Chapter 9
The Models

In this chapter we examine the main models of the new theories of international trade, as classified in Table 7.1. These theories also introduce new arguments in the debate on free trade versus protectionism (e.g. Baldwin, 1992, Brander and Spencer, 1984, 1985, Flam and Helpman, 1987, Gabel and Neven, 1988, Grossman and Richardson, 1985, Haberler, 1990, Pomfret, 1992, Venables, 1985, 1987), but these arguments are better studied in the context of trade policy (see Chap. 10, Sect. 10.8).

9.1 Neo-Heckscher-Ohlin Theories

This designation derives from the fact that in these theories (also called neo factor proportions) the departure from the traditional theory is kept to a minimum (in particular, the assumption of perfect competition is maintained), and the conclusion is obtained that intra-industry trade conforms (with due modifications) to the traditional statement of the Heckscher-Ohlin theorem.

The model that we examine is due to Falvey (1981), who starts from the idea that each industry does no longer produce a single homogeneous output, but instead can produce a range of products differentiated by quality (each quality is produced by many competing firms). Thus, according to the terminology introduced in Sect. 7.1, we are in the case of *vertical* differentiation. The second point of departure from the traditional theory is the nature of capital: the capital stock is no longer homogeneous, but consists of capital equipment *specific* to each industry. Because of its specificity the capital stock is immobile among industries, but of course freely mobile in the production of the various qualities within each industry. The labour force is—like in the traditional theory—homogeneous and hence mobile also among industries.

For simplicity, the analysis is limited to a single industry (hence we are in a partial equilibrium context). This industry owns a certain amount of specific capital

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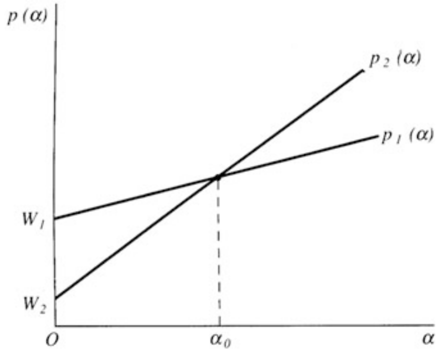

Fig. 9.1 Vertical differentiation and international trade

(whose rate of return, R, adjusts so as to maintain the full employment of the capital stock) and can employ any amount of labour at the current wage rate W. The industry under consideration produces a continuum of different qualities of the product (the assumption of the production of a continuum of qualities is made for mathematical convenience), with a constant-returns-to-scale technology. The problem now arises of defining the quality. For this purpose Falvey introduces a numerical index α such that greater values of α correspond to higher qualities, and assumes that the production of higher-quality goods requires a correspondingly higher quantity of capital per unit of labour. It is now possible to define the measurement units in such a way that the production of a good of quality α requires the input of one unit of labour and α units of capital. Given the assumption of perfect competition, for any quality the price equals the unit cost of production, namely

$$\begin{aligned} p_1(\alpha) &= W_1 + \alpha R_1, \\ p_2(\alpha) &= W_2 + \alpha R_2, \end{aligned} \tag{9.1}$$

where the subscripts 1 and 2 refer as usual to the two countries, whose technology is assumed identical (again in agreement with the Heckscher-Ohlin framework).

Without loss of generality we can assume that $W_1 > W_2$. It follows that international trade requires $R_1 < R_2$: in the opposite case, in fact, we see from Eqs. (9.1) that country 2 could produce any quality of the commodity at a cost (and hence price) which is lower than in country 1, so that there would be no scope for international trade. Assuming then $R_1 < R_2$, it follows that a certain subset of qualities will be produced in country 1 at a lower cost than in country 2, and vice versa for the other subset. In order to identify these two subsets, let us use a diagram (Fig. 9.1), where we have drawn the two linear price-cost relationships given in Eqs. (9.1). Let us note that $R_i (i = 1, 2)$ is the slope of line p_i, hence the p_2 line is steeper than p_1, since $R_2 > R_1$. We see from the diagram that prices are equal in the two countries in correspondence to the "marginal" quality α_0, while country 2 has a comparative cost advantage over country 1 for lower-quality products ($\alpha < \alpha_0$); conversely, country 1 has a comparative cost advantage for higher-quality products ($\alpha > \alpha_0$).

If we now make the plausible assumption that in both countries there is a demand for both lower-quality and higher-quality products, it follows that, in the typical situation of free trade with no transport costs, there will be international trade in the products of the industry considered: country 1 will export higher-quality products to (and import lower-quality products from) country 2. Since we are dealing with products of the same industry, what has taken place is indeed *intra-industrial* trade.

What is more, such a trade follows the lines of the Heckscher-Ohlin theorem, as can be easily shown. Given the assumptions made on the returns to the factors of production, we have $R_1/W_1 < R_2/W_2$, which means that country 1 is capital abundant relative to country 2 according to the price definition of relative factor abundance (see Sect. 4.2). Now, since higher values of α mean both higher qualities and higher values of the capital/labour ratio, we observe that country 1, the capital-abundant country, exports capital-intensive products (conversely country 2, the labour-abundant country, exports labour-intensive products).

In a subsequent model (Falvey & Kierzkowski, 1987) two industrial sectors have been introduced, one of the type treated above and the other traditional, namely producing a single homogeneous commodity. This model is able simultaneously to generate inter-industrial and intra-industrial trade along the lines of Heckscher-Ohlin theorem, in a context of perfect competition and very similar to the traditional one.

It is finally worthwhile emphasizing the fact, mentioned at the beginning of this section, that a plausible model of intra-industry trade has been produced with a minimum of departure from the traditional theory: apart from product differentiation, it has not been necessary to introduce economies of scale or monopolistic competition as other models do. This does *not* mean that these features are unimportant or uninteresting, it simply stresses that the phenomenon of intra-industry trade can be made to fit into the traditional theory, with results similar to those of the Heckscher-Ohlin model.

9.2 Monopolistic Competition and International Trade

In this section we shall present the foundations of a new theory of international trade as developed in the seminal papers by Krugman (1979, 1980; see also Gabszewicz et al., 1981, Grossman, 1992, Harrigan, 1994, 1996, Helpman, 1990, Helpman and Krugman, 1989, Markusen et al., 1995). The new theory features monopolistic competition and posits that the market structure, regardless of comparative advantage, gives rise to international trade. The section continues with the discussion of a number of developments such as a Heckscher-Ohlin-Krugman synthesis model, the home market effects, the gravity equation and the heterogeneity in firms performance.

9.2.1 The Krugman Model

9.2.1.1 Introduction

The two fundamental elements of this theory are the economies of scale internal to the firm and the demand for differentiated products. As we shall see below these two simple elements give rise to international trade. Trade is of the intra-indutry type and takes place even in the absence of comparative advantage.

9.2.1.2 The Demand Side

Two alternative theoretical foundations for the demand for varieties were proposed in the 1970s. These, gave a rigorous foundation to the treatment of demand under monopolistic competition and made it possible to extend the analytical apparatus of monopolistic competition to international trade theory. We review them both briefly.

The first is due to Dixit and Stiglitz (1977) and Spence (1976). They argue that behind the demand for differentiated goods there is simply the desirability of variety as such, which is implicit in the traditional indifference curves that are *convex* to the origin. If a consumer is indifferent between two goods—namely if the combinations (1,0) and (0,1) of these goods lie on the same indifference curve—then an intermediate combination like $(1/2, 1/2)$ is preferred to both extremes. This is because the intermediate combination lies on the straight line segment which joins the two extreme combinations, hence this combination will lie on a higher indifference curve. This can easily be formalized introducing a utility function such that the utility index increases, *ceteris paribus*, as the number of varieties consumed increases. Therefore each consumer demands all the existing varieties of a differentiated good.

It is convenient to present here the utility function used in Dixit-Stiglitz, then adopted in Krugman's works and vastly utilized in the international trade literature. The utility function takes the following functional form:

$$u = \left(\sum_{k=1}^{n} (D_k)^{\alpha} \right)^{\frac{1}{\alpha}}, \qquad 0 < \alpha < 1, \tag{9.2}$$

where D_k is the quantity consumed of the variety k and n is the number of varieties available to the consumer. In the appendix we expound the various properties of this utility function; our purpose here is just to show how it gives rise to the demand for variety. We begin by observing that each variety is equally liked, since each contributes to total utility in the same way. Therefore, in equilibrium (and if production costs are the same), each variety will have the same price. Since prices are identical, each variety will be demanded in the same amount as any other. Imagine then a consumer whose total consumption D is to be spread equally over a number of varieties. He will consume a quantity $D_k = D/n$ of each variety. Now replace $D_k = D/n$ into the utility function (9.2) so as to obtain $n^{\frac{1-\alpha}{\alpha}} D$. It is clear that utility increases with total consumption (D) and with the number of varieties (n). It is also clear that the consumer desires to spread a given total consumption (D) over the maximum possible number of varieties since utility increases in n for any given D. Thus, the consumer does indeed demand all existing varieties, and if new varieties become available he will demand them too.

The preferences *à la S-D-S* (Spence-Dixit-Stiglitz) have been used by Krugman in several works in which he builds a theory of international trade in differentiated goods based on monopolistic competition. This has been called *neo-Chamberlinian* monopolistic competition, because it is nearer to the original vision of Chamberlin himself (see Kierzkowski, 1985).

A second line of analysis of the demand side has been taken by Lancaster (1980), who observes that for all the varieties of a differentiated product to be demanded at the aggregate level, it is not necessary that such a demand also exists at the individual level: it is, in fact, sufficient that each consumer (or group of consumers) has different tastes and so demands a different variety of the product. He starts from an intuition of Hotelling (hence the name of *neo-Hotelling* monopolistic competition given to Lancaster's approach: see Kierzkowski (1985, p. 17)) and applies his own goods-characteristics approach to demand, arriving at a model of monopolistic competition that he extends to international trade. The Lancaster approach (already mentioned in Sect. 8.4.2) starts from the assumption that the consumer does not want the commodities as such, but the characteristics embodied in the commodities. It follows that the demand for the commodities is an indirect or derived demand that depends on the preferences with respect to the characteristics and on the technical properties that determine how the characteristics are embodied in the different commodities. The different individual reactions of different consumers with respect to the same commodity are then seen to be the result of *different individual preferences* with respect to the characteristics (which are perceived in the same way by all consumers) embodied in that commodity rather than the result of different individual perceptions of the characteristics of that commodity.

Lancaster's demand theory is more sophisticated and flexible than the *S-D-S* preferences, but to explain international trade (and intra-industry trade in particular) the reason why at the aggregate level all the varieties of a horizontally differentiated good are demanded does not make much difference. As Krugman observes (1990, p. 75), both approaches lead to a monopolistically competitive equilibrium in which several differentiated goods are produced by different firms all of which have monopolistic power but none of which earns monopolistic profits. Thus we shall follow Krugman (1980) and adopt the S-D-S preferences.

We now turn to the supply side of the model.

9.2.1.3 Technology and Production

As mentioned above, the main objective of the Krugman model is to show how the market structure generates international trade in the absence of comparative advantage. We therefore eliminate from the model any possible source of comparative advantage by assuming that the technology of production is identical between countries and so are factor proportions. Since we rule out any role for endowments it is convenient to assume that there is only one factor of production, namely labour. Further, since there is no comparative advantage, it is unnecessary to have two goods in the model. After all, the model wants to explain intra-industry trade and one good therefore suffices. The model is simplified to the utmost so that we can focus on its two essential elements: the desire for variety and internal economies of scale.

The technology of production is assumed to be identical for all firms and to be characterized by the presence of fixed and variable inputs, both in terms of labour. The production function may be conveniently written in terms of labour input, l, per q units of output: $l = F + cq$, where F is the fixed labour input and cq is the variable labour input. With w denoting wage, $w(F + cq)$ is the total cost. It is immediate that the average cost, $AC = w(F/q + c)$, is declining with the output of the firm while the marginal cost, cw, is constant. The presence of fixed cost makes it optimal for the firm to produce all its output in one plant. Indeed, if it produced in two or more plants it would incur a fixed cost Fw for each plant, which would increase the overall average cost.

Given the desire for variety, each firm will find it optimal to produce a variety different from that of every other firm. The reason is simple: by producing a different variety the firm will be the sole producer of that variety (a monopolist in the market for that variety) whereas if it produced an existing variety it would find itself in direct competition (duopoly) with the other firm producing that variety. Since monopoly profit is larger than duopoly profit, each firm will choose to differentiate its product. This differentiation is profitable since consumers like variety per se and are always happy to consume any existing variety and any new variety introduced in the market. Firms maximize profits by applying the general rule of profit maximization: *marginal revenue = marginal cost*. Since each producer is a monopolist in the market for its variety the profit maximization rule yields a price larger than the marginal cost. The price/marginal-cost ratio is called the mark-up and reflects the market power of the producer. Let $\mu > 1$ denote the mark up, the profit maximization condition is:

$$p^* = \mu c w. \tag{9.3}$$

The technology is identical across firms and all firms face identical demand because consumers like all varieties with the same intensity. Therefore, the profit-maximizing price is the same for all firms, this is why p^* has no index referring to any particular variety.

Free entry does not let any positive profit to remain. If profits were positive new firms (producing new varieties) would enter the market until profits were driven to zero. The free entry assumption therefore gives zero profit as an equilibrium

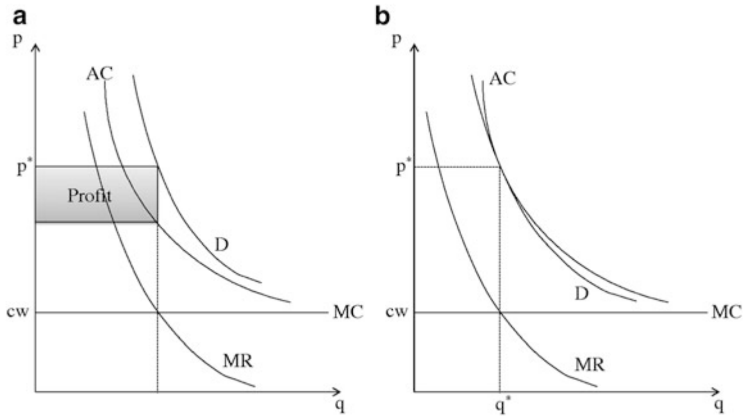

Fig. 9.2 Profit maximization

condition. Let $\pi = pq - w(F + cq)$ be the profit of a firm. Replacing p^* into the expression for profits the zero profit condition is $\mu cq - (F + cq) = 0$, which, solved for q, gives the equilibrium output of each firm:

$$q^* = \frac{F}{c\,(\mu - 1)} \tag{9.4}$$

The profit-maximization condition is represented in Fig. 9.2a, which depicts the situation of any firm. The curves labelled AC, MC, D, and MR represent average cost, marginal cost, demand for the variety in question, and marginal revenue respectively. The producer maximizes profits by choosing a price such that the corresponding marginal revenue is equal to the marginal cost.[1] Profits are represented by the gray area. But positive profits induce the entry of new firms, so Fig. 9.2a does not represent the equilibrium in the market. As new firms enter the market, total expenditure on the industry will be spread over a larger number of varieties. Consequently, the demand curve for any variety will shift to the left until it is tangent to the average cost curve. When tangency occurs, profit is zero because the average cost is equal to the price. The situation when the profit-maximization condition and the zero-profit condition are both satisfied is depicted in Fig. 9.2b. The demand-reducing effect for any existing firm due to the entry of new firms is called the *market crowding* effect. We shall refer to it in a number of occasions below in this chapter. In our discussion of the zero profit condition, we have referred to the profit-erosion (or demand-reducing) effect of entry to help the intuition. It should be clear, however, that in the model there is no entry or exit dynamics and the market settles immediately in the equilibrium depicted in Fig. 9.2b.

[1]In this model it is immaterial whether the producer maximizes profit by setting the price or the quantity.

Firms make zero profits, but they make an operating profit. The latter is defined as the difference between revenue and variable costs. More precisely, firms make an operating profit per unit sold given by the unit price minus the marginal cost: $p^* - wc$. The operating profit is therefore $(p^* - wc)\, q^*$. Since profits are zero, the operating profit is exactly equal to the fixed costs Fw, as can be easily verified by replacing p^* and q^* into the expression for operating profit.

Autarky Equilibrium

We first consider the autarky equilibrium and then a free-trade equilibrium between two identical countries. We do not use any country index in the discussion of the autarky equilibrium because countries are identical. There are four equilibrium conditions in each of the two economies. The first two are profit maximization and zero profit, which have been discussed above. The third, is the demand-equal-supply condition in the market for any variety (there are as many such conditions as there are varieties but these conditions are all identical and therefore reduce to just one condition). The fourth, is the demand-equal-supply condition in the labour market. The third and fourth condition are identical in autarky and we therefore need consider only one of them. Consider the labour market equilibrium. A firm's demand for labour is $F + cq^*$. Let n be the number of firms in the market, itself an endogenous variable. Total demand for labour is $n\,(F + cq^*)$. Equilibrium in the labour market requires that $L = n\,(F + cq^*)$, where L is labour endowment. Solving this equation for n and using expression (9.4), we obtain the equilibrium number of varieties (firms) in the economy, expression (9.4), we have the equilibrium number of varieties (firms) in the economy:

$$n^* = \frac{L}{F}\frac{\mu - 1}{\mu} \qquad (9.5)$$

It is instructive at this point to discuss the role played by μ and F in the results obtained in expressions (9.3)–(9.5). We recall that μ represents the market power of producers which, clearly, is increasing with the rigidity of the demand curve. Demand rigidity depends on the importance that consumers attach to variety per se. If the taste for variety per se is very high, the demand for any variety is very rigid (consumers are reluctant to substitute one variety for another) and the mark-up is therefore very large. Conversely, if the taste for variety is low, the demand curve is very elastic and the mark-up very small. With this in mind, it is clear why a stronger taste for variety (high μ) makes p^* higher, reduces the size of firms q^*, and increases the number of varieties, n^*. The fixed cost F plays no role in the determination of p^* since neither marginal revenue nor marginal cost depend on F. However, F plays a role in the determination of q^* and n^*. To understand this, consider the effect of an increase in F. With higher F, firms could only survive if they made higher operating profits, but this requires an increase in output, since the mark-up is constant (see expression (9.4)). Furthermore, since total demand for the good in question, wL, is constant, larger firm size is only possible if the number of firms declines (see expression (9.5)).

Free Trade Equilibrium

Consider now a world composed of two countries indexed by $i = 1, 2$. Countries have identical technology, identical preferences and endowments equal to L_1 and L_2. The profit-maximization condition gives $p_i^* = \mu c w_i$ for any i and the zero-profit condition gives $q_1^* = q_2^* = q^*$. Equilibrium conditions for the two labour markets give the number of varieties produced in each country:

$$n_1^* = \frac{L_1}{F}\frac{\mu - 1}{\mu} \tag{9.6}$$

$$n_2^* = \frac{L_2}{F}\frac{\mu - 1}{\mu} \tag{9.7}$$

Consumers demand all varieties, both domestic and foreign. Therefore, each variety is not only sold domestically but also exported. There is no comparative advantage, and yet there is international trade. International trade is the result of the market structure: the desirability of variety and single-plant production being the key elements. All trade is intra-industry, i.e., the exchange of different varieties of the same good.

In moving from autarky to free trade, the real wage in terms of any variety, w_i/p_i^*, remains unchanged; therefore there is no gain from trade resulting from changes in prices. Nevertheless, welfare increases because consumers can spread their expenditure over a larger number of varieties. The number of varieties available to consumers increases from n^* in autarky to $\left(n_1^* + n_2^*\right)$ in free trade.

Lastly, we need to establish the trade flows. We begin by noting that given the twin structure of technology and preferences, countries will have the same wage $w_1 = w_2 = w$. Thus, consumers in country i will spend a fraction $n_j^*/\left(n_1^* + n_2^*\right)$ of their expenditure on foreign varieties (with $j \neq i$). The value of country 1's imports, IMP_1, is therefore:

$$IMP_1 = \left[n_2^*/\left(n_1^* + n_2^*\right)\right] wL_1 = wL_1L_2/\left(L_1 + L_2\right) \tag{9.8}$$

and equals the value of country 2's imports, which is:

$$IMP_2 = \left[n_1^*/\left(n_1^* + n_2^*\right)\right] wL_2 = wL_1L_2/\left(L_1 + L_2\right) \tag{9.9}$$

which confirms that the trade balance is in equilibrium with wage equalization.[2] We need not worry about the equilibrium condition in the market for any variety, as this is identical to the trade balance equilibrium condition. Expressions (9.8) and (9.9) also show that the more similar countries are in size, the larger the volume of trade. For any given size of the world labour force, $L_1 + L_2$, the volume of trade is larger the nearer L_1 is to L_2. The reason is that the more alike countries are, the more evenly-distributed the number of firms between them, and these countries will therefore have a lot more to exchange with one another. While the volume of trade is determined, there is indeterminacy as to which variety is produced and exported by each country. This indeterminacy of the direction of trade is, however, irrelevant, since nothing hinges on who produces what.

The model is extremely simple and extremely powerful. Its simplicity comes at the cost of missing some important aspects of reality, such as the sensitivity of the mark-up to the intensification of competition or the presence of multiproduct firms. We shall address some of these aspects below, but here we anticipate that taking account of these elements does not change the fundamental result that market structure alone can generate international trade between identical countries. To fully appreciate the power of this model, we should recall that it solved one of the major puzzles in the field of international trade at the end of the 1970s, i.e., the large volume of intra-industry trade among very similar countries and the lack of a theory to explain that phenomenon.

The monopolistic competition model offers an entirely new explanation for international trade, but it would be a mistake to see it as incompatible with the Heckscher-Ohlin model. The two models can be combined in a single model where comparative advantage determines the specialization and direction of trade in goods and the market structure explains intra-industry trade. This is what we shall discuss in the next section.

9.2.2 A Simple Synthesis Model

The stratagem to simplify the analysis, already used in Sect. 4.3.2 to examine the factor price equalization set, is to start from an integrated world economy, which will be subsequently divided into two countries. So at the beginning we have a closed economic system (the world), producing two commodities: a differentiated commodity, say a manufactured good (henceforth called good A) and a homogeneous commodity, say food (henceforth called good B). In industry A there are increasing returns to scale and monopolistic competition, while in industry

[2]Here we have taken an innocuous shortcut. Wage equalization results from the equilibrium condition for the trade balance. But this would take us into some unnecessary technicalities. To simplify the exposition, we have "guessed" that wages equalize and have verified that the trade balance equilibrium condition is satisfied under wage equalization.

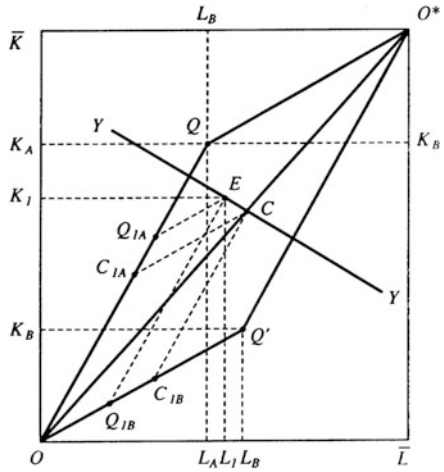

Fig. 9.3 Monopolistic competition and international trade

B there are constant returns to scale and perfect competition. Both industries use homogeneous capital and labour as factors of production; both factors are freely mobile between industries and fully employed. Given the prevailing set of factor prices and goods prices, there will be a certain factor allocation between the two sectors. Let us consider Fig. 9.3 (adapted from Krugman (1990, p. 76)), which can be considered as an extension to two countries of the box diagram explained in Sect. 3.1. In the diagram, the length of the sides of the box represents the total quantities of labour and capital existing in the economy ($\overline{L}$ and $\overline{K}$). Point Q (the end-point of vector OQ) gives the allocation of resources to sector A in the integrated economy. Thus sector A employs OK_A of capital and OL_A of labour. Similarly point Q', end-point of the vector OQ', represents the allocation of factors to sector B, which employs OK_B of capital and OL_B of labour. We see that good A is more capital-intensive than B, but this is not important.

Since both factors are fully employed, we have $OK_A + OK_B = O\overline{K}$, hence $OK_B = K_A\overline{K} = O^*K_B$. Similarly, $OL_A + OL_B = O\overline{L}$, hence $OL_B = L_A\overline{L} = O^*L_B$. Thus by construction we have $O^*Q = OQ'$, i.e. vector O^*Q has the same length and slope as vector OQ', and vector O^*Q' has the same length and slope as vector OQ. Hence OQO^*Q' is a parallelogram.

The next step in the analysis is to imagine the world divided into two countries, say country 1 and country 2, which are identical to the integrated economy as regards tastes (consumers also have the same structure of demand), technology, and market forms. The prices (of goods and factors) are also the same as in the integrated economy. The only difference is in factor endowments (note, incidentally, the analogy with the standard Heckscher-Ohlin assumptions). If we measure country 1's endowment starting from O and country's 2 endowment starting from O^*, the subdivision of $\overline{K}$ and $\overline{L}$ between the two countries can be represented by a point in the box. Let us suppose that such a subdivision is given by point E, so that country 1 has an endowment of OK_1 of capital and OL_1 of labour: the rest is the endowment of country 2.

Since the prices of goods and factors are assumed to be same as in the integrated economy, country 1 will produce the two goods with the same techniques used in the integrated economy, namely it will produce good A with the capital/labour ratio given by the slope of OQ and good B with the capital/labour ratio given by the slope of OQ'. With reference to the box OK_1EL_1, the allocation of K_1 and L_1 to the production of A and B can thus be determined (similarly to what we did in the integrated economy) by drawing the parallelogram $OQ_{1A}EQ_{1B}$, where the side EQ_{1A} is parallel to OQ_{1B}, and EQ_{1B} is parallel to OQ_{1A}.

Let us now draw through E the straight line YY having the same slope as the factor-price ratio p_L/p_K. We recall that profits disappear not only under perfect competition but also under monopolistic competition, so that the price coincides with the average cost of production, namely the cost of factors. Since national income coincides with the value of total factor rewards, which in turn coincides with national product, all the points along YY represent a value of the national income of country 1 equal to that existing at point E. If we then look at YY from the point of view of origin O^*, we can conclude that along this line, the value of country 2's national income (which can of course differ from that of country 1) is also constant. Therefore OC/OO^* measures country 1's share of world income (output).

Given the initial assumption of identical structures of demand in the two countries, it follows that both countries demand the goods—and hence consume the factor services embodied in them (see Sect. 3.1 for the transition from the space of goods to the space of factors)—in the same proportion. The consumption point will thus be along the diagonal OO^*. Since all national income is consumed, the consumption point is C. To determine the composition (in terms of the two goods) of the consumption basket represented by C we draw the usual parallelogram, obtaining points C_{1A} and C_{1B}. Since C_{1A} is nearer than Q_{1A} to the origin O, it contains a smaller quantity of good A. It follows that there will be *net* exports of A (we shall presently see why *net*), since consumption is smaller than output. Similarly we can see that point C_{1B} represents a consumption of good B greater than domestic output (point Q_{1B}): thus country 1 imports B.

We have reached the conclusion that country 1, the relatively capital-abundant country, exports the relatively capital-intensive good A, and exports the relatively labour-intensive good B. These results are perfectly in line with the conventional Heckscher-Ohlin theorem. But there is more to it than that: while international trade in good B will be of the conventional inter-industry type, trade in good A will be of the *intra-industry type*. We have in fact just seen that the exports of A are *net* exports: this means that country 1 will simultaneously export and import goods belonging to industry A, the exports being however greater than the imports. To show this, we must recall that—as a consequence of economies of scale in the production of each variety of commodity A—no country can produce the entire range of varieties of this commodity, but only part of it. Therefore, even if both countries produce manufactured goods, each will produce different varieties; which country produces which varieties cannot be determined, but this is not important for our analysis. In fact—independently of the hypothesis made on preferences (see Sect. 9.2)—consumers in each country are assumed to demand all varieties. Thus, to satisfy domestic demand, country 1 will import from country 2 the varieties that it does not produce, and export to country 2 the varieties that it produces, to meet country 2's domestic demand. There is, consequently, intra-industry trade (which in the aggregate, as we have seen above, gives rise to net exports of A from country 1), that will coexist with inter-industry trade.

This result is independent of the kind of preferences (S-D-S or Lancaster) assumed: these, however, come back into the picture when we go on to examine the gains from international trade. These gains are the availability of a greater number of varieties and an increased scale of production of the single varieties, giving rise to a lower unit cost of production thanks to scale economies. As Krugman shows (1990, p. 79), only the first type of benefit is possible with S-D-S preferences, while both types are possible with Lancaster preferences.

The welfare effects of international trade in the synthesis model come from comparative advantage and from the expansion of the number of varieties. Therefore, trade is certainly beneficial to both countries. There is, however, a new result with respect to the Heckscher-Ohlin model, concerning income distribution. We have seen in Sect. 4.3.1 that any trade liberalization in the Heckscher-Ohlin model hurts the relatively scarce factor and benefits the relatively abundant factor, in the sense that it reduces the real wage of the former and increases that of the latter. This notwithstanding, in the synthesis model it is possible that the welfare gain deriving from the increased number of varieties available to consumers may outweigh the loss for the relatively scarce factor coming from the loss of purchasing power in terms of any variety. Thus, as shown in Krugman (1981), it is possible that both factors gain from trade. The more alike countries are in terms of relative factor endowments and the stronger the taste for variety, the more likely this is to happen.

9.2.3 Monopolistic Competition and Welfare Effects of Trade Opening

In monopolistic competition there is a new source of welfare gain from international trade. This source is represented by the expansion of the number of varieties available to consumers when passing from autarky to free trade. Since consumers like variety per se, such expansion brings about an increase in welfare.

This source was the only one in the Krugman model (Sect. 9.2.1). The welfare effects of international trade in the synthesis model (Sect. 9.2.2) instead come from comparative advantage and from the expansion of the number of varieties. As we have seen when studying the Heckscher-Ohlin model, the presence of comparative advantage suffices for trade to be beneficial to all countries. In the synthesis model welfare is a fortiori beneficial to all countries since the welfare gain coming from the expansion of the number of varieties is added to the welfare gain obtained from comparative advantage. There is, however, a new result in the synthesis model. While in the Heckscher-Ohlin model the welfare of the relatively abundant factor increases and that of the relatively scarce factor declines, in the synthesis model it is possible that all factors gain from trade. As shown in Krugman (1981), this occurs when the welfare gain deriving from the increased number of varieties available to consumers outweighs the loss for the relatively scarce factor. The more alike countries are in terms of relative factor endowments and the stronger the taste for variety, the more likely this is to happen.

9.2.4 The Home Market Effect

In the presence of trade costs or other form of market segmentation, the size of expenditure in a country relative to the other country has an impact on wages and specialization. This impact is known as the "home market effect" and is the subject of this section. More precisely, the home market effect refers to either of these phenomena: (1) a positive relationship between a country's relative wage and relative size of expenditure; (2) a more than proportional relationship between the relative size of output of a good in a country and the relative size of that country's expenditure.[3]

To simplify matters, we shall assume that all international trade costs may be modeled as international transport costs. We shall adopt the iceberg transport costs already introduced in Sect. 6.3. Thus, for each unit of a variety sent from country i to country j, only a fraction $\tau \in (0, 1)$ of it arrives at its destination, the remaining $(1 - \tau)$ being lost in transit.

9.2.4.1 Demand and Wages

We consider again the model in Sect. 9.2.1 to which we add trade costs. The price charged by a firm to domestic and foreign consumers cannot be the same, since the latter includes trade costs. The mark-up is the same in all markets but the firm takes account of the fact that the marginal cost of producing for the foreign market includes the fraction of the variety lost in transit. The marginal cost of producing for the domestic market is still cw_i. The marginal cost of producing for the foreign market is instead $\frac{1}{\tau}cw_i$, since in order to sell one unit of output in the foreign

[3]The terminology "home market effect" appears for the first time in Helpman and Krugman (1985, chap. 10), where it refers to the second phenomenon mentioned in the text. Later it became clear that the two phenomena are just two different manifestations of the same economic mechanism. See Head and Mayer (2004) for a critical and comprehensive appraisal on the literature referring to either of these two phenomena.

market the firm has to produce $1/\tau$ units. Let p_{ii}^* and p_{ij}^* be, respectively, the profit-maximizing price in i and j of a variety produced in i. These prices are:

$$p_{ii}^* = \mu c w_i \tag{9.10}$$

$$p_{ij}^* = \frac{1}{\tau}\mu c w_i \tag{9.11}$$

Consider two identical countries. Since countries are identical, equilibrium will be such that all endogenous variables will be identical between countries, notably, $w_1 = w_2$, and $p_{11} = p_{22}$. Consider a symmetric demand shock by which demand increases in country 1 and decreases by the same magnitude in country 2, thus leaving world demand unchanged. Since there is only one good, the change in demand can only originate from a change in country size. With populations being initially $L_1 = L_2$, the shock is of the type $\Delta L_1 = -\Delta L_2 > 0$. Such a symmetric demand shock results in an excess demand for any variety produced in country 1 and in an excess supply for any variety produced in country 2. The reason is due to the presence of transport costs which make $p_{12} > p_{11}$. Since $p_{12} > p_{11}$, foreign demand for any variety produced in 1 is smaller than domestic demand. Therefore, the increase in demand originating from country 1 dominates the fall in demand originating from country 2 and overall demand for any variety produced in 1 increases.[4] Obviously, if we had assumed $\Delta L_1 = -\Delta L_2 < 0$ then we would have an excess supply for any domestic variety. In sum, at home, the home market shock dominates on the foreign market shock. We refer to this dominance as to the "home market dominance" in the demand shocks. The magnitude of the home market dominance (the excess demand or excess supply) depends on trade costs and on the taste for variety. The higher the trade costs, the bigger the excess demand or supply. In the extreme case of autarky, the excess demand or supply reaches its maximum value, since there is no fall in foreign demand. Second, the weaker the taste for variety, the greater the excess demand or supply. To understand this, recall that a weak taste for variety means that varieties are highly substitutable for one another. Therefore, any given price difference between a domestic and a foreign variety will induce a larger reduction in demand for the latter and the excess demand or supply generated by the shock will therefore be larger.

For clarity of exposition let us continue with the case where $\Delta L_1 = -\Delta L_2 > 0$. The excess demand resulting from the expenditure shock will have to be absorbed by a change in output and/or a change in prices. In the model we are using, there will

[4] **As an example, assume that** $L_1 = L_2 = 10$ **and** that the other model parameters are such that in the initial equilibrium $w_1 = w_2 = 1$ and that the expenditure on any domestic variety emanating from country 1's residents is 10 % of income while the expenditure on any domestic variety emanating from country 2's residents is 8 % of income. Initial national income is 10 in both countries. Now consider a shock $\Delta L_1 = -\Delta L_2 > 1$. The excess demand for any country 1's variety is $0.1 - 0.08 = 0.02 > 0$.

be changes in output and prices. Let us see why. The shock $\Delta L_1 = -\Delta L_2 > 0$ is in itself a shock to the labour force, causing an expansion in total industry output in country 1 and a reduction in total industry output in country 2. Since output per firm is constant, changes in total industry output occur via entry of firms in country 1 and exit of firms in country 2. The change in relative industry outputs induced by the change in relative labour forces is perfectly proportional to the latter. Indeed, from Eqs. (9.6) and (9.7) we obtain $n_1/n_2 = L_1/L_2$ which shows the perfect proportionality. So far we have established that an increase in L_1/L_2 causes an excess demand for varieties produced in country 1 and, via the labour market, an increase in the relative number of varieties produced in country 1. Interestingly, the increase in the relative number of varieties produced in country 1 is not sufficient to clear the excess demand for varieties produced in country 1 (likewise for the reduction of varieties in country 2 and the excess supply there). To understand this, consider the effect that the entry of a new firm has on other firms' profits. It is convenient to begin with the case of a country in autarky. Imagine that this country experiences an increase in demand of a given magnitude. If there were no entry by new firms, the excess demand would be distributed evenly overall firms, thus giving rise to positive profits. This induces the entry of new firms. The entry of new firms will subtract demand from existing firms by exactly the amount that brings them back to the initial level of demand and to zero profit. This is quite obvious: in autarky, the expenditure on every variety is wL/n^*, which shows that an equiproportional change in L and n^* leaves the expenditure per variety unchanged. This means that any increase in demand induced by ΔL is entirely absorbed by the corresponding increase in the number of varieties induced by ΔL itself. The fact that a new firm subtracts demand from other firms is called the market crowding effect, as we have already mentioned above. In autarky, the market crowding effect is perfect in the sense that the entry of a new firm reduces total demand for the aggregate of all varieties one for one. Let us now return to the situation of two countries and assume that country 1 experiences an excess demand of the same magnitude as the autarkic country in the previous example. Now the entry of new firms in country 1 induced by ΔL will subtract demand not only from domestic firms but also from foreign firms: it will therefore absorb only a fraction of the excess demand for domestic varieties. Likewise, the excess supply for country 2 varieties will not be cleared by the exit of firms induced by ΔL_2, precisely because part of the expenditure freed by the disappearance of those firms is reallocated to all firms, not only to those in country 2. Overall, the entry of firms in country 1 and the exit of firms in country 2 shifts demand towards the aggregate of varieties produced in country 1, thus generating further excess demand. Therefore, after proportional entry and exit there is still a residual excess demand for varieties produced in country 1.

The residual excess demand can only be absorbed by an increase in the relative price of varieties produced in country 1 (further entry is not possible since all labour is already employed). Since prices and wage are in constant proportion the increase in the relative price of domestic varieties brings about an increase in the relative wage of country 1, w_1/w_2. This result may be summarized as follows.

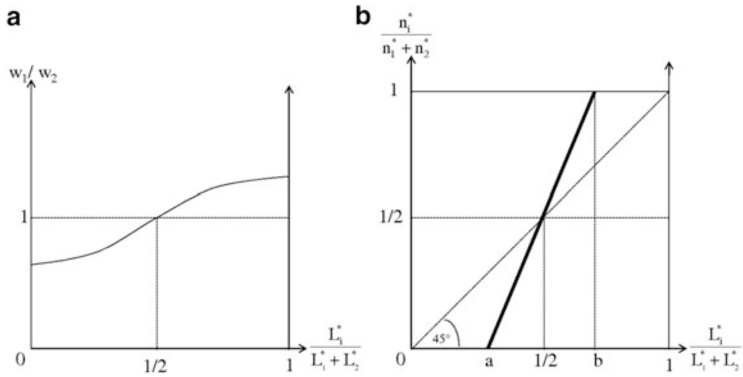

Fig. 9.4 The home market effect: (**a**) demand and wages (**b**) demand and specialization

Proposition 9.1. *In the model described in Sect. 9.2.1 and in the presence of international trade cost, the wage is higher in the country where demand is greater.*

Interestingly, the wage difference is due neither to different technologies nor to different factor proportions; it is only due to different market sizes. Figure 9.4a shows the relationship between relative wages and relative size of demand resulting from this model.

Note that the excess demand generated by the demand shock is simply due to the presence of trade costs and is not particularly related to monopolistic competition. It would occur, albeit with different intensity, even if the goods were homogenous. The fact that the excess demand is not entirely absorbed by proportional entry is instead due to product differentiation. This distinction has been used in some empirical studies to which we shall return in Sect. 9.4.

9.2.4.2 Demand and Specialization

In Sect. 9.2.4.1, the residual excess demand had to be absorbed by changes in wages, since the entry of additional firms was not possible due to the resource constraint. But this need not be the case in general. In this section we modify the model so that the excess demand will be absorbed uniquely by the entry of firms. This extension is based on Helpman and Krugman (1985, sect. 10.4), although the economic mechanism and results had already been presented in Krugman (1980). The only difference with respect to the model of Sect. 9.2 is that there are two goods, A and M. Consumers spend a fraction γ of total expenditure on good M and the remaining $(1-\gamma)$ on good A. Good A is produced using a constant-return-to-scale technology under perfect competition. Specifically, the production function is $A = L$, which means that one unit of labour input produces one unit of output. Since there is perfect competition in A, the price of A will be equal to the marginal cost, i.e., $p_{Ai} = w_i$. Good M is differentiated and the market structure is monopolistic competition as described in Sect. 9.2. International trade is free in good A while it is subject to iceberg costs in good M. Since there is free trade in A, the price of A must be the same in both countries, i.e., $p_{A1} = p_{A2} \equiv p_A$, which implies $w_1 = w_2 \equiv w$. The profit-maximizing price for any variety of good M is given by $p_{ii}^* = \mu c w$ and $p_{ij}^* = \frac{1}{\tau}\mu c w$ which differ from expressions (9.10) and (9.11) only in that the wage is the same in the two countries. We recall that the first subscript refers to the country where the good is produced and the second subscript refers to the country where the good is sold.

Consider now a symmetric expenditure shock. Since there are two goods, the expenditure shock may have two sources: (1) a symmetric shock to preferences such that γ changes in opposite directions in the two countries or (2) a symmetric shock to country size as in Sect. 9.2.4.1. The source of the shock is irrelevant and we shall choose the second. So let us consider a shock $\Delta L_1 = -\Delta L_2 > 0$. As in Sect. 9.2.4.1, the home market dominance makes that the symmetric expenditure shock gives rise to an excess demand for varieties produced in country 1. For the same reasons as in Sect. 9.2.4.1 this excess demand is not entirely absorbed by a proportional change in the number of varieties. Differently from the model in Sect. 9.2.4.1, in this section countries can specialize. Thus, the excess demand not absorbed by a proportional increase in the number of varieties will be absorbed by further entry of firms in country 1 and further exit in 2. Thus, industry M will expand more than proportionally with respect to changes in the relative labour force of country 1. This is possible because in country 1, the labour needed for a more than proportional expansion of the M industry may be taken from industry A. Likewise, the labour released by industry M in country 2 will be employed in industry A. This result may be stated as follows:

Proposition 9.2. *In the model described in this Sect. 9.2.4.2 there is a more than proportional relationship between the relative size of demand and the relative size of output in good M. Thus, the country with a relatively larger demand for M will specialize in the production of M.*

Interestingly, the source of international specialization is not comparative advantage but market size. Figure 9.4b shows the relationship between the relative size of output and the relative size of demand resulting from this model. Note that the relative size of output is $n_i p_{ii}^* q^* / \left(n_1 p_{11}^* q^* + n_2 p_{22}^* q^*\right)$ which equals $n_i / (n_1 + n_2)$ by virtue of expression (9.4) and since $p_{ii}^* = \mu c w = p_{jj}^*$. The relative size of demand is $L_i / (L_1 + L_2)$. The thick line in Fig. 9.4b represents the more than proportional relationship between the share of output and the share of demand. Naturally, the more than proportional relationship holds until one country is completely specialized. Such a situation is represented in Fig. 9.4b at point a (where country i has completely specialized in A) and at point b (where country j has completely specialized in A).

9.2.4.3 Robustness of the HME

A number of works have studied the robustness of the HME to reasonable model modifications. Head, Mayer, and Ries (2002) consider alternative forms of market structure. They find that the HME is pervasive and may emerge even in the presence of an oligopoly with homogeneous goods, as long as markets are segmented either by trade costs or by the demand structure. Brülhart and Trionfetti (2009) find that demand influences specialization even in the absence of trade costs as long as it gives rise to some form of market segmentation. Davis (1998), using a model similar to that in Sect. 9.2.4.2, notes that the relationship between the share of output and the share of demand in the differentiated good can only be proportional if there are prohibitive trade costs in A. Crozet and Trionfetti (2008) show that with trade costs in all goods (including good A) and product differentiation by country of origin, the more than proportional relationship becomes non-linear, being weaker for similar countries and stronger for countries of very different size. Behrens, Lamorgese, Ottaviano, and Tabuchi (2009) develop a multicountry and asymmetric trade cost model and show that the relationship between share of output and share of demand is not necessarily more than proportional in this setting. Head and Mayer (2004), in their critical and comprehensive appraisal of this literature, show that the HME can disappear when the intersectoral mobility of labour is less than perfect.

Other papers have studied the home market effect predominantly from the empirical point of view and we shall review them below in Sect. 9.4

9.2.5 Adding Some Realism to the Monopolistic Competition Model

In this section, we discuss two aspects of the monopolistic competition model described in Sect. 9.2 that seem particularly unsatisfactory. The first is that the mark-up is constant and the second is that firms only produce in one country.

9.2.5.1 Variable Mark-Up

Constant mark-up represents a convenient simplification when the objective is to show that the market structure generates international trade between identical countries, but it sacrifices too much realism when the objective is to study how firms adjust to trade opening. After all, the mark-up reflects the market power and it seems reasonable to think that in moving from autarky to free trade the market power of each firm declines because of fiercer competition. We shall refer to the equations of the model in Sect. 9.2.1 in discussing this matter. To be precise, however, we should change the demand structure (typically not that of S-D-S preferences) and specify some additional aspects of firms' behaviour. These modifications would bring us into a tedious taxonomy of cases without adding substantial matter to the understanding of the economic mechanisms. We therefore stay with the equations already obtained above since they approximate the equations obtained from alternative specifications of the model. Let μ^A and μ^T denote the mark-up in autarky and in free trade with $\mu^T < \mu^A$. First, we see from (9.3) and (9.4) that a decline in the mark-up reduces the price and expands the output of each firm. This is often referred to as the *pro-competitive effect* of international trade which results in lower mark-ups and lower average costs. Second, some firms will succumb to fiercer competition. Replacing μ^A in (9.5) and μ^T in either (9.6) or (9.7) shows that $n^* > n_i^*$, which means that the increased competition pushes some firms out of the market.[5] This is sometimes referred to as the *firm exit* effect. Furthermore, under some conditions on the demand functions (which we omit in order to avoid unnecessary technicalities), it is possible to show that the decline in mark-up is such that $n_1^* + n_2^* > n^*$. This means that the number of varieties available to consumers is larger in free trade than in autarky although each country will produce a smaller number of varieties. It should be clear that the pro-competitive effect and the firm exit effect are not specifically related to the presence of product differentiation. As a matter of fact, these effects are typical of oligopoly models with or without product differentiation; see Markusen (1981) for a deeper treatment. In monopolistic competition models these effects appear when the perceived elasticity of demand is not constant; see, e.g., Krugman (1979) and Ottaviano, Tabuchi, and Thisse (2002).

9.2.5.2 Multiproduct Firms

In the monopolistic competition model used above, firms are single-product (they only produce one variety) and national (they only produce in one country). This result seems at odds with reality. Firms often produce more than one variety and typically in different countries. This aspect of reality can easily be taken into account in the monopolistic competitive model if we assume, as is reasonable, that there are costs of trading between countries. The presence of trade costs entails that each national market is partially protected from foreign competition. Then, as argued in Baldwin and Ottaviano (2001), a firm would find it optimal to set up another production plant abroad, producing a variety different from that produced at home. Thanks to the market segmentation caused by trade costs, this strategy allows the firm to gain market share abroad without generating too much competition with its own home-produced variety. This does not affect the existence of intra-industry trade, however. Indeed, the variety produced abroad by the national firm is sold abroad and domestically like any other variety.

In conclusion, it is clear that taking into account multiproduct multinationals and variable mark-ups would make the model more realistic but would leave unchanged

[5] Firms are identical, so the model does not indicate which firms will succumb. This is an issue that we shall discuss in Sect. 9.2.7 below.

the fundamental result that the market structure gives rise to international trade between identical countries.

9.2.6 The Gravity Equation

Data on international trade flows show a remarkably stable empirical regularity known as the gravity equation. The gravity equation posits that the trade flow between two countries is increasing in the 'mass' of goods the exporter has to offer, increasing in the 'mass' of demand emanating from the importing country, and decreasing in trade costs. In the early specifications of the gravity equation, the mass of supply and demand were represented by GDP. This relationship was named gravity because of the analogy with the gravity between planets (stars, etc.), increasing in the planets' masses (GDPs) and decreasing in distance (trade costs). The relationship posited by the gravity equation has been confirmed over several decades of empirical studies. However, for long it lacked a neat theoretical foundation. The monopolistic competition model offers a very direct foundation for it which can be grasped by inspection of expressions (9.8) and (9.9) above. These expressions show that exports between countries are, ceteris paribus, increasing with the size of the exporter, L_1, with the size of the importer, L_2, and with the similarity in the size of the countries. Noting that the size of the labour force is, essentially, the GDP of the country, one can formulate a relationship between exports from one country to another as depending positively on the exporting country GDP, on the importing country's GDP and on the similarity of GDPs. Furthermore, declining trade flows with increasing distance are easily derived by enriching the model with iceberg trade costs (see Sect. 23.2.3.1 for a formal derivation). The theoretical foundation provided by the monopolistic competition model gave a lot more meaning to the gravity equation and stimulated further research which continues to date. The theoretical and empirical advancements since the pioneering study by Anderson (1979) are thoroughly discussed in Head and Mayer (2013).

9.2.7 Heterogeneous Firms

Firms are a major actor in international trade. Exporting is undertaken by firms in response to demand emanating by foreign firms and/or foreign consumers. Yet firms remain in the backstage in Ricardian and Heckscher-Ohlin theories of international trade. This is due to the perfect-competition and representative-firm assumptions adopted in these models. These assumptions have made it possible to focus on country/industry characteristics (comparative advantage) as determinants of international trade and specialization. Imperfect competition, and especially the Krugman model, has brought to light the importance of market structure. In this model firms play a more active role and their decisions are crucial in determining international trade. Yet, while the assumption of perfect competition is dropped, that of the representative firm is maintained. This assumption does not allow to examine how firms and the industry as a whole reorganize themselves when economies open up to international trade. Consider, for instance, the specialization induced by international trade in comparative advantage models: the industry with the comparative advantage expands and the other one contracts. These changes in the size of industries probably do not affect all firms in the same way, but comparative advantage models are silent on this matter since the assumption of identical atomistic firms rules out any scrutiny of what happens to them. Consider the Krugman model: in this model all firms export, and yet even a cursory inspection of data shows that only a very small fraction of firms are actually engaged in international trade. This diversified reality about firms and their response to trade opening found a theoretical collocation in the work of Melitz (2003).

Melitz developed a general equilibrium model where firms differ in their productivity levels. We can grasp the crucial mechanisms of this model by applying some modifications to the monopolistic competition model studied in Sect. 9.2.1. In the present context we assume the presence of iceberg trade costs. Let $\phi \equiv 1/c$ be the marginal productivity of labour (recall that c are the units of labour needed to produce one unit of output). We have already seen in Sect. 9.2.1 that in monopolistic competition with S-D-S demand, the profit-maximizing price for any firm is a multiple μ of the marginal cost:

$$p = \frac{\mu}{\phi} w \tag{9.12}$$

Unlike the model in Sect. 9.2.1, here the marginal productivity ϕ varies across firms. To simplify matters, assume that firms *draw* their marginal productivity ϕ from a probability distribution which has support $(0, \infty)$.[6] Once ϕ is drawn, the firm can compute its domestic and foreign profit. The profit of a firm is given by revenue minus variable costs minus fixed costs and the operating profit is given by revenue minus variable costs. Firms face a fixed costs of production, wF, and a fixed costs of exporting wF_x. Therefore domestic and foreign profits for a firm in country i are:

$$\pi_{ii} = \pi_{ii}^{o}\left(\overset{+}{\phi}\right) - wF \tag{9.13}$$

$$\pi_{ij} = \pi_{ij}^{o}\left(\overset{+}{\phi}\right) - wF_x \tag{9.14}$$

where the notation $\pi_{ii}^{o}(\phi)$ and $\pi_{ij}^{o}(\phi)$ indicates that domestic and foreign operating profits depend on productivity, ϕ. As indicated by the algebraic sign above ϕ, a rise in productivity increases operating (and total) profits. Since domestic and foreign

[6]The draw is not free. Firms have to pay a fixed cost equal to F_e units of labour in order to draw the marginal productivity. This stylized mechanism may reflect, for instance, the cost incurred in acquiring the relevant information about the expected costs and benefits of operating a business.

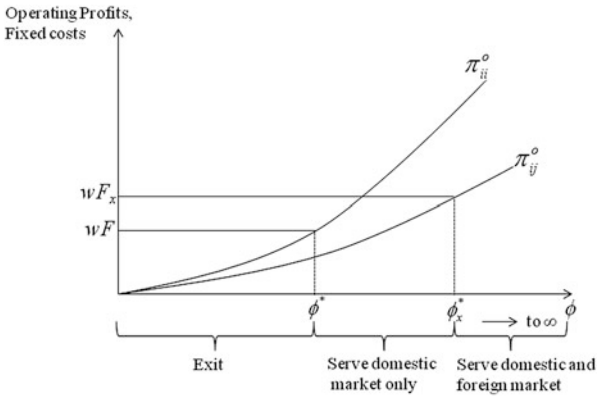

Fig. 9.5 Zero profit and zero foreign profit conditions

profits are independent, the firm takes two separate decisions after drawing ϕ: to stay or not to stay, to export or not to export. The firm will stay in the market if it draws a high enough ϕ for the profits on the domestic market to be non-negative. The firm will decide to export if it draws a high enough ϕ for profits in the foreign market to be non-negative.[7] These decisions give two separate zero-profit conditions:

$$\pi^o_{ii}(\phi) = wF \quad \text{Zero Domestic Profit Condition} \tag{9.15}$$

$$\pi^o_{ij}(\phi) = wF_x \quad \text{Zero Foreign Profit Condition} \tag{9.16}$$

Equation (9.15) is the zero-profit condition on the domestic market. The value of ϕ determined by this equation is in fact the smallest value of ϕ such that profit in the domestic market is non-negative. We refer to the value of ϕ determined by Eq. (9.15) as the zero profit productivity cutoff and denote it ϕ^*. A firm will stay in the market if it draws a value of ϕ larger or equal to ϕ^* and will exit otherwise. Equation (9.16) is the zero-profit condition on the foreign market. The value of ϕ determined by this equation is the smallest value of ϕ such that profit in the foreign market is non-negative. We refer to the value of ϕ determined by Eq. (9.16) as the zero exporting profit productivity cutoff and denote it ϕ^*_x. A firm will export if it draws a value of ϕ larger or equal to ϕ^*_x and will not export otherwise. Firms' decisions with respect to staying and exporting are depicted in Fig. 9.5.

ϕ is plotted on the abscissa and operating profits and fixed costs on the ordinate. The curves emanating from the origin represent domestic and foreign operating profits as functions of productivity, ϕ. The horizontal lines represent fixed

[7]Unlike the model studied in Sect. 9.2.1, the free entry condition and the zero profit condition are disjoint. The free entry condition requires that the expected profit from running a business should equal the entry cost wF_e. The expected profit from running the business depends on the expected value of ϕ, which in turn depends on the probability distribution of ϕ.

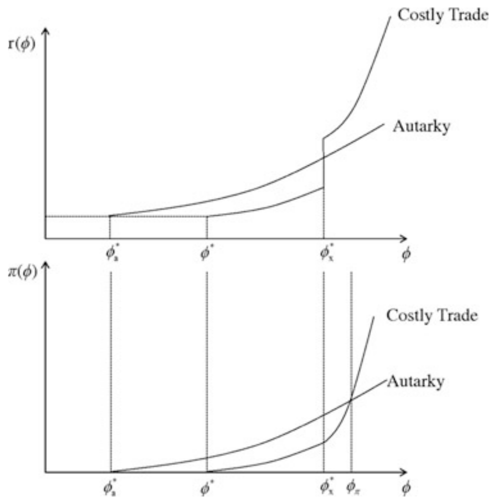

Fig. 9.6 From autarky to costly trade

production costs and fixed exporting costs. The intersection between each operating profit line and its corresponding fixed cost line gives the cutoff values ϕ_x^* and ϕ^*. In this figure, $\phi_x^* > \phi^*$. This ranking is consistent with the fact that while some firms do not export, exporting firms typically also supply the domestic market. It can be seen from Fig. 9.5 that this ranking of cutoff values obtains thanks to appropriate restrictions on the relative size of fixed costs, which we assume to be satisfied. Unlike the monopolistic competition model studied in Sect. 9.2.2, when firms are heterogeneous not all of them make zero profit. Only the firms that have drawn a productivity level equal to ϕ^* will make zero profit. Their situation is the same as that depicted in panel (b) of Fig. 9.2. We refer to these firms as the *cutoff firms*. Firms drawing a higher productivity level will make positive profits. Quite intuitively, individual market share and profits increase with productivity.

In autarky, no firm exports and only the zero-profit productivity cut-off is defined. Let ϕ_a^* be the zero-profit productivity cut-off in autarky. Free trade is characterized by $\tau = 1$ and $F_x = 0$. In free trade all firms export. Costly trade is characterized by $\tau \leq 1$ and $F_x > 0$. In costly trade, in general, not all firms export, since not all of them can afford to pay F_x and still make non-negative profits on the foreign market. The presence of fixed export costs (and not the presence of iceberg costs) endogenously generates the partition of all firms into exporting and non-exporting firms. If there were no fixed export costs, the model would simplify to the model developed in Sect. 9.2 with only minor differences. The effect of moving from autarky to costly trade is conveniently represented in Fig. 9.6 drawn from Melitz (2003). On the abscissa of the upper panel we measure revenues, r, and on the abscissa of the lower panel we measure profit, π. The notation $r(\phi)$ and $\pi(\phi)$ recalls that revenues and profits positively depend on the productivity level ϕ drawn by a firm. Firms drawing a productivity level $\phi < \phi_a^*$ will exit immediately without engaging in any production. Firms drawing a productivity level $\phi > \phi_a^*$ will stay in the market and produce. Sales and profits increase smoothly with productivity, thus firms having drawn a higher ϕ will sell more and make higher profits, as shown by the lines labelled "Autarky".

In moving from autarky to costly trade the *market crowding* effect pushes some firms out of the market. Clearly, it will be the least efficient firms that succumb. Therefore, the zero-profit productivity cut-off moves to $\phi^* > \phi_a^*$. Now, firms with productivity ϕ between ϕ_a^* and ϕ^* exit. But that is not all. Firms with productivity ϕ between ϕ^* and ϕ_x^* will find it profitable to produce only for the domestic market, whereas firms with productivity $\phi > \phi_x^*$ will sell in the domestic and foreign market. Furthermore, trade causes a reallocation of market share. Comparing the lines "Autarky" and "Costly Trade" in the upper panel we see that firms with productivity ϕ between ϕ_a^* and ϕ_x^* have lost market share, while firms with productivity $\phi > \phi_x^*$ have gained market share. Profits are reallocated too. In the lower panel we see that firms with productivity $\phi < \phi_\pi$ lose part or all of their profits, while firms with productivity $\phi > \phi_\pi$ expand their profits. Interestingly, firms with productivity ϕ between ϕ_x^* and ϕ_π gain market share but lose profits. Any further decline in trade costs will cause a shift of ϕ^* further to the right and a shift of ϕ_x^* further to the left, thereby causing the exit of more firms and increasing the number of firms able to export.

Clearly there are consequences on average productivity. Since the zero-profit productivity cut-off moves to the right, the average productivity of the industry increases with any decline in trade costs. The number of varieties available to consumers may increase or decrease; it tends to decline because of the exit of some domestic firms but to increase because of the increase in the number of foreign exporters. It can be shown that welfare increases when iceberg trade costs decline.

This model gives a richer picture of what happens inside an industry when a country moves from autarky to costly trade. The heterogenous firm model may be combined with a Heckscher-Ohlin model as proposed in Bernard, Redding, and Schott (2007). The resulting synthesis model exhibits inter-industry and intra-industry trade in a way analogous to the synthesis model studied in Sect. 9.2.2. But there are a number of additional results. One of the most interesting new results is that under some conditions on the probability distribution, the ex-ante probability of exporting is higher in the industry of comparative advantage. Another result is that, ceteris paribus, the zero-profit productivity cut-off, ϕ^*, is higher in the industry of comparative advantage, implying that the industry with the comparative advantage will have a higher average productivity, ceteris paribus, than the other industry. This, in turn, adds a sort of endogenously-determined Ricardian comparative advantage to an otherwise identical-technology Heckscher-Ohlin structure.

Many other models extensions have been developed in the literature after Melitz's work. We shall study some of them in Sect. 17.5 with particular attentions to the implications for the labour market. For a comprehensive discussion of theoretical developments see Redding (2011).

9.3 Oligopoly and International Trade

9.3.1 *Introduction*

In the previous sections, we have considered models based on market forms that might be called "structurally competitive", namely where the number of firms is sufficiently high for no firm influencing, with its own decisions, the decisions of the other firms. On the contrary, we consider here models based on oligopolistic markets, where the problems of strategic interdependence among a limited number of firms become essential.

As we know from microeconomics (see, e.g., Friedman, 1977, Varian, 1992), there does not exist a general model of oligopoly. Oligopolistic firms can act in collusion, tacit or explicit (as in cartels) or in a non-cooperative manner. When they do not cooperate, the result of their interaction depends on several factors: the decision variable of the firm (price or quantity), the nature of the firms' *conjectural variations* (i.e., of the assumptions that each firm makes as regards the other firms' reactions to its price or quantity changes), the specification of the product, the nature of the market (i.e., whether it is segmented or not), etc. Thus it not possible to give a *general* analysis of the effect of oligopoly on international trade. It is however possible—through the study of specific cases—to obtain interesting results especially as regards intra-industrial trade. In what follows we have set up our treatment according to the product type, in agreement with the classification in Table 7.1.

9.3.2 *Homogeneous Commodities*

International trade in homogeneous goods in a context of oligopolistic markets was examined by Markusen (1981), who assumed integrated markets, and by Brander (1981) and Brander and Krugman (1983), who assumed segmented markets. Here we shall follow the latter approach, because it can explain intra-industry trade in homogeneous goods. For a synthesis of the two approaches see Venables (1990).

Intra-industry trade in homogeneous goods, that we have already treated in Sect. 8.5, is explained by Brander as the result of the interaction among oligopolistic firms in different countries. Let us consider the simplest case of duopoly: one firm in country 1 and one in country 2, both producing the same homogeneous commodity. The decision variable is assumed to be the quantity, so that each firm has to decide how much of its output to sell at home and how much abroad (the whole output is produced domestically). Transport costs are modelled according to the iceberg assumption (see Sect. 6.3), are borne by the producers, and are assumed to be symmetrical—that is to say, the unit transport cost of the output of firm 1 to (the market in) country 2 is equal to the unit transport cost of firm 2's output to country 1. To make the model as simple as possible the technology is assumed internationally identical with identical production costs (marginal costs are constant); the demand

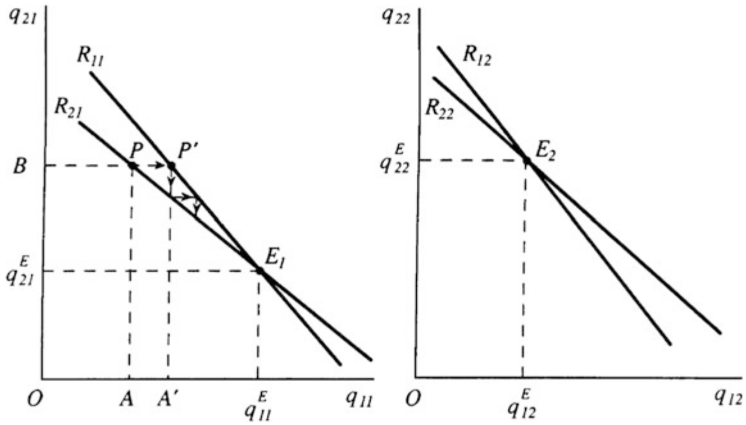

Fig. 9.7 Homogeneous duopoly and reciprocal dumping

functions are also internationally identical. The two markets are assumed to be segmented, so that firm i can sell at a different price at home and abroad. Naturally, since the product is homogeneous, in a given market the price will be identical for both the domestically produced and the imported good.

The strategic interaction between the firms is modelled following the Cournot hypothesis, according to which each firm maximises profit choosing its decision variable (the quantity) on the assumption that the quantity supplied by the other firm remains the same. The only (but important) difference between the conventional Cournot duopoly and the case under examination is that here each firm acts in two different markets, in each of which it employs a Cournot strategy as regards the other firm's supply to the same market. To be precise, if we denote by q_{ij} $(i, j = 1, 2)$ the quantity offered by firm i on market j, we have that firm 1 chooses q_{11} and q_{12} so as to maximise profit, assuming that q_{21} and q_{22} remain the same; similarly firm 2 will choose q_{21} and q_{22} so as to maximize profit, taking q_{11}, q_{12} as constant. In calculating its profit each firm must take account of transport costs on the part of its total output sold abroad, namely q_{12} for firm 1 and q_{21} for firm 2.

As we know from microeconomics (see, for example, Kreps (1990, sect. 10.1)) the equilibrium point in Cournot's duopoly can be determined employing the *reaction curves* (or *best-reply functions*, as they are sometimes called). A reaction curve shows the optimal quantity supplied by a duopolist for any given quantity supplied by the other one. In our case, we have two couples of such curves, namely one couple in each market, that we indicate by R_{ij} (reaction curve of firm i on market j). In Fig. 9.7 we have drawn the two couples of reaction curves, that for simplicity's sake we have assumed linear. They are also assumed to be *separable*, namely the reaction curve of a firm in a market only depends on the quantities being supplied (by the firm under consideration and by the rival) in that market, and not on the quantities being supplied in the other market. Thus, for example, R_{11}

does not shift as q_{22} and q_{12} change. This very convenient property depends on the assumption that the marginal cost is constant (see the Appendix, Sect. 23.3.2).

It can now be shown, through the usual dynamic mechanism underlying Cournot reaction curves, that the equilibrium point is stable in both markets. Consider for example market 1, and take an arbitrary initial situation in which the local firm offers OA. The foreign firm, given its reaction curve R_{21}, will offer OB (the ordinate of point P). The domestic firm, given the supply OB from the foreign firm, will then offer OA' (the abscissa of point P' on the domestic firm's reaction curve), and so forth. The dynamic path clearly converges to the equilibrium point E_1. A similar reasoning can be applied to market 2 to show that the equilibrium point E_2 is stable.

Given the assumptions made (identical size of the two markets, identical production costs, identical demand, identical transport costs), the two equilibrium solutions are symmetrical, i.e. $q_{11}^E = q_{22}^E$ and $q_{12}^E = q_{21}^E$. Furthermore, owing to the presence of transport costs, $q_{ii} > q_{ji}$, namely in each country the share of demand satisfied by the domestic firm is greater than the share satisfied by the foreign firm.

This form of intra-industry trade due to oligopolistic interaction can be seen as a form of dumping or *reciprocal dumping*, as Brander and Krugman (1983) called it. To show this, let us begin by observing that, due to the symmetry property, the overall quantity supplied to each market will be the same in both markets and hence, since the demand functions have been assumed identical, the price also will be identical in the two markets. It follows that, due to transport costs, for each firm the f.o.b. price of exports is lower than the domestic price of the same commodity, and therefore there is a kind of reciprocal dumping.

9.3.3 Vertically Differentiated Goods

Let us recall that we are in the case in which goods differ only in quality. In the neo-Heckscher-Ohlin model of Sect. 9.1, quality was assumed to be an increasing function of capital intensity; here, we assume that it is the expenditure on R&D (Research and Development) to enable firms to produce a better good. An additional important consideration is why in this section we assume an oligopolistic market rather than a competitive one like in the neo-H-O model. The reason is that when the burden of quality improvement falls on high fixed costs such as R&D expenditure, there is an upper limit to the number of firms that can profitably operate (for simplicity's sake we assume that each firm produces only one quality). Such a situation—i.e., very high fixed costs with respect to variable cost—is called *natural oligopoly* by Shaked and Sutton (1983) and other authors that have examined it. These studies, initially referred to a closed economy, were then extended to open economies (Shaked and Sutton, 1983, Motta, 1992).

On the demand side, we assume consumers with identical tastes but with different incomes: those with a higher income are willing to pay more for a higher-quality product. Thus the market is divided in a fairly simple manner: the highest quality supplied is bought by all consumers with an income above a certain critical level; the next to highest quality is bought by all consumers in the immediately lower income bracket, and so forth.

In studying international trade, the authors start from initially closed economies, amongst which trade is subsequently opened, and distinguish between the short and the long run. In the short run, given the upper bound to the number of firms that can coexist, the opening of international trade will in any case bring about a reduction in the number of firms existing in the combined economy (countries 1 and 2 form now a single world market). If we examine for example the extreme case of two equal countries, let B denote the maximum number of firms (and so of goods) that can coexist in each of them separately considered. In the combined market still B firms at most can coexist, which means that some firms will be eliminated from the markets through price competition (the assumption is that the oligopolistic interaction does not take place through the quantity, like in the Cournot model used in Sect. 9.3.2, but through prices, like in the Bertrand-Edgeworth oligopoly model). Hence, in the post-trade situation consumers will be better off thanks to lower prices, and intra-industry trade will occur because consumers will continue demanding the B varieties of the commodity, which are now produced partly in country 1 and partly in country 2.

When the two autarkic economies are different (the diversity being measured by a different income distribution), a greater number of firms can coexist in the combined world economy when trade is opened up; but this number becomes smaller as the income distributions get nearer.

Let us now come to the long run, always starting from two initially autarkic economies. The Shaked and Sutton model shows (see Sect. 23.4.2) that the number of firms that can survive in each country is only two, and that other firms that tried to enter the market would suffer losses (hence they do not enter). What happens when international trade is opened? We must as before distinguish two cases, that in which the two economies are identical, including income distribution, and that in which they are different as regards income distribution. In the former case the same result as in the two autarkic economies will continue to hold for the combined world economy, namely no more than two firms producing two different qualities will survive. The model cannot however forecast which are these firms, so that it might happen that the two surviving firms belong to the same country. In this case there would be one-way trade, for the other country would have to import both commodities; of course there will have to exist other sectors in which such country can export, because in the context of the pure theory no country can be only an importer. When, on the contrary, the two surviving firms belong to different countries, since the consumers in both countries demand both commodities, there will be intra-industry trade with the simultaneous import and export of different qualities of the commodity. Finally observe that, since each firm will serve not only the domestic but also the foreign market, the economies of scale will allow a price reduction, hence an increase in consumers' welfare (the gains from trade).

If income distribution is different in the two autarkic countries, the number of firms that can coexist in the world economy is greater; but for our purposes it is sufficient to observe that the result will be in any case the creation of intra-industry trade to satisfy consumers' demands in both countries.

9.3.4 Horizontally Differentiated Goods

Eaton and Kierzkowski (1984) considered the case of an economic system where two goods are produced: a homogeneous commodity (good A, produced under constant returns to scale) and a horizontally differentiated commodity (good B, produced under increasing returns to scale). While the market for good A is perfectly competitive, market B is oligopolistic.

The firms in sector B first choose the variety of the good to be produced (each firm is assumed to produce only one variety) and then decide the price. More precisely, the assumption here is that a firm incurs the fixed cost when it chooses a variety to produce, before it decides on the level of output and price. Thus, the decisions concerning entry and price are taken sequentially rather than simultaneously. According to the authors, this is consistent with the views of Linder (see Sect. 8.4.1), who holds that production is typically first developed for the domestic market; international trade takes place only later, when firms have already selected their models and incurred fixed costs.

Oligopolistic interaction takes place through prices, according to a modified Bertrand assumption. More precisely, when a firm contemplates price reductions it assumes that the other firms will not change their price, while when it considers price increases it anticipates that the competitors will lower their price.

The demand for the differentiated commodity follows Lancaster's approach based on characteristics (see Sect. 9.2). We must add that consumers will be willing to demand the differentiated good provided that the price of the variety they desire is not higher than a certain critical level, above which they will demand the homogeneous good only.

The opening of trade between such economies will give rise to a vast number of short-run and long-run effects, partly depending on the number of firms existing in the two countries before and after trade. Thus the authors are compelled to adopt a taxonomic approach. Among the several cases they examine there is that in which free trade is not the best situation for a country, which, on the contrary, can improve its welfare levying a tariff on imports of the differentiated good. To show this let us assume that in the pre-trade situation commodity B is not produced in country 2, for example because its price would be higher than the critical level, so that consumers do not demand it and spend all their income on the homogeneous commodity. In country 1, on the contrary, consumers demand both the homogeneous commodity and commodity B (only one variety, produced by a single firm, is assumed to exist) because their critical price is higher than that of country 2's consumers. Let us limit ourselves to the short-run effects, so that the productive situation remains unchanged. With the opening of trade country 1's producer of good B will try to sell also in country 2's market by lowering the price. But since no market discrimination is assumed to exist, this producer will have to lower the price also in the domestic market. Country 1's consumers will benefit, and the producer will get higher profits. It is in fact obvious that the producer under consideration, who already earned monopoly profits in country 1's market before the opening of trade, will decide to sell also in market 2 by reducing the price only if the elasticity of the two countries's combined demand shows this decision to be the superior alternative.

Let us now ask what happens to country 2. Local consumers will have no benefit, because the monopolist producer of commodity B will be able to charge a price that in the margin will leave country 2's consumers indifferent between consuming the homogeneous commodity only (like in autarky) or consuming both the homogeneous and the differentiated commodity. Thus we conclude that free trade benefits country 1 but leaves unchanged the welfare of country 2, contrary to the result of the traditional theory, according to which, as we know, free trade is beneficial to both countries.

Under the heading of intra-industry trade in horizontally differentiated goods produced by oligopolistic firms we also must mention the so-called "biological" model of trade (Bhagwati, 1982). In biology the same set of genetic traits, or genotype, interacts with different environments and gives rise to different actual biological forms, or phenotypes. In economics, the same set of know-how and technological capabilities (the genotype) will interact with different local historical and cultural environments (including different tastes) to give rise to different varieties of a horizontally differentiated good (the phenotypes). In other words, each country in autarky tends to specialize in the production of those varieties of a differentiated good that best suit the tastes of the domestic consumers. When trade is opened, consumers will be better off by consuming more varieties of the commodity, and intra-industry trade will result. For a formalisation of this approach see Dinopoulos (1988).

9.4 Empirical Studies in the Light of Theory

Most of the empirical studies on the non-traditional theories of international trade concern the monopolistic competition model in its several variants. These studies are the subject of the present section.

At the end of the 1970s there was a rather visible discrepancy between international trade theory and international trade facts. The theoretical paradigm based on comparative advantage was elegant, profound, and intellectually appealing but spectacularly at odds with the observed patterns of trade. As Deardoff (1984, p. 499) notes in his *Handbook* chapter, "The Ricardian and Heckscher-Ohlin theories are thought by many to provide a less than complete explanation of world trade. The reason for this dissatisfaction lies only partly in the somewhat ambiguous support that tests of the theories have provided. Rather, many authors have noted a number of empirical regularities in the data of international trade that seem, on the surface at least, to be unexplainable in terms of these dominant theories." In particular, three empirical regularities constituted a puzzle for the comparative advantage theories while standing strongly in support of the monopolistic competition model of international trade. The first was represented by the dominant presence of intra-industry trade. Many studies interpreted the large volume of intra-industry trade with respect to inter-industry trade as evidence in support of the monopolistic competition model and against the comparative advantage model (see Leamer & Levinsohn, 1995, for a critical appraisal). The second was represented by the excellent empirical performance of the gravity equation and the fact that the latter can be derived directly from the monopolistic competition model (as we have seen in Sect. 9.2.6). A prominent contribution based on this fact is Helpman (1987), which carried out an extensive empirical analysis of the monopolistic competition model on OECD data from 1956 to 1981. He tested both a model in which all trade is intra-industry and a model in which intra-industry and inter-industry trade coexist. His conclusion was that the theory finds some support in the data. The third was the gigantic volume of trade among developed countries (countries with similar technology and factor endowments) relative to the volume of trade between developed and developing countries (countries with different technology and factor endowments). This fact is precisely the contrary of what the Ricardian and Heckscher-Ohlin theory predicted. However, by the beginning of the 1990s, these views were challenged on theoretical and empirical grounds. Studies, such as Davis (1995), Deardorff (1998), Eaton and Kortum (2002), and Evenett and Keller (2002), showed that intra industry trade and gravity-type predictions may be derived from a variety of other models, not only in monopolistic competition. Furthermore, Hummels and Levinsohn (1995) found that the gravity equations also fitted excellently with a data set for non-OECD countries, a piece of evidence that they plausibly interpret as being at odds with the assumptions of the monopolistic competition model of trade. Davis (1996) showed that large volumes of trade between countries with similar endowments and technologies and small volumes between countries with different endowments and technologies do not require monopolistic competition and are perfectly consistent with the Ricardian and Heckscher-Ohlin theories. These studies, combined with the new evidence in favor of an amended version of the Heckscher-Ohlin-Vanek model (discussed in Sect. 4.4), made it clear that further investigation was needed to assess the empirical merits of the monopolistic competition model.

An innovative approach was proposed by Davis and Weinstein (1999, 2003). The novelty of their approach is that they identify a discriminating criterion that allows to distinguish between the monopolistic competition and the perfect competition models of Heckscher-Ohlin inspiration. The discriminating criterion is based on the demand-specialization manifestation of the home market effect (HME) that we have already encountered in Sect. 9.2.4.2. They argue that there is a more than proportional relationship between the share of output and the share of demand in monopolistic competitive sectors, while there is a less than proportional relationship in perfectly competitive sectors. They regress the share of output on the share of demand on a data set comprising a large number of countries and industries. The estimated coefficient of such regression indicates whether there is an HME. An estimated coefficient statistically larger than one is consistent with the HME and therefore constitutes evidence in favor of the monopolistic competition model of international trade. Conversely, an estimated coefficient smaller than one is inconsistent with the HME and therefore constitutes evidence in favour of the perfect competition model. Their results show evidence of the existence of the HME when using aggregate expenditure but only mild evidence of the existence of the HME at the sector level. The work of Davis and Weinstein has stimulated a lively research programme. Head and Ries (2001) use the sensitivity of the HME to changes in trade costs as a discriminating criterion. They find that the size of the relationship between share of output and share of demand decreases with trade costs in constant returns to scale and perfectly competitive sectors, while it increases with trade costs in increasing return and monopolistic competitive sectors. They use this feature as a discriminating criterion. They find evidence in support of both models depending on whether parameter identification comes from the cross section or from the time series, but the perfect competition model seems to be supported more strongly. Hanson and Xiang (2004) have tested a different version of the HME, namely that larger countries tend to export relatively more of high-transport-cost, strong-scale-economy goods and relatively less of low-transport-cost, weak-scale-economy goods. They tested this prediction on country pairs' exports to third markets and found evidence of HME in high transport-cost, strong-scale-economy industries, as predicted by the theory. Davis (1998) was the first to note that most of the theoretical and empirical studies on the HME assume the existence of an outside good (a freely-traded good produced with constant returns to scale and in perfect competition like good A in Sect. 9.2.4.2). He shows that prohibitive trade costs in the outside good eliminate the HME. Crozet and Trionfetti (2008) follow up on Davis' work. They find that in a slightly more general theoretical setting, the HME is attenuated and becomes non-linear. They also pursue an empirical investigation and find evidence of a pervasive but quantitatively mild presence of the HME in its non-linear shape. Brülhart and Trionfetti (2009) develop a new discriminating criterion using home-biased expenditure. The criterion predicts that countries' relative output and their relative home biases are positively correlated in differentiated-goods sectors (the "home-bias effect"), while no such relationship exists in homogeneous-goods sectors. Their empirical results suggest that the monopolistic competition model fits particularly well for a number of sectors that account for some 40 % of sample manufacturing output. Other works, such as Redding and Venables (2004) and Head and Mayer (2006), find evidence of the existence of the demand-wages manifestation of the HME discussed in Sect. 9.2.4.1.

Strong support in favour the synthesis model discussed in Sect. 9.2.2 is found in Romalis (2004). He examines how factor proportions determine the structure of commodity trade in a many-country version of the synthesis model to which he adds iceberg trade costs. The commodity structure of production and bilateral trade is fully determined thanks to trade costs and monopolistic competition. He finds two important results. The firs is that countries capture larger shares of world production and trade in commodities that make more intensive use of their abundant factors (the Heckscher-Ohlin theorem). The second is that countries that rapidly accumulate a factor see their production and export structures systematically shift towards industries that use that factor intensively (the Rybczynski theorem).

We have seen in Sect. 9.2 that welfare is higher in free trade than autarky because the number of varieties available to consumers expands. For a long time this source of gain from trade remained empirically unexplored. Broda and Weinstein (2006) were the first to measure this gain from trade. They estimate that the gain from trade for US consumers between 1971 and 2001 was 2.6 % of GDP. Expressed differently, they find that consumers in the US would be willing to pay 2.6 % of their income to access the wider set of varieties available in 2001 rather than those available in 1972.

Coming to heterogenous firm models we note that some empirical regularities, such that not all firms exports, that exporters are larger than non-exporters, and that trade liberalization leads to the reallocation of market shares, not only are explained by heterogenous firm models but constitute one of the motivations for the development of such models. This is only one the merits of this family of models. As Bernard, Jensen, Redding, and Schott (2012) note in their comprehensive and instructive appraisal of the empirical literature, heterogenous firm models also paved the way to new explorations on the relationship between trade liberalization and aggregate economic variables, such as the composition of intra-industry trade flows or the implications for the labour markets. Furthermore, they contributed to the understanding of the relationship between trade liberalization and the internal organization of the firm, of its decisions concerning offshoring, of the modalities of procuring inputs and of choosing the strategies of international expansion.

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