

Trade and gains from trade at the extensive and at the intensive margins*

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Abstract

We present a general equilibrium trade model that combines monopolistic competition à la Dixit-Stiglitz-Krugman with Cournot competition à la Markusen-Brander. Firms are free to either compete for the same existing varieties, or to relax competition by introducing new differentiated varieties at some cost. We show that both the gains from, and the distributional impacts of, trade depend on whether firms compete for the same varieties ('local competition' at the intensive margin) or for different varieties ('global competition' at the extensive margin). In particular, when countries produce the same set of varieties in autarky and when factors are owned equally, trade may neither expand consumers' choice sets nor yield any gains.

Keywords: monopolistic competition; Cournot oligopoly; gains from trade; product diversity; distributional impacts of trade

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1 Introduction

Intra-industry trade in similar products accounts for a substantial and increasing part of world commodity trade. Since the late 1970s, this observation has attracted a lot of attention and has stimulated a huge amount of theoretical and empirical research.¹ From a theoretical perspective, countries engage in intra-industry trade for two main reasons: *product differentiation* (Krugman, 1979, 1980; Helpman, 1981) and *oligopolistic firm behavior* (Markusen, 1981; Brander, 1981; Brander and Krugman, 1983). While these two reasons both stem from imperfect competition in product markets and are by no means mutually exclusive, they have been dealt with rather separately until now. On the one hand, the general equilibrium new trade literature examines the impact of product differentiation focusing on monopolistic competition by treating firms as negligible and a-strategic players. Doing so allows one to deal with the various interrelations between product and factor markets, yet comes usually at the price of quite stringent simplifying assumptions like constant demand elasticity.² The ‘strategic trade policy’ literature has, on the other hand, extensively dealt with oligopolistic competition in what is essentially a partial equilibrium framework. Consequently, its analysis of factor markets and their interrelations with product markets is limited, and normative conclusions need to be reached and extrapolated cautiously.

The first line of research, namely, the general equilibrium new trade literature, has focused almost exclusively on the highly tractable Dixit-Stiglitz-Krugman (henceforth, DSK) market structure (Dixit and Stiglitz, 1977; Krugman, 1980), which is the de facto benchmark for establishing both positive and normative results. Despite its analytical tractability and the deep insights it offers, the DSK framework suffers from several well-known drawbacks. First, there is a one-to-one relationship between firms and varieties. A by-product of this rather stringent assumption is that, when trade occurs, all countries become fully diversified in terms of the varieties they produce. Because there is no (finite) reservation price, trade then mechanically leads to a quite significant expansion of consumers’ choice sets, whereas the amount of each variety produced remains constant. In other words, trade affects the *extensive margin* of production (i.e., product diversity) but not its *intensive margin* (i.e., production scale). Recent empirical evidence by Hummels and Klenow (2005) shows that this is unrealistic and that the DSK framework starkly over-

¹Well-known early contributions include Krugman (1979, 1980, 1981), Helpman (1981), Lawrence and Spiller (1983) and Helpman and Krugman (1985). Although ‘new trade theory’ initially emerged to deal with the empirical shortcomings of classical trade theory, the empirics of new trade theory are more recent and still at an early stage (see, e.g., Head and Mayer, 2004, for a recent survey).

²Ottaviano *et al.* (2002) and Melitz and Ottaviano (2005) present monopolistic competition models with variable demand elasticity. Yet, their quasi-linear specification rules out income effects and reduces the role of factor markets in the analysis. See also Behrens and Murata (2006) for a monopolistic competition model that allows to concisely isolate the variety effect and the pro-competitive effect. Yet, this model has only a single production factor and cannot deal with the redistributive aspects of trade.

predicts the relationship between market size and product diversity, particularly when it comes to exports. Second, the main normative implication of the DSK framework is that, contrary to the classical Ricardian or Heckscher-Ohlin predictions, all agents in all countries engaged in intra-industry trade may gain. This is because every consumer receives the benefits of trade that arise from the joint interaction of increasing product diversity and ‘love of variety’. Put differently, the increase in product diversity may more than offset the redistributive aspects of international trade (Krugman, 1981). Since this result crucially hinges on the fact that trade increases consumers’ choice sets ‘sufficiently’, one may question its general validity in alternative modelling frameworks.

Our main objectives in this paper are twofold. First, we propose a model that allows to embed an oligopolistic market structure into a general equilibrium framework with differentiated products, thereby tying more closely together the strands of monopolistic and oligopolistic competitions. To the best of our knowledge, only few contributions deal with *both* product differentiation *and* oligopolistic firm behavior in general equilibrium until now.³ This is largely explained by the fact that general equilibrium models of oligopolistic competition are plagued by serious conceptual and technical problems, including the sensitivity of equilibrium to the choice of numéraire (Gabszewicz and Vial, 1972) and the bad behavior of reaction functions (Roberts and Sonnenschein, 1977). In such cases, the existence of equilibrium is not assured because some agents are ‘large enough’ in the aggregate economy to be able to influence macroeconomic variables. As pointed out by Neary (2003a,b), a simple solution to this problem consists in eliminating all ‘large’ agents by assuming that each one is negligible to the aggregate economy.⁴ Our model is, therefore, made tractable by considering firms which are large in their own market but small in the economy as a whole. Because of such a modelling strategy, we can analyze both product differentiation and oligopolistic firm behaviors in general equilibrium, which is the first contribution of this paper to the existing literature.

Second, our model concisely captures the fact that trade affects not only the extensive margin but also the intensive margins of production. Indeed, trade usually expands consumers’ choice sets, by offering access to more variety, and at the same time increases output of individual varieties and reduces firms’ market power. These changes *jointly* map into welfare gains, although only the first one arises in the DSK model. To capture these two effects in a full general equilibrium framework, we consider the case of imperfectly

³Neary (2003a,b) presents a general equilibrium oligopoly model of international trade, yet there is no entry at either the intensive or the extensive margin. Ishikawa *et al.* (2006) develop a general equilibrium model in which oligopolistic firms interact with a free entry competitive fringe. Yet, they do not consider trade issues and there is only a single production factor.

⁴This is typically done in continuum models of monopolistic competition. Formally, models with a continuum of agents are closely related to nonatomic games where “the single player has no influence on the situation but the aggregate behavior of “large” sets of players can change the payoffs” (Schmeidler, 1973, p.295).

competitive firms producing a continuum of horizontally differentiated varieties under firm-level scale economies using two production factors. We depart from the standard new trade models by assuming that there is not necessarily a one-to-one relationship between firms and varieties, as several firms may produce the same variety in an oligopolistic fashion. Thus, a firm competes against the others producing the same variety (*strategic 'local competition'*), as well as against those producing different imperfectly substitutable varieties (*non-strategic 'global competition'*). This allows for markups that decrease with the number of firms competing for each variety, while maintaining a tractable general equilibrium interaction framework between different varieties. Firms' decisions as to whether to create new varieties or to remain competing on existing varieties are endogenously driven by the trade-off between incurring additional sunk costs for creating a new variety (e.g., R&D and advertising costs), and enjoying less price competition as the result of a switch from fiercer 'local' to softer 'global' competition. Stated differently, we account for the fact that firms can relax competition by differentiating their products (Shaked and Sutton, 1982).⁵ We investigate what the impacts of trade liberalization are on the extensive and on the intensive margins in such a setting. The basic idea is that trade increases the competitive pressure on existing varieties since more firms compete for them, which may lead some firms to differentiate their varieties in order to relax competition. Consequently, trade may lead to a non-trivial expansion of consumers' choice sets by providing firms with additional incentives to introduce new product varieties, as highlighted in the trade-and-growth literature (e.g., Rivera-Batitz and Romer, 1991).

Our key results may be summarized as follows. First, we show that there is usually a large number of autarky equilibria that can be sustained in each country. Furthermore, the relative ranking of equilibria is such that all agents always prefer more product diversity. Focusing on symmetric equilibria only, we then investigate the impacts of free trade on both countries and both production factors under two alternative assumptions. (i) the case of 'full cross-country product differentiation' (henceforth, FCCPD), i.e., countries produce disjoint subsets of varieties in autarky; and (ii) the case of 'no cross-country product differentiation' (henceforth, NCCPD), i.e. countries produce identical subsets of varieties in autarky. In the case of FCCPD, we show that there are always gains from trade whether all agents own production factors equally, or some own only the variable factors while the others own only the fixed factors. In the case of NCCPD, the results are drastically modified. Indeed, we show that trade only leads to gains when there is an expansion in product variety, which will be the case if national markets are 'sufficiently competitive' before the trade opening. Furthermore, it is the variable factor that now usually gains from trade, whereas the fixed factor loses when there is no variety creation.

⁵In Shaked and Sutton (1982), firms may relax price competition by differentiating their products according to quality. Hence, they deal with vertical but not with horizontal product differentiation. Weitzman (1994) proposes a model of localized competition in which the degree of (horizontal) product differentiation is one of the firm's strategic variables.

Only the endogenous introduction of a ‘sufficient’ mass of new varieties will lead to gains from trade for all agents in all countries, thus revealing that the extreme assumption of fully disjoint sets of varieties under autarky is far from innocuous for the normative results.

The remainder of the paper is organized as follows. In Section 2, we present the model and analyze the closed economy equilibrium. Section 3 then extends the model to a general equilibrium ‘reciprocal dumping’ model of international trade. Sections 4 and 5 deal with the case of FCCPD and the case of NCCPD, respectively. Section 6 offers concluding remarks and points towards future research directions.

2 The model

Our model combines a standard monopolistic competition framework à la Dixit-Stiglitz-Krugman with a model of Cournot oligopoly à la Markusen-Brander.⁶ This allows for a setting in which firms are large in their own market but small in the aggregate economy.

2.1 Preferences

Consider an economy with a fixed mass of \bar{L} identical workers/consumers. The preferences of a representative consumer over a set N of horizontally differentiated varieties (with measure n) are of the Dixit and Stiglitz (1977) ‘constant elasticity of substitution’ type. He thus solves the following consumption problem:

$$\begin{aligned} \max_{x(v), v \in N} \quad & U \equiv \left(\int_N x(v)^{\frac{\sigma-1}{\sigma}} dv \right)^{\frac{\sigma}{\sigma-1}} \\ \text{s.t.} \quad & \int_N p(v)x(v)dv = y, \end{aligned}$$

where $\sigma > 1$ is the elasticity of substitution between any two varieties, and y is the consumer’s income.⁷ Because preferences are homothetic, the aggregate demand for variety v is given by:

$$X(v) \equiv \bar{L}x(v) = g(p(v)) = \frac{p(v)^{-\sigma}}{\int_N p(z)^{1-\sigma} dz} Y, \quad \text{with } Y = \bar{L}y. \quad (1)$$

⁶In this respect, our contribution is closely related to recent work by Neary (2003a,b), who combines a ‘quadratic’ monopolistic competition model with a Cournot duopoly. Yet, contrary to Neary, we allow the mass of varieties to be endogenously determined and consider that more than two firms may compete for each existing variety. This allows for both a richer industry structure and the creation of new varieties in response to competitive trade pressures.

⁷See Lawrence and Spiller (1983) for a closely related model. The main difference between their approach and ours is that they have a competitive outside sector but no oligopolistic firms, whereas the reverse holds true in our case.

Since there is a continuum of varieties, changes in any individual price $p(v)$ have no impact on the price aggregate so that

$$g'(p(v)) = -\sigma \frac{X(v)}{p(v)}. \quad (2)$$

2.2 Technology and market structure

There are two factors of production, both of which are supplied inelastically. The first factor (which we henceforth refer to as ‘labor’) enters the firm’s variable costs only, whereas the second factor (which we henceforth refer to as ‘capital’) enters the firm’s fixed costs only. Each agent is endowed with one unit of labor and \bar{K}/\bar{L} units of capital, so that the aggregate labor and capital supply is given by \bar{L} and \bar{K} , respectively. We will relax the rather stringent assumption of equal claims to production factors when discussing the distributional impacts of trade, yet we may keep it for now. Let c and F stand for the (constant) marginal labor requirement and the fixed capital requirement of each firm, respectively.

Each variety $v \in N$ is produced by $m(v) \in \mathbb{N}$ firms, which are Cournot competitors for that variety. Let $q_k(v)$ stand for firm- k ’s supply of variety v . Denote furthermore by w and r the wage rate and the rental rate of capital, respectively. Each variety- v firm chooses the quantity to maximize its profit

$$\Pi_k(v) = [p(v) - cw] q_k(v) - rF, \quad (3)$$

subject to the product market clearing constraint $q_k(v) + Q_{-k}(v) = X(v)$, where we define $Q_{-k}(v) \equiv \sum_{l \neq k} q_l(v)$. Note that since firms are negligible, they are ‘aggregate income’-takers, which is both an empirically plausible and a technically convenient assumption (e.g., Bonanno, 1990). Using (2), this yields the following first-order conditions:

$$\frac{\partial \Pi_k(v)}{\partial q_k(v)} = [p(v) - cw] - \frac{p(v)}{\sigma X(v)} q_k(v) = 0.$$

In what follows, we assume that all firms producing the same variety v are identical and, therefore, have the same market share: $q_k(v) \equiv X(v)/m(v)$. Straightforward calculation shows that the equilibrium price for variety v is then given by

$$p(v) = \frac{\sigma m(v)}{\sigma m(v) - 1} cw, \quad (4)$$

which is decreasing in the number $m(v)$ of firms competing for variety v . It is furthermore decreasing in σ : the closer substitutes the different varieties are, the lower the equilibrium prices for all varieties. The first effect is linked to *local competition* (i.e., competition among the firms producing the same variety), whereas the second effect is related to *global competition* (i.e., competition among firms producing different varieties).

Entry and exit of firms *for each existing variety* is assumed to be free. Consequently, for any given value of the rental rate r , incumbent firms earn non-negative profits:

$$\begin{aligned}\Pi_k(v) &= [p(v) - cw] \frac{Y}{m(v)} \frac{p(v)^{-\sigma}}{\int_N p(j)^{1-\sigma} dj} - rF \\ &= \frac{Y [\sigma m(v) - 1]^{\sigma-1}}{\sigma^\sigma m(v)^{\sigma+1} \int_N \left[\frac{\sigma m(j)}{\sigma m(j) - 1} \right]^{1-\sigma} dj} - rF\end{aligned}\tag{5}$$

$$\equiv \pi(m(v)) \geq 0, \quad \text{for any } v \in N;\tag{6}$$

whereas a potential entrant will earn negative profit:

$$\pi(m(v) + 1) < 0, \quad \text{for any } v \in N.\tag{7}$$

Note that because of the integer constraint, incumbent firms may a priori earn strictly positive profits from selling any variety v . Yet, since capital is a fixed factor that is perfectly mobile across varieties, in equilibrium, the operating profits of the least profitable industry are wholly absorbed by the equilibrium rental rate r . Since industries are symmetric and $\partial\pi(m(v))/\partial m(v) < 0$, the least profitable industry is obviously the one with the largest number of competitors. Building on this observation, we first prove that in equilibrium the same number of firms compete for each variety v .

Lemma 1 (symmetric entry) *At any equilibrium, $m(v) = m$ for all $v \in N$.*

Proof. Let v_{\max} denote the least profitable variety, i.e., the one such that $\pi(m(v_{\max})) = 0$ at the equilibrium rental rate r . Then,

$$m(v_{\max}) \geq m(v), \quad \text{for any } v \in N\tag{8}$$

because $\partial\pi(m(v))/\partial m(v) < 0$. Suppose furthermore that there exists a variety v' such that $m(v') < m(v_{\max})$. Since both $m(v')$ and $m(v_{\max})$ are integers, (8) implies that

$$m(v') + 1 \leq m(v_{\max}).$$

However, $\partial\pi(m(v))/\partial m(v) < 0$ implies that

$$\pi(m(v') + 1) \geq \pi(m(v_{\max})) = 0,$$

which contradicts (7). Hence, $m(v) \geq m(v_{\max})$ holds for all v and, together with (8), consequently, we derive $m(v) = m(v_{\max})$ for all v . ■

Note that an important by-product of the symmetry result of Lemma 1 is that *all firms will earn zero profits* at the equilibrium rental rate r .

In our setting, firms are allowed to differentiate their products and to *introduce new varieties* in order to relax competition for existing brands. To do so, the firm has to incur once an additional sunk cost R for innovation (think, e.g., of R&D). Formally, a firm will choose to introduce a new variety if and only if it can reap enough monopoly profits to cover its fixed costs and the additional costs for creating this new variety. Let v_{new} denote the new variety. The *no-entry condition* is then given by:

$$\Pi_1(v_{\text{new}}) = \pi(m(v_{\text{new}})) = \pi(1) = \frac{Y [\sigma - 1]^{\sigma-1}}{\sigma^\sigma \int_N \left[\frac{\sigma m(j)}{\sigma m(j) - 1} \right]^{1-\sigma} dj} - rF \leq rR. \quad (9)$$

Note that $m(v_{\text{new}}) = 1$ because the firm expects to be a monopolist on the new variety. Note, furthermore, that the effect of the new variety on the price index is negligible because of the continuum assumption.

In what follows, we denote by \mathbf{m} the distribution of the numbers of firms across the different product varieties v . Furthermore, we refer to a pair (\mathbf{m}, N) , which describes how firms are distributed across a set N of varieties, as an *industry structure*. Note that both the distribution of firms across varieties (i.e., \mathbf{m}) and the range of varieties (i.e., the set N and its measure n) are variable in our model.

2.3 Equilibrium in the closed economy

Factor market clearings for capital and labor, along with the aggregate income constraint, imply that:

$$\bar{K} = F \int_N m(v) dv, \quad \bar{L} = c \int_N X(v) dv, \quad (10)$$

and

$$Y = \bar{L}w + \bar{K}r + \int_N m(v)\Pi(v)dv, \quad (11)$$

where $\Pi(v)$ stands for the profit of a firm producing variety v . For notational convenience, we omit the subscript because all firms producing the same variety earn an equal amount of profit by symmetry. Moreover, since all firms are negligible by the continuum assumption, the creation of a new variety has a negligible impact on the capital market. Hence, we can neglect it in condition (10). By Lemma 1, $m(v) = m$ for all v . This symmetry implies that prices and quantities are also the same for all varieties and allows us to suppress the variety index v in what follows. Some straightforward computations show that the equilibrium conditions are then given as follows:⁸

⁸In what follows, we express all nominal variables in terms of r , i.e., we choose the capital rental as our numéraire. It can be readily verified that the choice of numéraire is immaterial in this model, contrary to standard oligopoly models (Gabszewicz and Vial, 1972). This is both due to the existence of a continuum of firms and because firms make zero profits.

- free entry and the equilibrium rental r equate the profits (6) to zero for all firms

$$\frac{Y}{\sigma m^2 n} - rF = 0; \quad (12)$$

- the factor market clearing and aggregate income conditions (10) and (11) reduce to

$$\bar{K} = Fnm, \quad \bar{L} = cnX = c\frac{Y}{p} = \frac{Y(\sigma m - 1)}{w\sigma m}, \quad Y = w\bar{L} + r\bar{K}; \quad (13)$$

- the no-entry condition (9) holds so that no firm can profitably introduce a new variety

$$\frac{Y[\sigma - 1]^{\sigma-1}}{\sigma^\sigma n} \left[\frac{\sigma m}{\sigma m - 1} \right]^{\sigma-1} - rF \leq rR. \quad (14)$$

The set of conditions (12) and (13) can be solved to yield:

$$\frac{w}{r} = \frac{\bar{K}(\sigma m - 1)}{\bar{L}}, \quad \frac{Y}{r} = \bar{K}m\sigma \quad \text{and} \quad n = \frac{\bar{K}}{Fm}, \quad (15)$$

which, together with the no-deviation condition (14), characterizes the set of equilibria.

Two comments are in order. First, as can be seen from (15), there is an inverse relationship between m and n . This is due to the fact that all firms compete for the same fixed capital stock. Hence, expanding the range of varieties necessarily reduces the number of firms producing existing varieties and vice versa. Second, as can be seen from (15), the wage-rental ratio w/r is *increasing in the number of oligopolistic firms* per industry. The reason for this is that when there are more oligopolistic firms, competition on existing varieties increases, which reduces prices and expands firms' production scales. This in turn raises labor demand and, therefore, wages. Since the total mass of firms $nm = \bar{K}/F$ is constant, capital demand and the rental rate r are unchanged, which implies an increase in w/r . If, on the contrary, firms relax competition by differentiating their products, prices rise and outputs fall. Since demand for labor also falls, the wage decreases with respect to the rental rate. This result shows that changes in the industry structure from the intensive to the extensive margin shift the returns from the variable to the fixed factor of production. Depending on the strength of this effect, the classical redistributive problems of international trade reappear due to changes in industry structure, even in new trade models with a single sector.

Substituting Y/r and n , as given by (15), in the no-deviation condition (14), the set \mathcal{E} of feasible values for m (which we henceforth call the *range of thickness* of each industry), is characterized as follows:

$$\mathcal{E} = \left\{ m \in \mathbb{N}, \quad \frac{F}{R + F} \left(\frac{\sigma - 1}{\sigma m - 1} \right)^{\sigma-1} m^{\sigma+1} \leq 1 \right\}. \quad (16)$$

Note that the inequality in (16) is independent of the factor endowment ratio \bar{K}/\bar{L} . Put differently, changes in relative factor endowments do not change the range of thickness.

Furthermore, it is readily verified that the left-hand side of the inequality is strictly increasing in m . Hence, there exists a unique threshold \hat{m} such that the no-deviation condition is violated for all $m > \hat{m}$. Let us start with the following result.

Proposition 1 (existence) *The equilibrium set \mathcal{E} is non-empty for all admissible parameter values since the monopolistically competitive industry structure $m^* = 1$ and $n^* = \bar{K}/F$ can always be supported as an equilibrium.*

Proof. Letting $m = 1$ and using $F/(R + F) \leq 1$, we obtain the result immediately from the definition (16) of \mathcal{E} . ■

Proposition 2 (monopolistic competition) *When $R = 0$, the equilibrium industry structure is uniquely determined and given by the monopolistically competitive structure.*

Proof. When $R = 0$, the feasible values of m are such that

$$m^{\sigma+1} \left(\frac{\sigma - 1}{\sigma m - 1} \right)^{\sigma-1} \leq 1.$$

The left-hand side is strictly increasing for all $\sigma > 1$ and $m \geq 1$, whereas the equality holds for $m = 1$. Since $m \in \mathbb{N}$, the result follows. ■

Proposition 1 shows that monopolistic competition is always an equilibrium, whereas Proposition 2 highlights the traditional result that it is the only equilibrium when firms can costlessly differentiate their products. This is because it is always more profitable to be a monopolist on a new variety than to compete for an already existing one. Finally, as expected, the degree of indeterminacy rises with the value of R&D costs.

Proposition 3 (indeterminacy) *The higher R , the larger the range of industry thickness that can be sustained in equilibrium.*

Note, in particular, that when R goes to infinity, any configuration (from monopolistic competition to a very competitive setting) can be sustained once it has somehow been established. In other words, there is much structural inertia and the set of possible equilibria gets very large as the value of R increases.

Proposition 3 raises the classical selection problem. Indeed, there is no a priori satisfying way to choose between the different possible equilibria. In what follows, we will thus discuss the properties and the desirability of the different equilibria that may be sustained. A first important question is whether a ranking of the industry structures in terms of their social desirability is possible. It is easy to establish the following result.

Proposition 4 (welfare ranking) *In a closed economy where agents own all factors equally, welfare is strictly increasing in n and, therefore, strictly decreasing in m .*

Proof. Substituting the equilibrium price, quantity, and wage-rental ratio into the utility function we obtain:

$$V = n^{\frac{1}{\sigma-1}} \frac{1}{m\sigma c r} \frac{y \bar{L}}{\bar{K}} = \frac{1}{c} n^{\frac{1}{\sigma-1}},$$

which is strictly increasing in n and, since $m = \bar{K}/(Fn)$, strictly decreasing in m . ■

Proposition 4 shows that welfare depends only on the mass of varieties n consumed when agents equally own both labor and capital. Since by equation (13) this mass is inversely related to the number of Cournot competitors for each variety, the monopolistic competition outcome leads to the highest prices but also the largest choice of variety. This outcome is always the preferred one, thus showing that consumers' 'love for variety' dominates the competition (price) effects.

How does Proposition 4 depend on the assumptions of factor distribution? To see this most clearly, consider the polar case where there are two types of agents who each own only one production factor: \bar{L} workers and \bar{K} capitalists. In such a setting, aggregate income remains unchanged, but a worker's income is w , whereas a capitalist's income is r . Subscripting variables pertaining to workers by L and to capitalists by K , we then have

$$V_L = n^{\frac{1}{\sigma-1}} \frac{w}{p} = n^{\frac{1}{\sigma-1}} \frac{\sigma m - 1}{c\sigma m} \quad \text{and} \quad V_K = n^{\frac{1}{\sigma-1}} \frac{r}{p} = n^{\frac{1}{\sigma-1}} \frac{1}{c\sigma m} \frac{\bar{L}}{\bar{K}}$$

which, after substitution of the equilibrium expressions and using $n = \bar{K}/(Fm)$, are both decreasing functions of m . Hence, there is no 'class conflict' when it comes to the social ranking of industry structures: any shift of factor prices in favor of capital, due to a decrease in m and a corresponding increase in n , is more than offset by the consumption variety gains for workers (see Krugman, 1981, for related results).

To sum up, we may conclude that the monopolistic competition outcome provides the upper bound to the utility that can be achieved in the closed economy. The pro-competitive gains of entry for existing varieties do not allow to compensate for foregone variety losses.⁹

3 Equilibrium in the open economy

Assume now that two countries of the kind described above, say 1 and 2, may engage in international trade. Variables associated with each country will be subscripted accordingly. To simplify the analysis, we assume that the two countries are perfect mirror images in terms of factor endowments and size, i.e., $L_1 = L_2 = \bar{L}$ and $K_1 = K_2 = \bar{K}$. We further assume that each country produces a *subset* of the world variety set N_W in

⁹Although this result is likely to depend on the chosen modelling framework, it suggests that the regulation of entry is a complicated issue once general equilibrium resource constraints and factor prices are taken into account.

autarky. Let N_1 (resp., N_2) stand for the set of varieties produced in country 1 (resp., 2), with measure n_1 (resp., n_2). By definition $N_W = N_1 \cup N_2$, with measure $n_W \leq n_1 + n_2$.

In principle, an infinity of cases need to be distinguished, depending on which subsets of world varieties the two countries produce in autarky. In what follows, we deal, for simplicity, with two simple polar cases only:

1. both countries produce only different varieties (i.e., $N_1 \cap N_2 = \emptyset$), which we call the *full cross-country product differentiation case* (FCCPD);
2. both countries produce only the same varieties (i.e., $N_1 = N_2$), which we call the *no cross-country product differentiation case* (NCCPD).

Note that the latter case contrasts starkly with the standard monopolistic competition models of international trade, which always assume that there is FCCPD. Analyzing the NCCPD case allows us to circumvent the problem that trade mechanically expands the range of product variety in most new trade models and yields several new insights.¹⁰

We now extend the model presented in the foregoing to both cases of FCCPD and NCCPD within a single framework. To do so, we modify our model along the lines of ‘reciprocal dumping’ à la Brander (1981) and Brander and Krugman (1983), which assumes that firms are Cournot competitors and that markets are spatially segmented.¹¹ Contrary to the standard reciprocal dumping models, our specification allows us to deal with general, rather than partial, equilibrium.

Denote by $X_{ii}(v)$ and $X_{ji}(v)$ the demands in country $i = 1, 2$, $j \neq i$, for variety v satisfied by home firms and by foreign firms, respectively. Reverting to the setting in which all agents have identical factor endowments, we have

$$X_{ii}(v) + X_{ji}(v) = \bar{L}x_i(v) = \frac{p_i(v)^{-\sigma}}{\int_{N_W} p_i(z)^{1-\sigma} dz} Y_i, \quad \text{with } Y_i = \bar{L}y_i, \quad (17)$$

where $p_i(v)$ denotes the price in country i . Solving for the inverse demands, taking the price aggregates as given, it is readily verified that

$$\frac{\partial p_i(v)}{\partial X_{ii}(v)} = \frac{\partial p_i(v)}{\partial X_{ji}(v)} = -\frac{1}{\sigma} \frac{p_i(v)}{X_{ii}(v) + X_{ji}(v)}.$$

Since markets are segmented and marginal cost is constant, markets are strategically separable so that firms choose their quantities for each market independently. Firm k ’s

¹⁰Behrens and Murata (2006) use an alternative monopolistic competition model that allows for pro-competitive effects, and show that trade always reduces the range of products produced in the global economy, but expands the range of products consumed. These results again rely on the assumption of a one-to-one relationship between firms and varieties.

¹¹There is a substantial amount of empirical evidence suggesting that international markets are segmented and that firms’ pricing behavior is discriminatory (e.g., Verboven, 1996; Haskel and Wolf, 2001).

profit, when it produces variety v in country $i = 1, 2$, is then given by

$$\Pi_i^k(v) = [p_i(v) - cw_i] q_{ii}^k(v) + [p_j(v) - cw_i] q_{ij}^k(v) - rF. \quad (18)$$

Note that the wages w_1 and w_2 may a priori differ across countries (local labor markets), whereas the rental rates $r_1 = r_2 = r$ are equalized under the assumption that capital is internationally mobile.

The first-order conditions for profit maximization by country- i firms are given by

$$\begin{aligned} p_i(v) - cw_i &= \frac{1}{\sigma} \frac{p_i(v)}{X_{ii}(v) + X_{ji}(v)} q_{ii}^k(v) \\ p_j(v) - cw_i &= \frac{1}{\sigma} \frac{p_j(v)}{X_{jj}(v) + X_{ij}(v)} q_{ij}^k(v), \end{aligned}$$

with mirror expressions holding for country- j firms. Focusing on the symmetric case

$$q_{ii}^k(v) = \frac{X_{ii}(v)}{m_i(v)} \quad \text{and} \quad q_{ij}^k(v) = \frac{X_{ij}(v)}{m_i(v)}, \quad \text{for all } k$$

we then have:

$$\begin{aligned} p_i(v) - cw_i &= \frac{s_{ii}(v)}{\sigma m_i(v)} p_i(v) \\ p_j(v) - cw_i &= \frac{s_{ij}(v)}{\sigma m_i(v)} p_j(v), \end{aligned}$$

where

$$s_{ii}(v) \equiv \frac{X_{ii}(v)}{X_{ii}(v) + X_{ji}(v)} \quad \text{and} \quad s_{ij}(v) \equiv \frac{X_{ij}(v)}{X_{jj}(v) + X_{ij}(v)}$$

denote country- i firms' market shares in both countries. Using the first-order conditions, as well as $s_{ii} + s_{ji} = 1$, we then readily obtain the following profit maximizing prices:

$$p_1(v) = p_2(v) = \frac{c\sigma [m_1(v)w_1 + m_2(v)w_2]}{\sigma [m_1(v) + m_2(v)] - 1} \quad (19)$$

as well as the firms' export market shares:

$$s_{ij}(v) = \frac{m_i(v)[w_i + m_j(v)\sigma(w_j - w_i)]}{m_1(v)w_1 + m_2(v)w_2}, \quad \text{for } i \neq j. \quad (20)$$

Note that firms producing variety v can profitably export from country j to country $i \neq j$ if and only if the 'no cut-off' condition

$$p_i(v) > cw_j \quad \iff \quad \frac{c \left[1 + m_i(v)\sigma \left(\frac{w_i}{w_j} - 1 \right) \right]}{m_i(v)\sigma - 1} > 0 \quad (21)$$

holds, which is *endogenously determined in the full equilibrium* since it depends on both the numbers m_i of firms and on the wage ratio w_i/w_j .¹² In what follows, we will focus on cases in which condition (21) always holds.

To determine the equilibrium, we finally need the factor market clearing and no-deviation conditions as in the closed economy case.

Factor market clearing conditions: Factor market clearings for each national labor market and the global capital market require that

$$\bar{L} = \int_{N_1} [cX_{11}(v) + cX_{12}(v)] dv, \quad (22)$$

$$\bar{L} = \int_{N_2} [cX_{22}(v) + cX_{21}(v)] dv, \quad (23)$$

$$2\bar{K} = F \int_{N_1} m_1(v) dv + F \int_{N_2} m_2(v) dv \quad (24)$$

where, using (17) and (20), we have

$$X_{ii}(v) = s_{ii}(v) \frac{p_i(v)^{-\sigma}}{\int_{N_W} p_i(z)^{1-\sigma} dz} Y_i \quad \text{and} \quad X_{ij}(v) = s_{ij}(v) \frac{p_j(v)^{-\sigma}}{\int_{N_W} p_j(z)^{1-\sigma} dz} Y_j \quad (25)$$

for country- i firms. Mirror expressions hold for country- j firms. Finally, we have as always the aggregate income constraint $Y_i = \bar{L}w_i + \bar{K}r$ for $i = 1, 2$.

Free entry and no-deviation conditions: Free entry for each variety occurs, and the rental rate r adjusts, until no firm can enter to earn a strictly positive profit. Stated differently,

$$\Pi_i^k(v) = [p_i(v) - cw_i] \frac{X_{ii}(v)}{m_i(v)} + [p_j(v) - cw_i] \frac{X_{ij}(v)}{m_i(v)} - rF \equiv \pi_i(m_i(v)) \geq 0,$$

for all active firms and varieties in both countries $i = 1, 2$, and

$$\pi_i(m_i(v) + 1) < 0.$$

¹²The endogenous determination of the range of exports is a neglected issue in the monopolistic competition trade literature. Neary (2003a, p.7, emphasis in the original) points out that “[...] with Dixit-Stiglitz preferences, the consumer always demands all goods even if some are much more expensive than others. This matters in the context of trying to explain intra-industry trade. Dixit-Stiglitz preferences come close to *assuming* that intra-industry trade will take place.” Melitz (2003) extends the CES framework by using heterogeneous firms which face fixed costs of exporting. In such a context only a subset of firms exports, but this subset is determined by other considerations than price (or quantity) competition. Finally, Ottaviano and Melitz (2005) use a quasi-linear quadratic framework to endogenize the set of exporting firms as a function of trade costs.

Furthermore, no firm can profitably deviate by starting to produce a new variety in country i , which is the case if

$$\begin{aligned}\Pi_i^1(v_{\text{new}}) &= \pi_i(m_i(v_{\text{new}})) \\ &= [p_i(v_{\text{new}}) - cw_i] q_{ii}(v_{\text{new}}) + [p_j(v_{\text{new}}) - cw_i] q_{ij}(v_{\text{new}}) - rF \\ &= \sigma^{-\sigma} \left(\frac{\sigma - 1}{cw_i} \right)^{\sigma-1} \left[\frac{Y_i}{\int_{N_W} p_i(v)^{1-\sigma} dv} + \frac{Y_j}{\int_{N_W} p_j(v)^{1-\sigma} dv} \right] - rF \leq rR,\end{aligned}$$

where

$$p_i(v_{\text{new}}) = p_j(v_{\text{new}}) = \frac{\sigma}{\sigma - 1} cw_i,$$

are the prices of the new monopolist ($m_i(v_{\text{new}}) = 1$, $m_j(v_{\text{new}}) = 0$) for variety v_{new} ; and where the $p_i(v)$'s are the prices for the remaining varieties in country $i = 1, 2$.

4 Trade with full cross-country product differentiation (FCCPD)

In almost all new trade models with product differentiation, countries are strictly speaking not fully symmetric: indeed, they all produce a *different set of varieties* in autarky. We also start with this special case where countries are symmetric in terms of factor endowments, technology, preferences, the number (size of the set) of industries operating, and the number of firms in each industry; whereas they produce completely disjoint sets of varieties in autarky. The next section then tackles the, in our opinion, more interesting question of what happens in a trading world where the FCCPD assumption is not satisfied.

In autarky, the two countries produce the sets N_1 and N_2 (with $N_1 \cap N_2 = \emptyset$ under FCCPD) of varieties, respectively. The masses of varieties are assumed to be the same: $n_1 = n_2 \equiv n_A$, where autarky values are subscripted with A . Since we focus on the case where all varieties are produced by the same number of firms in each country, furthermore, the capital market clearing condition for each country implies that the number of firms producing each variety in each country is the same: $m_1 = m_2 \equiv m_A$. Thus, under autarky, all the variables (including the range of industry thickness) in each country are still given by (15) and (16), with n_A and m_A replacing n and m , respectively.

Now, suppose that countries are allowed to trade with (21) being satisfied. This may alter the industry structures in the two countries. As has been suggested, however, there are multiple equilibria and, for the industry structures, we have many cases to consider. Here, instead of characterizing all the cases, which would not give us many insights, we rather focus on a specific situation in which the industry structures in the autarky are preserved in the following sense: In country 1, the set N_1 of varieties continues to be produced and each variety is still produced by m_A firms. Similarly, in country 2, the set N_2 of varieties continues to be produced and each variety is still produced by m_A firms.

Then, the set of varieties available in each country becomes $N_1 \cup N_2$ and, therefore, the mass of available varieties expands to $n_F \equiv 2n_A$, where subscript F refers to world market variables with trade under FCCPD. On the other hand, since each variety is produced by m_A firms, $m_1 = m_2 = m_A \equiv m_F$. Note that such industry structures satisfy the capital market clearing condition (24):

$$n_F = \frac{2\bar{K}}{Fm_F}.$$

Therefore, it is supported by the equilibrium.

Since countries are perfect mirror-images, from the labor market clearing conditions and the income constraint, with $w_1 = w_2 = w$ and $Y_1 = Y_2 = Y$, we obtain¹³

$$\frac{w}{r} = \frac{\bar{K}(\sigma m_F - 1)}{\bar{L}} \quad \text{and} \quad \frac{Y}{r} = \bar{K}\sigma m_F. \quad (26)$$

Because $m_F = m_A$, the wage-rental ratio and the income-rental ratio remain unchanged after the trade opening. Furthermore, the no-deviation condition can be expressed as follows:

$$\frac{F}{F+R} \left(\frac{\sigma-1}{\sigma m_F - 1} \right)^{\sigma-1} (m_F)^{\sigma+1} \leq 1. \quad (27)$$

Since $m_F = m_A$, this condition is satisfied if and only if the parallel condition is satisfied in autarky. Therefore, *trade does not lead to any expansion in the set of varieties produced in the global economy*, i.e., there is no variety creation.

Proposition 5 (no variety creation by free trade under FCCPD) *Suppose that each variety is produced by more than one firm under autarky. Then, under FCCPD, no new varieties are created by a switch from autarky to free trade.*

Note, finally, that under FCCPD consumers necessarily gain from trade because the mass of available varieties increases. This is the standard result of symmetric new trade models with product differentiation.

Proposition 6 (gains from free trade under FCCPD) *Under FCCPD, all agents gain from free trade when they equally own production factors.*

Proof. The equilibrium indirect utility is given by

$$V^F = \frac{1}{c} (n_F)^{\frac{1}{\sigma-1}},$$

which obviously exceeds the indirect utility under autarky $(n_A)^{\frac{1}{\sigma-1}} c^{-1} = (n_F/2)^{\frac{1}{\sigma-1}} c^{-1}$. This establishes the result. ■

¹³Consider a variety produced in country i , that is, $v \in N_i$ ($i = 1, 2$). For such a variety, we have $m_i(v) = m_F$ and $m_j(v) = 0$ ($j \neq i$). Then, (20) implies that $s_{ij}(v) = 1$ and $s_{ji} = 0$. This is followed by $s_{ii}(v) = 1$ and $s_{jj}(v) = 0$ by construction. We can use these results to compute (25).

So far, we have assumed that aggregate income is equally distributed across consumers who own both labor and capital. If we, however, consider different types of consumers (workers and capitalists), the existence of gains from trade will again depend on the income distribution. In that case, the incomes of each type of consumers are w (for workers) and r (for capitalists). Some straightforward computations yield the following indirect utilities:

$$V_F^L = \left(\frac{2\bar{K}}{Fm_F} \right)^{\frac{1}{\sigma-1}} \frac{\sigma m_F - 1}{c\sigma m_F}, \quad \text{and} \quad V_F^K = \left(\frac{2\bar{K}}{Fm_F} \right)^{\frac{1}{\sigma-1}} \frac{\bar{L}}{c\sigma m_F \bar{K}}.$$

It is readily verified that V_L^F and V_K^F are decreasing in m_F . Stated differently, the monopolistic competition outcome is the preferred one and welfare of both types of agents increases with product diversity.

The indirect utility differential between autarky and free trade is given as follows:

$$\begin{aligned} \Delta V_F^L &= \left(2^{\frac{1}{\sigma-1}} - 1 \right) \left(\frac{\bar{K}}{Fm_A} \right)^{\frac{1}{\sigma-1}} \frac{\sigma m_A - 1}{c\sigma m_A} > 0 \\ \Delta V_F^K &= \left(2^{\frac{1}{\sigma-1}} - 1 \right) \left(\frac{\bar{K}}{Fm_A} \right)^{\frac{1}{\sigma-1}} \frac{\bar{L}}{c\sigma m_A \bar{K}} > 0, \end{aligned}$$

which allows us to establish the following result.

Proposition 7 (no class conflict under FCCPD) *Consider the economy with FCCPD where workers and capitalists exist. Then, all the agents gain from free trade.*

5 Trade with no cross-country product differentiation (NCCPD)

In the preceding section, we have exclusively examined the case where countries produce completely different sets of varieties in autarky. We have shown that there are automatically gains from trade due to an expansion of consumers' choice sets. This finding contrasts starkly with that of classical trade models where there is, on the contrary, no expansion of consumers' choice sets due to trade and all gains from trade materialize through efficiency gains driven by the sectoral reallocation of resources. While this latter aspect is clearly important, recent empirical findings suggest that product variety may be an even more important, yet still neglected, part of gains from trade (see, e.g., Feenstra, 1994, 1995; Hummels and Klenow, 2005; Broda and Weinstein, 2006; Broda *et al.*, 2006).¹⁴

¹⁴Felbermayr and Kohler (2006) propose an empirical specification in which the extensive margin is not interpreted as the creation of new varieties among existing trading partners, but as the establishment of previously unexploited trading relationships. Since in our model the occurrence of trade is endogenous, an interesting extension to this type of question is left for future research.

In this section, we therefore analyze the case where *an expansion of varieties is not assumed a priori but is brought about by trade*. Put differently, we show that international trade may itself be a *cause* of product variety, instead of a simple *consequence*. To make our point most clearly, we consider a setting in which countries are symmetric in terms of factor endowments, technology, preferences, the number (size of the set) of industries operating, and the number of firms in each industry; in addition, they also produce exactly the same set of goods in autarky. Stated differently, there is no cross-country product differentiation (NCCPD) in autarky, so that *countries are really a priori completely symmetric in all respects*.

In autarky, the sets of varieties produced in the two countries are congruent: $N_1 = N_2$. This implies that the masses of varieties are equal, namely, $n_1 = n_2 = n_A$. As in the previous section, we focus on the case where all varieties are produced by the same number of firms in each country, i.e., $m_1 = m_2 = m_A$.

Now, let the two countries engage in trade. As in the case of FCCPD, we focus on the situation where the autarky industry structure continues to hold: $n_N = n_A$ varieties are produced in the world and $m_N = 2m_A$ firms compete for each existing variety in the world market, where subscript N refers to world market variables with trade under NCCPD. Again, this structure satisfies the capital market clearing condition,

$$n_N = \frac{2\bar{K}}{Fm_N}$$

and, consequently, is supported by equilibrium.

First of all, substituting $m_1 = m_2 = m_N/2$ and $w_1 = w_2 = w$ into (19) gives the following price markup rate:

$$\frac{p_1(v)}{w} = \frac{p_2(v)}{w} = \frac{c\sigma m_N}{\sigma m_N - 1} = \frac{2c\sigma m_A}{2\sigma m_A - 1}.$$

This is lower than the rate at the autarky, which is equal to $c\sigma m_A/(\sigma m_A - 1)$. Thus, the price markup shrinks as a result of the trade opening. This is because under NCCPD, twice as large number of firms end up competing in each industry, which makes the competition in each industry fiercer. It is worth pointing out that such a result, namely that international trade may actually *intensify* competition in each industry, does not arise in the traditional monopolistic competition model à la Krugman (1980). In that type of model, markups are constant and do not depend on the number of firms competing for each variety (as each firm is a monopolist on its own variety).

Furthermore, solving the labor market clearing conditions and the income constraint for each country, with $m_1 = m_2 = m_N/2$, $w_1 = w_2 = w$, and $Y_1 = Y_2 = Y$, we then obtain:

$$\frac{w}{r} = \frac{\bar{K}}{\bar{L}}(m_N\sigma - 1), \quad \text{and} \quad \frac{Y}{r} = \bar{K}m_N\sigma.$$

Notice that the wage-rental ratio rises as a result of the trade opening, because $m_N = 2m_A$. This is explained as follows. As has been explained, the competition in each industry

becomes fiercer by the trade opening. This induces each firm to expand its output level and, as a result, its labor demand. On the other hand, the *total* number of firms in the world does not change ($m_N n_N = 2m_A n_A$). Therefore, the demand for capital also remains the same, and this asymmetrical change in factor demands leads to the rise in the wage-rental ratio. By the same token, the income-rental ratio Y/r also rises by the trade opening.

Because competition among firms producing an existing variety is severer at the NCCPD trade equilibrium than at the autarky, one might conjecture that firms have a greater incentive to deviate from the existing industry and create a new variety in the trade regime than at the autarky. This conjecture turns out to be right, at least as long as the competition has been sufficiently fierce at the autarky. To see this, note that the no-deviation condition can be expressed as follows:

$$\frac{F}{F+R} \left(\frac{\sigma-1}{m_N \sigma-1} \right)^{\sigma-1} m_N^{\sigma+1} \leq 1. \quad (28)$$

Since this condition is the same as the counterpart of the closed economy model (16), we can pay an attention to \hat{m} , the maximum number of oligopolists that satisfies (28). Recalling that $2m_A$ firms competing for each variety after trade opening, we have the following result:

Proposition 8 (variety creation under NCCPD) *Under NCCPD with free trade, when $m_A > \hat{m}/2$, any trading equilibrium is such that*

$$m_N < 2m_A \quad \text{and} \quad n_N > n_A.$$

In other words, there will be variety creation in the global economy when the autarky thickness of industry is sufficiently large.

Proof. Assume that $m_A > \hat{m}/2$. After the initial trade opening, $2m_A > \hat{m}$ firms produce each variety. Yet, this is incompatible with the no-deviation condition, so that some firms relax competition by switching into new varieties. Therefore, $m_N < 2m_A$ will hold in the new trading equilibrium and there is exit of firms for each variety. Consequently, we have

$$n_N m_N = \frac{2\bar{K}}{F} < 2m_A n_N \quad \implies \quad \frac{\bar{K}}{F m_A} = n_A < n_N,$$

which establishes the result. ■

We next show that the existence of gains from trade under NCCPD crucially depends on how the industry structure changes once trade is allowed for. This will highlight the existence of a trade-off between pro-competitive effects and product diversity.

Proposition 9 (gains from free trade under NCCPD) *Assume that agents equally own all factors. When trade does not expand product variety, there are no gains from free trade; whereas all agents gain from free trade when trade does expand variety.*

Proof. Some straightforward computations show that the equilibrium indirect utility in both countries under trade is given by

$$V_N = n_N^{\frac{1}{\sigma-1}} c^{-1}.$$

Welfare under free trade with NCCPD therefore exceeds its autarky level if and only if $n_N > n_A$. ■

The intuition underlying this result is as follows. If free trade does not expand product variety, all gains from trade materialize through resource reallocation and the implied changes in factor and product prices. Yet, when agents own all factors equally, the changes in product prices, in wages, and in the rental rate of capital just offset each other, thus leaving all agents at the same utility level. Proposition 9, therefore, clearly hinges on the assumption that each agent has claims to both labor and capital income.

To see what happens when that assumption is removed, let us assume, as before, that agents may be divided into workers and capitalists. When there is no variety creation, on the one hand, we have:

$$\begin{aligned} V_N^L &= \left(\frac{2\bar{K}}{Fm_N} \right)^{\frac{1}{\sigma-1}} \frac{\sigma m_N - 1}{c\sigma m_N} \\ V_N^K &= \left(\frac{2\bar{K}}{Fm_N} \right)^{\frac{1}{\sigma-1}} \frac{\bar{L}}{\bar{K}c\sigma m_N}. \end{aligned}$$

It can be again readily verified that both V_N^L and V_N^K are decreasing in m_N .

On the one hand, consider the case with no variety creation. The relationship $m_N = 2m_A$ yields the following indirect utility differential between autarky and free trade:

$$\Delta V_N^L = \left(\frac{\bar{K}}{Fm_A} \right)^{\frac{1}{\sigma-1}} \frac{1}{2c\sigma m_A} > 0, \quad \Delta V_N^K = - \left(\frac{\bar{K}}{Fm_A} \right)^{\frac{1}{\sigma-1}} \frac{\bar{L}}{2c\sigma m_A \bar{K}} < 0.$$

Thus, we have established the following result.

Proposition 10 (class conflict under NCCPD) *Assume that consumers consist of both workers and capitalists. Under NCCPD, free trade always makes labor better and capital worse off when there is no variety creation.*

As in the foregoing section, this result is due to the fact that trade intensifies competition among firms, thus leading to lower prices and operating profits. The latter aspect maps into lower capital rentals and makes capitalists worse off.

On the other hand, when trade leads to the creation of new varieties, i.e., $m_N < 2m_A$ and $n_N > n_A$. Since

$$\begin{aligned}\Delta V_N^L &= \left(\frac{\bar{K}}{\bar{F}}\right)^{\frac{1}{\sigma-1}} \frac{1}{c} \left[\left(\frac{2}{m_N}\right)^{\frac{1}{\sigma-1}} \left(1 - \frac{1}{\sigma m_N}\right) - \left(\frac{1}{m_A}\right)^{\frac{1}{\sigma-1}} \left(1 - \frac{1}{\sigma m_A}\right) \right] \\ \Delta V_N^K &= \left(\frac{\bar{K}}{\bar{F}}\right)^{\frac{1}{\sigma-1}} \frac{1}{c\sigma} \frac{\bar{K}}{\bar{L}} \left[\left(\frac{2}{m_N}\right)^{\frac{1}{\sigma-1}} \frac{1}{m_N} - \left(\frac{1}{m_A}\right)^{\frac{1}{\sigma-1}} \frac{1}{m_A} \right].\end{aligned}$$

It is easy to show that there are ranges of variety creation for which both factors gain from free trade.

Proposition 11 (Pareto improvement under NCCPD) *Assume that consumers consist of both workers and capitalists. There exists, under the free trade with NCCPD, an equilibrium industry structure that makes both the workers and capitalists better off than at the autarky.*

Proof. To see that this possibility may arise, consider the special case where $m_N = m_A$, i.e., firms differentiate after the trade opening such that the free trade mass of oligopolists in each industry is equal to the autarky mass. Clearly, both ΔV_L^N and ΔV_K^N are then strictly positive, which implies gains from trade for every consumer. ■

Proposition 11 shows that who gains and who loses crucially depends on how product variety reacts to international trade, which is in the end an empirical question that deserves some more attention.

6 Conclusions

As is well known, gains from trade under imperfect competition mainly accrue from the expansion of consumers' choice sets (product diversity) and reductions in firms' markups (pro-competitive effects). Although the monopolistic competition literature has been paying little attention to pro-competitive effects and has mainly focused on product diversity, recent empirical evidence points to the importance of both effects (Hummels and Klenow, 2005). This paper is one of the first attempts to present a simple general equilibrium model dealing with both of these aspects of trade.

Using that model, we have shown that the assumption of a one-to-one correspondence between firms and varieties, a typical feature of most monopolistic competition models, is not innocuous when it comes to assessing the welfare impacts of trade. The existence of gains from trade indeed crucially hinges on how trade affects consumers' choice sets, which itself depends on how similar the two countries are in terms of the varieties they produce before trade. Furthermore, factor prices and ownership of production factors are equally important aspects to take into consideration.

We have shown that when countries' sets of varieties are disjoint under autarky, free trade expands consumers' choice sets in each country and, therefore, brings about gains from trade, at least as long as agents own all factors equally. However, when countries' sets of varieties are identical under autarky, trade need not yield gains. The reason is two-fold: First, it does not expand consumers' choice sets; and second, although markups should fall due to more competition in the production of each variety, consumer prices rise because the variable factor becomes more expensive. When combined with the fall in capital rentals, agents' utilities are left unaffected by trade.

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