that produce and sell each a single variety. The big firm then lets each division competing with the others, as well as with the firms belonging to the monopolistically competitive fringe. As a consequence, the big and small firms choose to sell their varieties according to the same pricing rule as the small firms, that is, *all firms operate under monopolistic competition*. However, all firms need not sell at the same price and have the same markup because the big and small firms are likely to have different marginal costs. In sum, the presence of a monopolistically competitive fringe vastly changes the behavior of the big firm, which otherwise may behave strategically. But why is it so?

It is well known that, under quadratic preferences, the inverse demand for a variety depends on two variables, that is, the quantity sold of this variety, as well as the total output bought by consumers. Hence, the market process has the nature of an aggregative game in which the total output is the market statistic. However, our setting differs from standard aggregative games because the equilibrium value of the market aggregate is here *independent* of the big firm's strategy. Therefore, the incumbent finds it rational not to try manipulating the market. In other words, each division chooses its profit-maximizing output without accounting for the output selected by the others. We call this the *dilution of market power*.

The dilution of market power has a strong contestability flavor. Indeed, the entry of small firms, which act non-strategically, suffices to discipline the big firm as this one chooses sell its output as the small firms do. What is surprising (at least to us) is the fact that adopting such an aggressive behavior is rational on the part of the big firm. Note also the difference with Baumol (1980) and others. The threat of entry is not sufficient here to make the market more competitive. It is the *turnover* of small firms that incentives the incumbent to become non-strategic and, therefore, as competitive as the small firms. Another major difference is that the key factor lies in the nature of preferences, rather than in cost considerations.

Last, if the big firm faces an exogenous shock that lowers (raises) its marginal cost, this firm chooses to increase (decrease) its output. Therefore, fewer (more) small firms remain in business, the reason being again that the total output is constant. In this case, we say that there is *stabilization of competition*. Stabilization means here that, although the incumbent's new strategy affects the market aggregate when the mass of small firms is exogenously given, the aggregate remains constant because the small firms are free to entry or exit the market in response to the big firm's new strategy.

It is worth stressing that those two properties, i.e. the dilution of market power and the stabilization of competition, hold true when the market involves several big firms and when all firms are heterogeneous. Furthermore, when the big firms chooses to accommodate the entry of a monopolistically competitive fringe, both the big and small firms are equally aggressive. This is to be contrasted with Etro (2008) who shows that the leaders are more aggressive than the followers when only big firms are free to enter the market in the second stage of the game. This difference in results is due to the fact that, in our setting, the followers select an aggressive strategy by pricing at average cost. Therefore, the leaders cannot adopt a more aggressive behavior than the followers.

In short, *our setting allows for an endogenous determination of market structure*: according to the size of the market there is either oligopolistic competition or monopolistic competition. The dilution of market power and the stabilization of competition properties are definitely not standard in theories of imperfect competition. It is, therefore, important to find out how robust these two properties are? More precisely, under which market conditions can we expect the dilution of market power, the stabilization of competition, or both to remain valid. This is the question we address in Section 3.

We show that the dilution of market power and the stabilization of competition hold for all preferences such that firms' profits depend only upon their own strategy and a single market aggregate. We also assume that the aggregate must affect profits either positively or negatively, which means that a firm's strategy and the market aggregate are either complements or substitutes. We then illustrate this result by assuming additive preferences. Examples of such preferences include the CES (Dixit and Stiglitz, 1977) and the CARA (Behrens and Murata, 2007). Whereas most industrial organization models assume the existence of an outside good, the profits earned by the big firms are here distributed to consumers whose income is thus endogenous. Given the prevalence of the CES model of monopolistic competition in many economic fields, it is important to know when this market structure provides a good description of the way real markets work. In a sense, this is what we accomplish in Section 3 by identifying conditions under which monopolistic competition emerges as the equilibrium outcome in the market that involves both large and small firms.

In Section 4, we consider the case where profits depend on two or more aggregates. To highlight the effects at work, we return to the baseline model of Section 2, but without assuming the presence of an outside good. Consumers' purchasing behavior is then restricted by their incomes. Under such circumstances, the inverse demand for a variety depends on *two* distinct aggregates, namely the total output, as in Section 2, and the marginal utility of income, as in Section 3. **In this case, the zero-profit condition associated with free entry and exit does not allow one to pin down the equilibrium values of the two aggregates, so that the size of the monopolistically competitive fringe affects the large firm's profits. Results are clear-cut: the stabilization of competition and the dilution of market power do not hold, and thus we back to a setting akin oligopolistic competition in which the monopolistically competitive fringe behaves like a pseudo-player.**

Having said that, the following question suggests itself: is the presence of two monopolistically competitive fringes sufficient to retrieve the two desired properties? For two fringes to coexist in equilibrium, fringe 1's firms, say, must have a lower marginal cost than fringe 2's firms, whereas the fixed cost of the former must exceed the fixed cost of the latter. In this case, both the stabilization of competition and the dilution of market power are restored. Although we show this result in the case of two particular market aggregates, it is readily verified that it remains valid for other preferences and aggregates.

Section 5 concludes.

Related literature. The foregoing discussion shows that our paper is related to different strands of literature, including industrial organization, trade theory and general equilibrium under imperfect competition. In what follows, we discuss the most relevant contributions. Building on cooperative game theory, Gabszewicz and Mertens (1971) and Shitovitz (1973) show the following: when large traders are similar to each other, or when for each large trader there are small traders similar to it, the core of an exchange economy coincides with the set of competitive allocations. Under these circumstances, the market power of big traders is diluted (Gabszewicz, 2002). Our results have a similar flavor. However, as suggested by Okuno et al. (1980), it is more natural to study such issues in a non-cooperative setting, which is what we accomplish in this paper. Our paper is more directly linked to Shimomura and Thisse (2012) and Parenti (2014) who study a market structure in which oligopolistic and monopolistically competitive firms interact simultaneously. **Their results and ours will be compared in the concluding section**. Etro (2006, 2008) models the idea of big and small firms by assuming that a firm is big when it is the leader of a Stackelberg game, whereas the small firms are the followers. Unlike us, the small firms are able to manipulate the market outcome. Neary (2010) suggests a different approach in which firms choose to be big or small. Instead, we assume that firms are born big or small, but our results show that, under some conditions, the differences in kind is immaterial for the equilibrium outcome.

Closer to us is the approach developed by Anderson et al. (2013). The great merit of this paper is to link together results that are a priori disparate. Once firms have chosen to enter, their profits depend on their own action and an aggregate of all firms' actions. Anderson et al. determine conditions under which the aggregate stays the same under free entry and shocks on parameters and market institutions (the stabilization of competition). These conditions include the existence of firms that make zero profits in the free entry equilibrium. In our setting, such firms are those belonging to the monopolistically competitive fringe. Although Anderson et al.'s paper and ours may be alike in some respects, they are different in several others. While Anderson et al. show that the stability of competition may arise under different regimes, we are interested in studying the impact of a monopolistically competitively competitive fringe on the market outcome when the big firms act as the leaders and the small firms as the followers. This staging, which we borrow from the dominant firm model, allows us to explore the dilution of market power. Second, Anderson et al. impose restrictions on the aggregate, while the aggregator is given here by *any* function mapping firms' strategies into a scalar. Last, our analysis is not restricted to the case of a scalar aggregate as we show that the stabilization and dilution properties hold true when the number of aggregates and fringes is the same. For all these reasons, the two papers are to be viewed like complements rather than substitutes.

2 The dominant-firm model revisited

2.1 The case of one big firm

The economy involves two goods - a horizontally differentiated good and a homogenous good - and one production factor - labor. The labor market is perfectly competitive and labor is chosen as the numéraire.

As discussed in the introduction, our aim is to study a mixed market involving big and small firms characterized by different market behaviors: one *big* firm can manipulate the market aggregate that affect their profits, whereas a large number of *small* firms are unable to influence this aggregate. The small firms react to the big firm's behavior by choosing to enter/exit the market as well as their output volume once they are in business. As said in the introduction, we capture the difference between big and small firms by assuming that the supply side of the economy involves (i) a continuum M of single-product (SP-) firms and (ii) one multi-product (MP-) firm that supplies a given range $[0, n]$ of varieties. We refer to $n > 0$ as the *scope* of the big firm and to the array of small firms as the *monopolistically competitive fringe*.

Whereas M is endogenous, we treat n as exogenous. In this way, we are able to capture the impact of the big firm's scope on the equilibrium market structure. Note, however, that the product range can be endogenized when the fixed cost of this firm $F(n)$ is $\cup$-shaped in the number n of varieties. In other words, the large firm enjoys scope economies when n is not too large, but faces scope diseconomies when n exceeds some threshold. The equilibrium value of n varies across the regimes considered below, which conceals the direct impact of n on the market outcome while making the formal analysis more cumbersome.

On the demand side, there is a continuum of identical consumers of unit mass or, equivalently, a representative consumer. Consumers share the same quadratic preferences nested into a linear upper-tier utility (Ottaviano et al., 2002):

$$\mathcal{U} = A + \mathbb{X} - \frac{\beta}{2}\left(\int_0^M x_i^2 \mathrm{d}i + \int_0^n X_k^2 \mathrm{d}k\right) - \frac{\mathbb{X}^2}{2}. \tag{1}$$

where

$$\mathbb{X} \equiv \int_0^M x_i \mathrm{d}i + \int_0^n X_k \mathrm{d}k \equiv \mathbb{X}_{sp} + \mathbb{X}_{mp} \tag{2}$$

is the total consumption (or total output since there is a unit mass of consumers) of the differentiated good, A the consumption of a homogeneous good, x_i the consumption of the variety provided by the SP-firm $i \in [0, M]$, and X_k is the consumption of the variety $k \in [0, n]$ provided by the MP-firm. Observe that $\mathbb{X}_{sp}$ ($\mathbb{X}_{mp}$) is the SP- (MP-) firms' total output in (2). The interaction across varieties is captured by $\mathbb{X}^2$. To ease the burden of notation, the coefficient of $\mathbb{X}$ in (1) is normalized to 1 by factorizing this coefficient, while the coefficient of $\mathbb{X}^2$ is also normalized to 1 by choosing appropriately the unit of the differentiated good. Hence, a lower value of β means a weaker love for variety, a larger market size, or both.

Each consumer is endowed with one unit of labor and an equal ownership share of all firms. She maximizes her utility subject to the budget constraint:

$$A + \int_0^M p_i x_i \mathrm{d}i + \int_0^n P_k X_k \mathrm{d}k \leq y \equiv 1 + \Pi + \int_0^M \pi_i \mathrm{d}i, \tag{3}$$

where p_i denotes the price of variety i and P_k the price of variety k, while Π stands for the profits earned by the MP-firm and π_i for the profits made by the SP-firm i.

First-order conditions for utility maximization with respect to each variety $i \in [0, M]$ and each variety $k \in [0, n]$ yield the following inverse demand functions:

$$p(x_i, \mathbb{X}) = 1 - \mathbb{X} - \beta x_i \qquad p(X_k, \mathbb{X}) = 1 - \mathbb{X} - \beta X_k. \tag{4}$$

For simplicity, we normalize here all marginal costs to zero and denote by $f > 0$ a SP-firm's fixed cost. Therefore, firm i's profits are given by

$$\pi_i = p(x_i, \mathbb{X})x_i - f.$$

Note that we have normalized the market size to 1. If the market size were given by L, the fixed cost f would be replaced with f/L in the analysis developed below. Therefore, a larger market is equivalent to a lower fixed cost f, which facilitates the entry of small firms.

The MP-firm's profits are given by

$$\Pi = \int_0^n p(X_k, \mathbb{X})X_k \mathrm{d}k. \tag{5}$$

Because each SP-firm is negligible, it accurately treats the total output $\mathbb{X}$ as a parameter. By contrast,

(2) shows that the big firm understands that its action affects the value of $\mathbb{X}$ through its total output $\mathbb{X}_{mp}$.

2.2 The market outcome

We investigate the outcome of a game in which the large firm is aware of the impact of its action on the monopolistically competitive fringe, whereas the small firms treat the big firm's action parametrically. In other words, the big firm is the leader and the small firms the followers of a sequential game. This staging may be justified on the following grounds. First, a big firm has the ability to commit to the market through the large investment it has to make to build its production capacity, which is typically chosen before marketing the product. Second, the assumption of free entry and exit reflects the high turnover characterizing small firms in many industries. One of the main reasons for such a high turnover is precisely that the small firms invest little money to be in business. We seek a subgame perfect Nash equilibrium and solve the game by backward induction.

2.2.1 Stage 2: the small firms' equilibrium strategies

A SP-firm observes the choice made by the MP-firm through the total output $\mathbb{X}_{mp}$ and chooses its profit-maximizing output. This yields the equilibrium output and profits as a function of $\mathbb{X}$:

$$x^*(\mathbb{X}) = \frac{1-\mathbb{X}}{2\beta} \qquad \pi^*(\mathbb{X}) = \beta\left(x^*(\mathbb{X})\right)^2 - f = \frac{1}{4\beta}\left(1-\mathbb{X}\right)^2 - f.$$

Since free entry and exit prevails in the SP-subsector, the zero-profit condition ($\pi^*(\mathbb{X}) = 0$) implies that the total output is constant and equal to

$$\mathbb{X}^* \equiv 1 - 2\sqrt{\beta f}. \tag{6}$$

Hence, in a mixed market equilibrium *the total output is independent of the big firm's action*: it depends only upon the preference parameter β, which measures the degree of differentiation among varieties, and the small firms' cost parameter f, which determines the easiness of entry in the fringe. However, $\mathbb{X}^*$ is independent of the scope n of the big firm.

Substituting $\mathbb{X}^*$ into $x^*(\mathbb{X})$ allows determining the equilibrium output of a small firm, and thus its equilibrium price:

$$x^* = \sqrt{\frac{f}{\beta}} \qquad p^* = \sqrt{\beta f}. \tag{7}$$

Therefore, small firms' equilibrium price and output are independent of the big firm's choice, which implies that the MP-firm influences the monopolistically competitive fringe through the mass of SP-firms only. In addition, the zero-profit condition implies that the SP-firms price their varieties at their average cost: $p^* = f/x^*$.

Using the equality

$$\mathbb{X}^* = \mathbb{X}_{mp} + M(\mathbb{X}_{mp})x^*,$$

we obtain the equilibrium mass of SP-firms M^* conditional upon $\mathbb{X}_{mp}$:

$$M^*(\mathbb{X}_{mp}) = (1 - \mathbb{X}_{mp})\sqrt{\frac{f}{\beta}} - 2f. \tag{8}$$

This expression shows that the SP-subsector acts as a *buffer* stabilizing the total output at the value $\mathbb{X}^*$ through a change in the equilibrium mass of SP-firms. When the MP-firm increases (decreases) its total output $\mathbb{X}_{mp}$, the size of the SP-subsector shrinks (expands). If $\mathbb{X}_D$ is the solution to the equation $M^*(\mathbb{X}_{mp}) = 0$, the monopolistically competitive fringe disappears when

$$\mathbb{X}_{mp} \geq \mathbb{X}_D \equiv 1 - 2\sqrt{\beta f}.$$

2.2.2 Stage 1: the large firm's equilibrium strategy

The MP-firm chooses its output anticipating SP-firms' optimal responses. In other words, the MP-firm treats $\mathbb{X}^*$ as a given. Thus, the MP-firm's adjusted inverse demand for each its variety k is defined as follows:

$$p(X_k, \mathbb{X}^*) = 1 - \mathbb{X}^* - \beta X_k \qquad \text{if } \mathbb{X}_{mp} < \mathbb{X}_D, \tag{9}$$

$$p(X_k, \mathbb{X}_{mp}) = 1 - \mathbb{X}_{mp} - \beta X_k \qquad \text{if } \mathbb{X}_{mp} \geq \mathbb{X}_D.$$

As in Bain (1956) and Dixit (1979), the entry of small firms may be (i) blockaded, (ii) deterred, or (iii) accommodated by the incumbent. Dixit shows that the strategy chosen by the incumbent depends on the entry cost of the potential entrant relative to the market size. In the foregoing, we study what these three regimes become when entrants are small firms. The main distinctive feature of our approach lies in the asymmetry between the two kinds of firms.

Blockaded entry. Assume that the big firm is an unconstrained monopolist. In this case, it is readily verified its profit-maximizing output and profits are given by

$$\mathbb{X}_{mp}^* = \mathbb{X}_B \equiv \frac{n}{2(\beta + n)} \qquad \Pi_B(n) \equiv \frac{n}{4(\beta + n)}. \tag{10}$$

This market configuration arises when $\mathbb{X}_D \leq \mathbb{X}_B$.

Entry deterrence. Assume now that $\mathbb{X}_D > \mathbb{X}_B$. When the incumbent chooses an output preventing the entry of small firms, then $\mathbb{X}_{mp}^*$ must be such that $M^*(\mathbb{X}_{mp}^*) = 0$, that is, $\mathbb{X}_{mp}^* \geq \mathbb{X}_D$. Let us show that the equality holds in equilibrium. Being equal to the smallest value of $\mathbb{X}$ that deters entry, $\mathbb{X}_D$ has the nature of a "limit output." If the incumbent chooses to deter entry, its profit-maximizing output is given by $\mathbb{X}_D > \mathbb{X}_B$. Since profits (5) are strictly concave and maximized at $\mathbb{X}_B$, the incumbent's profits earned at $\mathbb{X}_{mp}^* > \mathbb{X}_D$ must be lower than those it makes at $\mathbb{X}_D$. Therefore, $\mathbb{X}_{mp}^* = \mathbb{X}_D$, and thus the incumbent's profits are equal to

$$\Pi_D(n) = \mathbb{X}_D \left[1 - \left(1 + \frac{\beta}{n}\right) \mathbb{X}_D\right]. \tag{11}$$

Accommodating entry. When entry is accommodated, the incumbent faces an inverse demand for variety k that accounts for the mass $M^*(\mathbb{X}_{mp})$ of small firms that enter the market in the second stage. Although the MP-firm is a priori able to manipulate $\mathbb{X}$ through $\mathbb{X}_{mp}$, it anticipates that the mass (8) of SP-firms will adjust in a way such that the equilibrium value of $\mathbb{X}$ is always stabilized at $\mathbb{X}^*$ regardless of the value taken by $\mathbb{X}_{mp}$. As a consequence, the MP-firm accurately treats $\mathbb{X}^*$ as a parameter, so that the demand for its variety k is given by

$$p(X_k, \mathbb{X}^*) = 1 - \mathbb{X}^* - \beta X_k.$$

Using (6), it is straightforward to show that the profit-maximizing output and price of variety k under accommodating entry are given by

$$X^* = \sqrt{\frac{f}{\beta}} \qquad P^* = \sqrt{\beta f},$$

which are the same as those given by (7), that is, the equilibrium output and price of a SP-firm. Therefore, the big firm's total output is given by $\mathbb{X}_A^* = nx^*$, and thus its equilibrium profit under accommodated entry is equal to

$$\Pi_A(n) = nf. \tag{12}$$

Equilibrium. We now determine under which conditions on the parameter n each of the above three configurations is the market equilibrium.

(i) Entry is blockaded if and only if $\mathbb{X}_B$ weakly exceeds $\mathbb{X}_D$, which is equivalent to the condition

$$n \geq n_B \equiv 2\beta \frac{\mathbb{X}_D}{1 - 2\mathbb{X}_D}. \tag{13}$$

Since $\mathbb{X}_B = (1/2)n/(\beta + n) < 1/2$, $\mathbb{X}_D$ must be smaller than $1/2$ for $\mathbb{X}_B$ to exceed $\mathbb{X}_D$. In other words, if the incumbent is sufficiently large, the market sufficiently small (f is high), or both, then the monopolist may accurately ignore the potential entry of SP-firms. Otherwise, entry can never be blockaded. This is because the market size is too large (f is too small) for the big firm to ignore the small firms. In this event, does the incumbent deter or accommodate entry?

(ii) Assume now that $\mathbb{X}_D > \mathbb{X}_B$ or, equivalently, $n < n_B$. If the incumbent chooses to deter entry, its profits are given by (11). By contrast, if the incumbent accommodates entry, its profits are given by (12). As a consequence, the incumbent chooses its limit output $\mathbb{X}_D$ if and only if $\Pi_D(n) \geq \Pi_A(n)$. When the equality prevails, it must be that $nX_k^* = \mathbb{X}_D$, which holds if n is equal to

$$n_A \equiv 2\beta \frac{\mathbb{X}_D}{1 - \mathbb{X}_D}. \tag{14}$$

Observe that n_A is positive and finite because $\mathbb{X}_D < 1$. Moreover, n_B always exceeds n_A.

Therefore, if $n_A < n < n_B$, the big firm chooses to deter the entry of small firms by choosing the limit output $\mathbb{X}_D$.

(iii) Last, when $n \leq n_A$, the MP-firm accommodates the presence of SP-firms. In this event, the big firm chooses to sell the quantity x^* given by (7) for each of its varieties, which it prices at the same level as the varieties sold by the small firms. In other words, *if the big firm is not "too" big, the market is governed by monopolistic competition.*

To sum up, the nature of the equilibrium depends on the scope of the big firm, whereas it depends on the entry cost in the standard duopoly setting (Dixit, 1979). As n steadily decreases, the incumbent's profits and markups (weakly) decrease, thus implying that the big firm's market power fades away (see Figure 1 for an illustration). During this process, *the market outcome displays a continuous transition from pure monopoly to monopolistic competition* through entry deterrence. Note that the same holds when the market size keeps rising, where as n remains constant.

Insert Figure 1 about here

2.3 The case of several big firms

Let us now show that results similar to those obtained above remain valid when there are $N > 1$ big firms, where firm $j = 1, .., N$ supplies a mass $n_j > 0$ of varieties. We keep the same notation as in the foregoing, so that the total output $\mathbb{X}$ is now given by

$$\mathbb{X} = \int_0^M x_i \mathrm{d}i + \sum_{j=1}^{N} \int_0^{n_j} X_{jk} \mathrm{d}k.$$

Even though we assume throughout that N is exogenous, the equilibrium number N^* of large firms can be determined by free entry. Given N^*, the argument develop here applies. In other words, the free entry of large firms need not deter the entry of small firms.[1]

It can be shown that the three regimes described in the case of a single MP-firms also arise when there are N such firms. In this case, the values of n_A and n_B depend on N. Since our emphasis is on mixed markets, we focus here on the case of accommodating entry only.

The big and small firms do not necessarily share the same marginal cost. Furthermore, the big firms can be heterogeneous, perhaps because they have developed different technologies. Let $C_j > 0$ be the marginal production cost of the big firm j. Our main focus being on how the big firms behave when they face a monopolistically competitive fringe, it is analytically convenient to assume that the small firms share the same marginal cost c. For analytical simplicity, we assume that the small firms are homogeneous. However, by using the argument developed by Zhelobodko et al. (2012), it is readily verified that the results proven in this section holds true when the small firms are heterogeneous and operate in an environment à la Melitz (2003). Note also that C_j may be larger or smaller than c.

Under these circumstances, profit functions can be rewritten as follows:

$$\Pi_j = \int_0^{n_j} \left[p(X_{jk}, \mathbb{X}) - C_j\right] X_{jk} \mathrm{d}k \qquad \pi_i = \left[p(x_i, \mathbb{X}) - c\right] x_i - f.$$

Since the demand functions are again linear, the Nash equilibrium of the subgame is given by

$$P_j^* = \frac{C_j}{2} + \frac{1 - \mathbb{X}^*}{2} \qquad p_i^* = \frac{c}{2} + \frac{1 - \mathbb{X}^*}{2}, \tag{15}$$

$$X_j^* = \frac{1 - \mathbb{X}^* - C_j}{2\beta} \qquad x_i^* = \frac{1 - \mathbb{X}^* - c}{2\beta}, \tag{16}$$

[1] See Norman and Thisse (1999) for an example in a spatial model of product differentiation.

where the zero-profit condition for the SP-firms yields

$$\mathbb{X}^* = 1 - c - 2\sqrt{\beta f}. \tag{17}$$

As in the foregoing, the total output $\mathbb{X}^*$ is constant with (17) being equal to (6) when $c = 0$. Evidently, the mass of small firms $M^* > 0$ if and only if

$$\sum_{j=1}^{N} n_j < n_A \tag{18}$$

holds true, a condition that we assume to be satisfied for the equilibrium to be given by a mixed market.

It follows from (15) that the big and small firms no longer choose the same prices because they face different marginal costs. However, they still adopt *the same pricing rule*, which turns out to be the rule that prevails under monopolistic competition. Hence, we have shown:

Proposition 1. *Assume quadratic preferences and* $N \geq 1$ *MP-firms. If* (18) *holds, then the MP-firms accommodate the entry of a monopolistically competitive fringe and choose to mimic SP-firms' behavior.*

This proposition has several important implications. First, when the big firms are not too big, *the strategic interdependence among these firms is dissolved in an ocean of small firms.* This amounts to saying that each MP-firm behaves like a *multi-divisional firm* in which each division produces a specific variety and maximizes its own profits, while ignoring demand linkages within the firm's product range.

Second, the size of the monopolistically competitive fringe does not matter for the decisions made by the big firms. What matters for these firms to be non-strategic is the sole existence of entry and exit flows in the SP-subsector. To put it differently, when the size of the MP-subsector as a whole is not "too" big, i.e.(18) holds, all firms behave as if they were operating under monopolistic competition. Although the mechanisms at work are very different, this result has a strong contestability flavor: *the flow of small firms incentivizes the big firms to sell their varieties at the monopolistically competitive prices.*

Last, the equilibrium price of a variety produced by the big firm j depends on its own marginal cost C_j but not on the other big firms' marginal costs C_k with $k \neq j$. In particular, without affecting our results, the marginal cost faced by a big firm may be variety-specific (C_{jk}), as in the core-competence models of Norman and Thisse (1999) and Eckel and Neary (2010). Because large firms typically have access to a wider range of technologies than small firms, their markup are likely to be firm-specific, if not variety-specific.

It is worth stressing that Proposition 1 has two additional far-reaching implications.

Cost shock. The expression (15) implies that an exogenous drop of the marginal cost C_j affects firm j's price, whereas the other big firms' prices remain the same. This shock does not affect the small firms' price either, but it reduces the size of the monopolistically competitive fringe because firm j's output rises. More generally, as long as the market is mixed, (17) implies that a technological change affecting the MP-subsector has *no* impact on the toughness of competition, as measured by the total output $\mathbb{X}^*$. However, the SP-subsector shrinks or expands for $\mathbb{X}^*$ to remain constant.

By contrast, a change in the productivity of small firms not only has an impact on the SP-subsector, but always affects the pricing decisions of the big firms because $\mathbb{X}^*$ takes on a new value. For example, if the small firms adopt a technology that increases their productivity, their common price goes down, which makes them more aggressive. As a consequence, competition becomes tougher ($\mathbb{X}^*$ increases) and the big firms adjust by reducing their prices.

Entry or merger. Assume now that an additional big firm, $j = N + 1$ enters the market. If the market is still mixed after this entry, (15) and (16) show that the big firms do not react: their prices and outputs remain the same. In contrast, the SP-subsector shrinks for $\mathbb{X}^*$ to remain constant. In the same vein, when two or several big firms choose to merge, the other big firms do not react. In sum, provided that the mass of SP-firms is positive, an external shock on the number MP-firms does not affect these firms' equilibrium strategies, the reason being that the shock is totally absorbed by the SP-subsector.

If the shock is sufficiently strong to trigger the disappearance of the monopolistically competitive fringe, the big firms adopt a strategic behavior and react to exogenous cost shocks, entry or merger. On the other hand, if the shock is not too strong, (15) and (16) show that *the market is completely stabilized by the monopolistically competitive fringe*.

The above analysis highlights two important results. First, when the big firms are not very big relative to the market size, they rationally choose to adopt a tough pricing rule, namely that used by the small firms. In other words, they give up their capacity to manipulate the market by contracting their output, and thus their market power is diluted, a result which we christen *dilution of market power*. Second, a shock on a big firm does not affect the actions selected by the other big firms. To put it differently, competition is stabilized across big firms, a property that we call *stabilization of competition*. These results are non-standard, not to say surprising. We study below the relations between those two properties and determine conditions under which both or each of them hold.

3 When do dilution and stabilization hold?

In what follows, we consider two general settings in which the dilution and stabilization properties hold.

3.1 Scalar market aggregate: the general case

The analysis of Section 2 suggests that the existence of a unique market aggregate $\mathbb{X}$ is the key factor in explaining (i) why the big firms choose to behave non-strategically and (ii) why these firms do not react to exogenous shocks. In what follows, we consider a game in which a firm's demand depends on two variables: (i) the firm's action and (ii) a *scalar* that aggregates all the decisions made by all firms. In this event, the profit functions have the following form:

$$\Pi_j = \int_0^{n_j} [P(X_{jk}, \Lambda) - C_j] \, X_{jk} \mathrm{d}k \qquad j = 1, ..., N, \tag{19}$$

$$\pi_i = [p(x_i, \Lambda) - c] \, x_i - f \qquad i \in [0, M], \tag{20}$$

where Λ is the market aggregate, while $P(X_{jk}, \Lambda)$ $(p(x_i, \Lambda))$ is the inverse demand function for variety j (i), which decreases with X_{jk} (x_i).

Assumption 1. Let Λ be a scalar. The profit functions (20) are continuous, strictly quasi-concave in x_i for all admissible Λ, and strictly decreasing (or increasing) in the aggregate Λ for all x_i.

These conditions are satisfied by the linear demands where $\Lambda = \mathbb{X}$ (see Section 2). The strict quasi-concavity assumption is made for the best reply to be a well-defined function. That π_i strictly decreases (increases) with Λ means that the market aggregate Λ is a substitute (complement) of x_i.

As in the dominant firm model of Section 2, we consider a sequential game in which the big firms are the leaders and the small firms the followers. Unlike Acemoglu and Jensen (2013) and Anderson et al. (2013), our aggregator Λ need not be additive in firms' actions (X_{jk} and x_i), neither the sum of monotone functions of each firm's action ($H_{jk}(X_{jk})$ or $h_i(x_i)$). We now show that the dilution and stabilization properties still hold for the profit functions (19) and (20).

Consider the second stage. Being negligible to the market, each SP-firm accurately treats the aggregate Λ as a parameter and determines its best reply function $x^*(\Lambda)$. This function exists under Assumption 1. In this event, the zero-profit condition may be rewritten as follows:

$$\pi_i^*(\Lambda) \equiv \pi_i(x^*(\Lambda), \Lambda) = 0. \tag{21}$$

Assumption 1 implies that $\partial \pi_i / \partial \Lambda$ is always strictly negative (positive). It then follows from the envelop theorem that the optimal profit function $\pi_i^*(\Lambda)$ is also decreasing (increasing) in Λ, so that the equation (21) has at most one solution Λ^*. Therefore, as long as SP-firms are in business in the second-stage subgame, the equilibrium value Λ^* of the aggregate is *uniquely* determined and independent of the actions chosen by the big firms. Although the market aggregate Λ depends on the actions chosen by big firms, the equilibrium value of Λ is independent of what these firms do.

Since the value Λ^* is anticipated by the big firms in the first stage of the game, each big firm j chooses the quantity X_{jk}^* of each of its varieties that maximizes its profits given by $[p(X_{jk}, \Lambda^*) - C_j]\, X_{jk}$, which depends only upon X_{jk}. As a consequence, we have:

Proposition 2. *Assume that the big firms accommodate the entry of a monopolistically competitive fringe. If Assumption 1 holds and Λ is a scalar, then both the dilution and stabilization properties hold.*

Comparing mixed and oligopolistic markets, we want to make the following comments. First, a mixed market functions "as if" all firms were to operate under monopolistic competition. To put it differently, the small firms incentivize the big firms to become non-strategic and, therefore, more aggressive. Second, consumers enjoy lower prices on the varieties provided by the MP-firms. Last, the market outcome is the same regardless of the strategy - quantity or price - used by the big firms. In other words, Bertrand and Cournot competition yields the same market outcome. This strikingly differs from what we know in oligopoly theory and shows once more that a mixed market obeys very different rules.

We discuss below a special, but meaningful, example of preferences that satisfy Assumption 1.

3.2 Additive utility

The first aggregate that comes to mind in a general equilibrium setting is the marginal utility of income. For this reason, we consider an economy with one good and one production factor. Consumers share the same additively separable preferences given by

$$\mathcal{U} = \int_0^M u(x_i)\mathrm{d}i + \sum_{j=1}^N \int_0^{n_j} U_j(X_{jk})\mathrm{d}k, \tag{22}$$

where u and U_j are strictly increasing and concave, with $u(0) = U_j(0) = 0$. Observe that the varieties supplied by the big and small firms need not enter symmetrically into individual preferences.

In the present context, firms' profits feedback into the consumer program through the budget constraint:

$$\int_0^M p_i x_i \mathrm{d}i + \sum_{j=1}^N \int_0^{n_j} P_{jk} X_{jk}\mathrm{d}k \le y \equiv 1 + \sum_{j=1}^N \Pi_j + \int_0^M \pi_i \mathrm{d}i, \tag{23}$$

where we make the heroic assumption that profits are evenly distributed across consumers.

Denoting by λ the Lagrange multiplier, the utility-maximizing conditions yield the following inverse demand functions:

$$p_i(x_i, \lambda) = \frac{u'(x_i)}{\lambda} \qquad P_{jk}(X_{jk}, \lambda) = \frac{U_j'(X_{jk})}{\lambda}, \tag{24}$$

where $\Lambda = \lambda$ is the market aggregate.

Stage 2. Firm i's profits are given by

$$\pi_i = \left[\frac{u'(x_i)}{\lambda} - c\right] x_i - f,$$

where

$$\lambda = \frac{\int_0^M x_i u'(x_i)\mathrm{d}i + \sum_{j=1}^N \int_0^{n_j} X_k U_j'(X_{jk})\mathrm{d}k}{y}.$$

Being negligible to the market, a small firm has no impact on the values of y and λ. By contrast, the decision made by a big firm affects both y and λ through the budget constraint (23). Whether the big firms treat the income y parametrically (Shimomura and Thisse, 2012) or manipulate y through the profits redistributed to consumers (d'Aspremont et al., 1996), does not affect the conclusion: λ is *never* the sum of (monotone functions of) firms' actions.

Setting

$$r(x) \equiv -\frac{xu''(x)}{u'(x)},$$

Zhelobodko et al. (2012) show that combining the first-order condition for profit-maximization and the zero-profit condition yields the equilibrium output x^* as a solution to the equation

$$\frac{xr(x)}{1 - r(x)} = \frac{f}{c},$$

so that x^* is independent of y and λ. As a consequence, the price or output decisions made by the SP-firms are independent of what the MP-firms do. Moreover, it is readily verified that

$$\lambda^* = \frac{u'(x^*)[1 - r(x^*)]}{c}, \tag{25}$$

which is also independent of the MP-firms' actions. Therefore, as in Section 2, the equilibrium value of λ is *stabilized* by the sole entry and exit of small firms.

Stage 1. Since the MP-firm j anticipates the equilibrium values of p^* and x^*, this firm is able to compute the resulting value of λ^* and to determine the adjusted inverse demand for its variety k:

$$p_{jk}(X_{jk}, \lambda^*) = \frac{U_j'(X_{jk})}{\lambda^*},$$

which is the counterpart to (9). Thus, as in Proposition 1, the big firms choose strategically to mimic the small firms (dilution of market power), while a big firm does not react to a shock affecting the other big firms (stabilization of competition).

Equally important, when choosing its price, a big firm does not have to care about the equilibrium value of the income y because the adjusted inverse demand $P_{jk}(X_{jk}, \lambda^*)$ is independent of y, while the equilibrium value of λ is determined by the small firms' actions only. Accordingly, despite the fact that big firms are atomic players, the presence of a monopolistically competitive fringe washes out *all* forms of strategic interactions through the mass of small firms, that is, the direct interactions among big firms considered in oligopoly theory, as well as the indirect interactions channeled by the redistribution of firms' profits to consumers.

4 Dilution and stabilization under two aggregates

So far we have discussed the case in which the demand functions depend on a single market aggregate. In the baseline model of Section 2, the aggregate is the total output; in Section 3, the aggregate is the marginal utility of income. These two aggregates capture different types of market interactions. Total output stems directly from demand linkages across varieties, but it disregards the impact of income. In contrast, the marginal utility of income captures the substitution effects channeled by the budget constraint, but it ignores how total consumption affects the utility derived from consuming a specific variety. In this section we consider the more general case in which both effects are at work, that is, demands depend on *two* aggregates. To achieve our goal, we consider a quadratic utility.

4.1 Two aggregates and one fringe

Consider the basic setting of Section 2 where the utility is now given by

$$\mathcal{U} = \mathbb{X} - \frac{\beta}{2}\left(\int_0^M x_i^2 \mathrm{d}i + \int_0^n X_j^2 \mathrm{d}j\right) - \frac{\mathbb{X}^2}{2}. \tag{26}$$

Note the difference with (1) that includes two goods. Because the differentiated product is now the only consumption good, the marginal utility of income is endogenous and affects the demand for each variety.

Each consumer maximizes her utility subject to the budget constraint:

$$\int_0^M p_i x_i \mathrm{d}i + \int_0^n P_k X_k \mathrm{d}k \leq y \tag{27}$$

where y stands for the consumer's income.

The utility-maximizing conditions yield the inverse demand functions for variety $i \in [0, M]$ and variety $k \in [0, n]$:

$$p(x_i, \mathbb{X}, \lambda) = (1 - \mathbb{X} - \beta x_i)/\lambda \qquad p(X_k, \mathbb{X}, \lambda) = (1 - \mathbb{X} - \beta X_k)/\lambda,$$

which depend on the two aggregates $\mathbb{X}$ and λ. Note that λ and $\mathbb{X}$ have a different impact on demands: a lower λ rotates clockwise the demand schedules around the saturation point, whereas a lower $\mathbb{X}$ shifts the demand schedules upward by increasing the sole intercept. Thus, when both $\mathbb{X}$ and λ fall (rise), each firm faces a higher (lower) demand.

The SP-firms' and MP-firm's marginal costs are, respectively, denoted by c and C. We assume that that the big firm is (weakly) more efficient than the small firms, that is, $C \leq c$. The SP-firm i's profit is then given by

$$\pi_i = (p(x_i, \mathbb{X}, \lambda) - c)\, x_i - f.$$

Since the SP-firms treat the aggregates $\mathbb{X}$ and λ parametrically, their profit functions are strictly concave with respect to x_i. Of course, any equilibrium of the SP-subsector features symmetry among small firms: $\mathbb{X}_{sp} = Mx$. Similarly, we may assume without loss of generality that the big firm produces the same quantity X of each of its varieties: $\mathbb{X}_{mp} = nX$.

In the second stage, the MP-firm's total output $\mathbb{X}_{mp}$ is given and observed by the SP-firms. This induces a second-stage subgame whose unknowns are x, λ and $\mathbb{X}$. We first study how these variables vary with $\mathbb{X}_{mp} = nX$. We first show that the SP-firms' output x decreases with the big firm's output. Combining the zero-profit condition and the labor market balance yields

$$\left(c + \frac{f}{x}\right)\mathbb{X} - \left(c + \frac{f}{x} - C\right)\mathbb{X}_{mp} = 1. \tag{28}$$

Using the zero-profit and the first-order conditions, we can write the profit-maximizing price of an SP-firm as follows:

$$p = c + \frac{f}{x} = c\frac{1 - \beta x - \mathbb{X}}{1 - 2\beta x - \mathbb{X}}.$$

Solving for $\mathbb{X}$ yields

$$\mathbb{X} = 1 - \beta\,(2 + (c/f)x)\,x. \tag{29}$$

Plugging (29) into (28) leads to

$$\left(c + \frac{f}{x}\right)\left[1 - \beta\left(2 + \frac{cx}{f}\right)x\right] - \left(c + \frac{f}{x} - C\right)nX = 1. \tag{30}$$

Since

$$nX \leq \mathbb{X} = 1 - \beta\,(2 + (c/f)x)\,x,$$

the left-hand side of (30) decreases both with x and X. Therefore, the output $x^*(X)$ chosen by a SP-firm in the second stage decreases with the large firm's output X. It then follows from (29) that *the market aggregate* $\mathbb{X}$ *increases with* X, and thus the big firm is incentivized to manipulate $\mathbb{X}$. This is to be contrasted with Section 2 where this aggregate is independent of the action undertaken by the large firm.

4.2 Two aggregates and two fringes

Preferences are still given by (26), but the demand schedules are now defined as follows:

$$p(x_{s,i}, \mathbb{X}, \lambda) = (1 - \mathbb{X} - \beta x_{s,i})/\lambda \qquad p(X_k, \mathbb{X}, \lambda) = (1 - \mathbb{X} - \beta X_k)/\lambda$$

where $s = 1, 2$ is the index of a monopolistically competitive fringe. Therefore, we have:

$$\mathbb{X} \equiv \int_0^{M_1} x_{1,i}\mathrm{d}i + \int_0^{M_2} x_{2,i}\mathrm{d}i + \int_0^{n} X_k\mathrm{d}k \equiv \mathbb{X}^1_{sp} + \mathbb{X}^2_{sp} + \mathbb{X}_{mp}.$$

As usual, we may disregard the subscript i. The SP-firms belonging to the same fringe share the same marginal cost, but firms belonging to different fringes have different marginal costs ($c_1 < c_2$). Moreover, for the two monopolistically competitive fringes to be active, one fringe cannot be more efficient than the other. For this reason, we assume that $c_1 < c_2$ and $f_1 > f_2$.[2]

The MP-firm's total output $\mathbb{X}_{mp} = nX$ is observed by all the SP-firms, which determines the second-stage equilibrium values $\lambda^*, \mathbb{X}^*, x_1^*$ and x_2^*. Since the market statistics $(\lambda, \mathbb{X})$ are given, a s-type SP-firm maximizes its profit given by

$$\pi_s(x_s) = \left(\frac{1 - \beta x_s - \mathbb{X}}{\lambda} - c_s\right)x_s - f_s \qquad s = 1, 2. \tag{31}$$

[2] Note that the model can easily be reformulated to allow the two fringes to supply varieties having different qualities, as in Fajgelbaum et al. (2011).

The optimal profit π_s^* of a s-type firm is obtained as in the foregoing. Therefore, the free-entry condition for each type $s = 1, 2$ may be written as follows:

$$\pi_s^*(\mathbb{X}, \lambda) = \frac{(1 - \mathbb{X} - \lambda c_s)^2}{4\beta\lambda} - f_s = 0. \tag{32}$$

Since $\pi_1^* = \pi_2^* = 0$, it follows from (32) that

$$1 - c_1\lambda - 2\sqrt{f_1\beta\lambda} = 1 - c_2\lambda - 2\sqrt{f_2\beta\lambda}, \tag{33}$$

which can be rearranged as follows:

$$c_1 + 2\sqrt{\frac{f_1\beta}{\lambda}} = c_2 + 2\sqrt{\frac{f_2\beta}{\lambda}}. \tag{34}$$

Since $c_1 < c_2$ and $f_1 > f_2$, this equation has a unique positive solution λ^* given by

$$\lambda^* = 4\beta\left(\frac{\sqrt{f_1} - \sqrt{f_2}}{c_2 - c_1}\right)^2 > 0. \tag{35}$$

The expressions (**??**) and (35) can be combined to pin down the equilibrium value of $\mathbb{X}$:

$$\mathbb{X}^* = 1 - c_i\lambda^* - 2\sqrt{f_i\beta\lambda^*} \qquad i = 1, 2, \tag{36}$$

which decreases in λ^*. As a result, $\mathbb{X}^*$ need not be positive. In the foregoing, we focus on parameter constellations for which $\mathbb{X}^* > 0$.

To sum up, when both fringes are active, the two unknowns λ and $\mathbb{X}$ are given by (35) and (36). As in the case of one aggregate and one monopolistically competitive fringe, the two aggregates λ^* and $\mathbb{X}^*$ are independent of the big firm's behavior, thereby implying that both the dilution and stabilization properties characterize the market equilibrium.

We summarize this finding in the following proposition.

Proposition 3. *Assume the quadratic utility* (26) *with an income effect. If there are two active monopolistically competitive fringes, then both the dilution and stabilization properties hold true.*

The dilution of market power implies that the big firm's profit made from selling each variety is given by

$$\Pi(X) = \left(\frac{1 - \mathbb{X}^* - \beta X}{\lambda^*} - C\right) X,$$

so that the equilibrium per variety output of the big firm is given by

$$X^* = \frac{1 - \mathbb{X}^* - C\lambda^*}{2\beta},$$

which is assumed to be positive.

It remains to check when the two monopolistically competitive fringes are active. We know that

$$M_1 x_1^* + M_2 x_2^* = \mathbb{X}^* - nX^*, \tag{37}$$

while labor balance implies

$$M_1(f_1 + c_1 x_1^*) + M_2(f_2 + c_2 x_2^*) = 1 - CnX^*. \tag{38}$$

Substituting $\mathbb{X}^*$ into (36) and solving for x_s yields

$$x_1^* = \sqrt{\frac{f_1\lambda^*}{\beta}} > \sqrt{\frac{f_2\lambda^*}{\beta}} = x_2^*.$$

Observe that X^* exceeds x_1^* if $C < c_1$, whereas $x_1^* > X^* > x_2^*$ if $c_1 < C < c_2$. Note also the difference with (7) where $\lambda^* = 1$.

The expressions (37) and (38) define a system of two linear equations with two unknowns, M_1 and M_2. If the solutions are positive, then the market outcome involves two active fringes, and thus Proposition 3 holds true. Otherwise, there is at most one active fringe, which implies that the dilution and stabilization properties are not satisfied. As shown by (36), for the two fringes to be active it must be that the fixed and marginal costs of each monopolistically competitive fringe are not too high. Therefore, *whether the dilution of market power and the stabilization of competition hold depends on the constellation of parameters that characterizes the market.* This echoes what we have seen in Section 2 where the market equilibrium may, or may not, satisfy the dilution and stabilization properties according to the value of some parameters.

One may wonder if all the conditions imposed above are consistent. To show this, it is sufficient to consider the following numerical example: $\beta = 0.25$, $n = 0.1$, $C = 0.1$ for the big firm, whereas $c_1 = 0.25$, $f_1 = 0.25$, $c_2 = 0.5$, $f_2 = 0.18$ for the two fringes where $C < c_1 < c_2$ and $f_2 < f_1$. Solving the game yields the equilibrium values $\lambda^* = 0.0917749$ and $\mathbb{X}^* = 0.825584$. As a result, we have $X^* = 0.330476$, $x_1^* = 0.302944$, $x_2^* = 0.257056$, $M_1^* = 0.119779$ and $M_2^* = 2.94197$.

In the foregoing, we have chosen to focus on quadratic preferences because they allow us to highlight the role played by two market aggregates. However, it should be clear that generating different forms of imperfect competition within the same setting keeps its relevance under more general preferences.

5 Concluding remarks

In this paper, we distinguish between two kinds of firms, i.e. multi-product firms and single-product firms. The former can a priori manipulate the market whereas the latter cannot because they are negligible. Our results are best illustrated by our new version of the dominant firm model. Depending upon its scope, the dominant firm can either accommodate a monopolistically competitive fringe, or deter entry, or behave like an unconstrained monopolist. The most interesting case arises when entry is accommodated while firms' profits depends on a single aggregate like total output or the marginal utility of income. In this case, we show that this aggregate is determined by the sole entry of small firms. Therefore, even when the dominant firm has a large market share, this firm finds it profit-maximizing to disregard its ability to manipulate the market, as well as the cannibalization among its varieties, practicing instead "divisionalization."

More generally, we have shown that the presence of a monopolistically competitive fringe may vastly affect the behavior of several large firms. For this, we have considered a game in which the monopolistically competitive fringe, formed by single-product firms, adjusts to the decisions made by the dominant firms, which are multi-product. Such a staging seems reasonable in markets where firms are vastly asymmetric in terms of sale. Our results suggest that *consumers' preferences, more than producers' costs, determines the nature of the market structure*, thus implying that the emphasis put on firms' cost heterogeneity could well be exaggerated. Nevertheless, when big firms compete under *two* market aggregates, e.g., total output and the marginal utility of income, market stabilization and dilution of market power cease hold. However, when there are two monopolistically competitive fringes, both properties are restored. **In short, we find it fair to say that our model permits to determine under which conditons oligopolistic or monopolistic competition emerges an equilibrium outcome.**

References

[1] Acemoglu, D. and M.K. Jensen (2013) Aggregate comparative statics. *Games and Economic Behavior* 81, 27-49.

[2] Anderson, S.P., N. Erkal and D. Piccinin (2013) Aggregate oligopoly games with entry. CEPR Discussion Paper N°9511.

[3] Aumann, R.J. (1964) Markets with a continuum of traders. *Econometrica* 32, 39-50.

[4] Bain J. (1956) *Barriers to New Competition*. Cambridge (Mass.): Harvard University Press.

[5] Baumol W.J. (1980) Contestable markets: An uprising in the theory of industry structure. *American Economic Review* 70, 1-15.

[6] Behrens, K. and Y. Murata (2007) General equilibrium models of monopolistic competition: A new approach. *Journal of Economic Theory* 136, 776-787.

[7] d'Aspremont, C., R. Dos Santos Ferreira and L.-A. Gérard-Varet (1996) On the Dixit-Stiglitz model of monopolistic competition. *American Economic Review* 86, 623-629.

[8] Dixit, A.K. (1979) A model of duopoly suggesting a theory of entry barriers. *Bell Journal of Economics* 10, 20-32.

[9] Dixit, A.K. and J.E. Stiglitz (1977) Monopolistic competition and optimum product diversity. *American Economic Review* 67, 297-308.

[10] Eckel, C. and J.P. Neary (2010) Multi-product firms and flexible manufacturing in the global economy. *Review of Economic Studies* 77, 188-217.

[11] Etro, F. (2006) Aggressive leaders. *RAND Journal of Economics* 37, 146-154.

[12] Etro, F. (2008) Stackelberg competition with endogenous entry. *Economic Journal* 118, 1670-1697.

[13] Gabszewicz, J.J. (2002) *Strategic Multilateral Exchange*. Cheltenham, U.K.: Edward Elgar.

[14] Gabszewicz, J.J. and J.-F. Mertens (1971) An equivalence theorem for the core of an exchange economy whose atoms are not "too" big. *Econometrica* 39, 713-721.

[15] Gabszewicz, J.J. and J.-P. Vial (1972) Oligopoly à la Cournot in general equilibrium analysis. *Journal of Economic Theory* 4, 381-400.

[16] Hart, O. (1985) Imperfect competition in general equilibrium: an overview of recent work. In K. Arrow and S. Honkapohja (eds.), *Frontiers in Economics*, Oxford: Basil Blackwell, 100-149.

[17] Hottman, C., S.J. Redding and D.E. Weinstein (2014) What is 'firm heterogeneity' in trade models? The role of quality, scope, markups, and cost. Columbia, memo.

[18] Markham, J.W. (1951) The nature and significance of price leadership. *American Economic Review* 41, 891-905.

[19] Melitz, M. (2003) The impact of trade on intraindustry reallocations and aggregate industry productivity. *Econometrica* 71, 1695-1725.

[20] Neary, J.P. (2010) Two and a half theories of trade. *The World Economy* 33, 1-19.

[21] Norman, G. and J.-F. Thisse (1999) Technology choice and market structure: Strategic aspects of flexible manufacturing, *Journal of Industrial Economics* 47, 345-372.

[22] Okuno, M., A. Postlewaite and J. Roberts (1980) Oligopoly and competition in large markets. *American Economic Review* 70, 22-31.

[23] Ottaviano, G.I.P., T. Tabuchi, and J.-F. Thisse (2002) Agglomeration and trade revisited. *International Economic Review* 43, 409-436.

[24] Parenti, M. (2014) International trade with David and Goliath. Memo, CORE, memo.

[25] Shimomura, K.-I. and J.-F. Thisse (2012) Competition among the big and the small. *RAND Journal of Economics* 43, 329-347.

[26] Shitovitz, B. (1973) Oligopoly in markets with a continuum of traders. *Econometrica* 41, 467-505.

[27] Uslay, C., Altintig, Z. Ayca and R.D.Winsor (2010) An empirical examination of the "Rule ofThree": Strategy implications for top management, marketers, and investors. *Journal of Marketing* 74, 20-39.

[28] Zhelobodko, E. S. Kokovin, M. Parenti and J.-F. Thisse (2012) Monopolistic competition in general equilibrium: Beyond the constant elasticity of substitution. *Econometrica* 80, 2765-2784.