CHAPTER 3

Revisiting Strategic Trade Theory

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3.1 Introduction to Strategic Trade Theory

Traditional theories of international trade explain trade in terms of the differences in endowments of factors such as resources, technology, or even tastes. This orthodoxy has been challenged from the 1970s onward by a group of trade theorists who have tried to explain the pattern of specialization between countries, the effects of protectionism, and so on, in terms of increasing returns and imperfect competition. This departure from tradition has drawn on various concepts from industrial organization theory, in particular the concept of imperfectly competitive markets. This deviation from the standard assumption of perfect competition in the trade models naturally leads one towards a theory of strategic trade. This approach has succeeded in providing explanations for the high volume of intraindustry trade, the existence of multinational corporations, and the emergence of an international technology gap. Furthermore, the literature in this area has deepened our understanding of the issues involved in trade policy analysis.[1]

What is strategic trade theory? Let us present the argument in a stylized manner so as to highlight the central issue. Suppose there are only two trade partners, represented by one domestic firm and one foreign firm, competing

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in the world market. Since there are only two firms, they are unlikely to act as price takers under perfect competition. Strategic interaction among the trade partners arises naturally in such a scenario with the profits of each of the firm being contingent on the actions of other rival firm. Such interdependence may arise through price, output, investments, R&Ds, and so on. This generates a strategic game between the two firms, in particular a duopolistic one.

The problem is to predict how the two firms will behave optimally in such a situation. Consider a situation where the two firms are engaged in quantity competition, and one of the firms becomes cost efficient and is thus able to reduce its marginal cost. Thus, given the output of a rival firm, it is optimal for the incumbent firm to expand. The new Cournot equilibrium indicates a higher market share and profit for the cost-efficient firm and a lower market share and profit for the rival foreign firm. Therefore, the cost-efficient firm not only directly gains due to the reduction in costs, but also because the cost reduction indirectly improves its strategic position in the market, which thereby induces the rival to contract. The efficient firm therefore benefits more than the amount of the costs savings.

If we extend this idea to the intraindustry trade framework, where firms indulge in trade in a duopolistic market structure with homogenous or differentiated products, some critical insights can be drawn. Note that an export or a production subsidy, which are some policy instruments vested with the government, have the same effect as a cost reduction for the domestic firm. Now the question is, while the policy clearly benefits the domestic firm, does it serve the national interest? There are two effects of a subsidy. One effect is the direct costs saving, which is just a transfer. In addition, because of the subsidized costs, it allows the domestic firm to expand, and hence the foreign rival's best response is to contract.

Formally, given that output levels are strategic substitutes, the best response function of the domestic firm will shift out, inducing an increase in the domestic firm's market share and hence profit by an additional amount. This is the 'strategic effect' of subsidy. It implies that the profit of the domestic firm rises by more than the amount of subsidy. Thus, the benefit of the firm exceeds the cost of the taxpayers (which is used to finance the cost reduction subsidy). This idea can be traced, among others, to Brander and Spencer (1983). The basic point is quite general and helps to focus on the strategic role of government policies in diverting profits from foreign to domestic firms. Helpman concludes his theoretical

survey with the statement that "international theory has taken the advantage of a new framework that has brought it closer to reality than before."

Traditional trade theory suggests that trade protection measures such as tariff or import quotas would increase the price of a good for both domestic producers and consumers and reduce imports, which is welfare-reducing except in some well understood cases. In contrast, the new trade theory shows that government protection measures may boost the welfare of the country in relation to free trade in the presence of a small number of firms. If, however, all countries try to protect their domestic industries, then there would be losses due to a fragmented world market, arising not only from the failure to specialize (according to comparative advantage), but also from the inefficient scale of production. But an individual firm can conceivably increase the scale of production in a protected industry sufficiently to reap a net benefit, possibly even to lower prices to domestic consumers. Thus, while traditional theory advocates trade protection only as a second-best measure to correct for market failure, the new trade theory identifies other possible gains from trade protection.

Trade policy is traditionally more concerned with the protection of domestic import—competing industries, rather than export promotion. Tariffs are imposed not as strategic policy, but simply as a way of raising revenue. There is, however, a very old argument for protection that does have a strategic interpretation, that is, the infant industry argument. Temporary protection of an industry that is too inefficient to compete with foreign rivals, might be justified on the grounds that this might allow the industry to become efficient enough to compete with foreign firms. One weakness of this argument is that it must rely on either the idea that firms in an industry generate positive externalities among themselves, or the claim is that the firms are unable to make efficient long-term investment through the capital markets.

The principal obstacle to the formal modelling of increasing returns to scale in the 1970s was the problem of market structure. The fact that increasing returns and perfect competition are incompatible, and therefore it was usual for the trade theorists to stick to the assumption of perfect competition, as shown by the equality $p = MC$, cannot be extended in a framework of increasing returns with marginal costs pricing (because it will lead to losses).

The rest of this chapter is organized as follows. In the next section we discuss some relevant literature. In Sect. 3.3 we seek to extend Krugman's (1984) seminal work on "import protection as export promotion." While

we discuss the model in Sect. 3.4, the analysis for the three different cases of free-entry of firms is taken up in Sect. 3.5. Finally, Sect. 3.6 concludes the discussion.

3.2 Brief Literature Survey on Strategic Trade

Strategic trade theory can be broadly classified into three categories as: (i) the Marshallian external economy approach, (ii) the Chamberlinian large-group analysis of competition, and (iii) the oligopolistic approach.

3.2.1 Marshallian External Economy Approach

There is a small body of literature that allows for increasing returns of scale, but assumes that it is wholly external to the firms, so that costs fall only with an increase in the size of the industry, but not with the size of the firms. Under this framework the assumption of perfect competition is naturally preserved. However, such external economies are hard to model both theoretically, as well as empirically. Further, such a framework cannot address issues related to market structure. Explicit general equilibrium analysis of trade in the presence of external economies began with Mattews and was continued in a number of papers, including Kemp and Negeshi (1970), Melvin (1969), Chacoliades (1978), and Panagariya (1981).

However, most of the literature about this approach fails to generate useful insights. The notable contributions in this category are by Ethier. He demonstrated that the analysis of trade in the presence of Marshallian external economies is greatly clarified if we work from allocation of resources to production and trade, and not the other way around. Marshallian increasing returns and comparative advantage can be synthesized in a tractable manner through factor prices and factor content, rather than through commodity trade. To integrate Marshallian increasing returns with comparative advantage, we assume that the trading world reproduces the aggregate outcomes of a hypothetical perfectively integrated economy. Using this framework we find that both factor proportions and scale economies are sources of gains from trade. In particular, one can show that:

1. Factor proportion theory continues to hold, although there is indeterminacy in the precise pattern of trade. Consequently, a country will

be the net exporter of services of factors with which it is abundantly endowed.
2. There will be geographical concentration of each industry subject to the country-specific increasing returns. This concentration will be the compelling force for trade even in a situation of equal factor endowments in the two countries.
3. Gains from trade arises because the pretrade autarkic prices are different.
4. Additional gains arise if there are increasing returns for the traded industries (irrespective of their location).

3.2.2 Chamberlinian Approach

Chamberlin (1933) argued that in some industries firms practice product differentiation and therefore acquire some monopoly power. Thus, they face downward-sloping demand curves. However, along with the presence of economies of scale, free entry implies that firms only earn normal profits. The revival of Chamberlin's "large group" analysis in the industrial organization literature in the 1970s has motivated trade theorists to discard the assumption of perfect competition and formalize product differentiation and monopolistic competition (Dixit and Stiglitz 1977). Thus, it has become possible to build trade models involving scale of scale and imperfect competition.

In this framework, it is not the difference between the countries but economies of scale that induces trade in similar products, that is, intraindustry trade. The gains from trade (Dixit and Stiglitz 1977) comes from the increase in the number of available varieties, as well as from the scale of production of each variety. The scale effect, however, depends on the elasticity of demand of individual varieties. Under the Dixit and Stiglitz (1977) approach, this elasticity is assumed to be constant, thus leading to greater varieties through trade but not greater scale.

This framework has been widely used in the international trade. Krugman (1979, 1980, 1981), for example, proves that the international exchange of goods can, in addition to improving allocation of resources, bring about greater variety. Under the Lancaster (1979, 1980) approach, trade is likely to lead to more elastic demand, thus leading to greater diversity, as well as to lower average costs. Helpman and Krugman (1985a, b) argue that both scale and diversity will move monotonically with gross industry output. Thus, trade is beneficial if the world output is larger

than what the national output would have been in the absence of trade. So, gains from scale will be translated into gains from trade. Therefore, unlike Heckscher Ohlin, here trade is motivated mainly by economies of scale, and we may expect that even the scarce factors gain.

Thus, gains for all factors are more likely the more similar is the country's endowment to that of the world as a whole (Krugman 1984). Several authors such as Kemp and Negishi (1970), Eaton and Panagariya (1979), and Markusen and Melvin (1981) have shown that gains from trade can be guaranteed if the output of all goods produced under the IRS is greater under free trade than under an autarky.

An alternative approach to product differentiation was developed by Lancaster (1979). He assumed that each product represents a bundle of characteristics, and consumers have preferences over these attributes. This again leads to a demand for varieties at the aggregate level. This extended framework has been further developed by Lancaster (1980) and Helpman (1981). Helpman generalizes the Heckscher and Ohlin model by introducing product differentiation and monopolistic competition, and demonstrates that his findings are capable of explaining North–South trade. Here intraindustry trade takes place because each country produces a unique variety of differentiated products.

In contrast to Lancaster's model, Avner and Sutton (1984) extended their analysis to vertical product differentiation where consumers of different income levels choose different varieties. In this model, the interaction of taste and technology decides the number of firms in the equilibrium, independent of market structure. Trade drives away the low-quality producers from the market and enhances consumers' welfare in the long run.

Ethier suggested that international trade under increasing returns to scale is more likely to be important in intermediate goods, than in final goods, and the gains from trade comes from the increasing specialization of their production process. Ethier also established results on the relationship between interindustry and intraindustry trade, as well as on the distributional implications of trade that reinforce the findings of the earlier works by Helpman, Dixit, Norman, Lancaster, and Krugman.

If there is factor mobility, there is an incentive for movement in large economies, a process that reinforces the size advantage of these economies (Helpman and Razin 1984; Krugman and Helpman 1985). If transport costs are important but not prohibitive, then Krugman (1980) and Venables (1985) demonstrated that, other things being equal, countries will tend to be net exporters of goods for which they have a large domestic market.

The Chamberlinian framework has been useful in analyzing the role of trade in technology and the role of multinational firms—issues which cannot be analyzed under perfect competition. Feenstra and Judd (1982) showed that fixed costs plays a significant role in trade in technology. Dixit (1984) raises the old debate on North–South trade and shows that the failure of the underdeveloped South is often due to the monopoly power of the North. Dixit also addresses the issues of technological progress and tariffs. On the empirical side, Grubel and Lloyd (1975) examine the significant role of intraindustry trade between developed countries with similar factor endowments and technological know-how. Stewart focuses on the implications of the new trade theories for the South.

3.2.3 Oligopolistic Approach

This approach takes place in an imperfectly competitive world where issues such as interactions and interdependence among the firms take center stage. This approach has yielded some important findings that were not captured in the earlier two approaches. The first finding is the role of trade in reducing monopoly power and increasing competition. The second finding is the possibility that market segmentation and price discrimination can lead to seemingly pointless intraindustry trade. Suppose that there is some industry in the two countries such that few firms compete over quantity. Also assume that under autarky the prices of the goods are the same in both countries. When trade is opened up, each firm will become part of the larger, more competitive market. It will find itself facing a higher elasticity of demand, leading to an expansion of output. Thus, industry output will expand and prices will fall. Moreover, if countries are symmetric, welfare will rise due to the reduction of monopoly distortion.

The possibility of gains from trade in this framework was earlier discussed by Caves (1974) and more recently by Dixit and Norman (1980). They showed that the effect of opening trade in a Cournot market is that it leads to a world industry that has fewer larger firms, but where competition is nonetheless increased. Thus, the opening of trade not only leads to a reduction in monopoly distortion, but also to an increase in productive efficiency. Moreover, Cournot quantity competition can led to a third possible explanation of trade.

Brander (1981) shows that trade may arise purely because imperfectly competitive firms have an incentive to gain incremental sales by dumping in each other's home markets. Consider an industry consisting of two firms,

each in a different country, engaged in Cournot competition through trade. In the autarkic situation, each of the firms was a monopolist in their respective country. As trade opens up, each firm has an incentive to sell a little bit in the other's home market, as long as the price exceeds the marginal costs.

Brander and Krugman (1983) extended the original Brander model by establishing that trade equilibrium with cross-hauling exists for arbitrary forms of market demand and in the presence of transport costs. This approach, however, relies on the assumption that the market is segmented so that the firms make independent decisions regarding their supplies in geographically separated markets.

Ben-zvi and Helpman (1992) and Venables (1990a, b) examined a model with positive transport costs, but by dropping the assumption of a segmented market they found that cross-hauling of identical goods never takes place.

Markusen (1981) treats the world as a single integrated market where producers choose an aggregate output level and then arbitraging determine the cross-country allocation of sales. In this model, there are gains from trade even though no trade actually takes place in equilibrium. Competition between producers in the imperfectly competitive sectors of each economy leads to an expansion of sectoral output relative to that under autarky.

Itoh and Ono (1982), Harris (1984), and Krishna (1992) have studied quantitative restrictions, such as import quotas and voluntary export restraints, in the context of oligopolistic trade models. While the first two authors have assumed a domestic firm as a Stackelberg leader, Krishna (1992) assumes that both the domestic and foreign firms compete with prices simultaneously. Under an assumption of efficient rationing, she then studies the mixed strategy equilibrium of this game.

Quantitative restrictions (QR) under Stackelberg and Nash settings have different implications, compared to tariffs on the outcome of oligopolistic competition—as Bhagwati (1965) first noted for the case of a domestic monopolist facing a competitive foreign fringe. QRs limit the response of foreign rivals to noncompetitive actions by the local producers. Krishna and Itoh (1988) show that it is possible that when trade is restricted by domestic content requirements, policy intervention may cause the foreign firm to react more aggressively to price increases by the home firm, and so the equilibrium may support less collusion and yield lower profits for both firms than under free trade.

There has been substantial work carried out on the normative implications of trade policy in an oligopolistic market structure. Katrak and Svedberg argue that tariffs can be used to extract rents from foreign monopolists. Brander and Spencer (1981) extend the result to the case of general demand functions. Under Cournot duopoly, a domestic producer will always benefit from tariff protection, and a small tariff levied against a good supplied by foreign monopolists improves domestic welfare, provided the marginal revenue curve is steeper than the demand curve in the equilibrium.

However, both Corden (1974) and Brander and Spencer (1981) argue that a subsidy, rather than a tariff, may be the optimum policy. They also explain why tariff liberalization has tended to be multilateral and how tariffs can be used to extract rents, when a foreign monopolist facing potential competition from domestic firms charges an entry-deterring price. They also argue that a positive tariff may be required to maximize global welfare, but such a tariff would be generally lower than a noncooperatively selected tariff.

Brander and Spencer (1985) consider a simple framework involving two firms (domestic and foreign) engaged in Cournot competition in a segmented third world market. They show that if the home government is the only one actively using policy, then an export subsidy raises home welfare whenever the reaction functions are strategic substitutes. The subsidy lends credibility to aggressive output expansion by the home firm, and so foreign firms responds by surrendering market share and profits. Tariffs can play a similar strategic role when the firms behave as quantity competitors in the home market.

Spencer and Brander (1983) examine a two-stage competition, where R&D subsidies serve to shift profits from foreign to domestic firms. Later works have refined the Brander and Spencer argument for export subsidies and import tariffs in support of domestic competitors. Dixit (1984) and Eaton and Grossman (1986) demonstrate that export subsidy, when competition takes place in a third world country market, weakens as the number of domestic participants increases in the industry. Hence the optimal subsidy becomes zero at some critical number of domestic firms in the industry, and the orthodox terms of the trade argument lead to an optimal export tax. Eaton and Grossman (1986) also try to link the various market structures under oligopolistic competition and the nature of optimal trade policy.

Related literature examines the role of policy in regulating entry and exit by firms. Dixit and Kyle (1985) show that policies can be used strategically

to deter or promote entry. Consider an industry in which a foreign firm has already borne the sunk costs of entry. Suppose a domestic firm contemplates entry but cannot cover its fixed costs in the case of duopolistic competition with the foreign incumbent. As long as the domestic firm earns positive profits as monopolists and its marginal costs are not too much higher than its foreign counterpart, then the home country will benefit from an import prohibition. This protectionist policy will generate a welfare effect as seen from the fact that consumer surplus is not affected by the switch from one monopolist to another, but the producer's surplus increases from zero is the policy induces entry by a domestic.

Horstmann and Markusen (1986) and Venables (1985) explore a case in which free entry drives the profit of the marginal entrants to zero in an oligopolistic framework. Horstmann and Markusen assume a framework where the domestic and foreign firms are engaged in quantity competition, allowing the goods to command the same price in the world market. The domestic firm will derive an advantage in the global competition through export subsidies and import tariffs. Any profit that are shifted strategically to the domestic firms are dissipated because of the costs of en-try, and national welfare falls. Venables (1985) finds a contrasting result in the case where national markets are segmented and inter market transport costs are positive, showing that import tariffs are welfare enhancing. Domestic consumers benefit from the expansion in the number of foreign firms because transport costs are reduced. These results, along with others, are synthesized in Markusen and Venables (1988).

This review establishes that certain types of trade interventions are beneficial in some circumstances, but not in others. Most of the literature cited is theoretical, however, since empirical work is lagging behind. Recent work uses calibrated equilibrium to study some of these questions. The procedures involve trying on a particular model of industry by specifying the mode of conduct, the extent of market integration, the possibilities of entry and exit, and so on. The researchers then insert into the model the data and parameters that are readily available. Finally, unavailable data and parameters are generated by the researchers, so that the equilibrium solution of the model matches the observed outcome for some base year.

Turning to specific studies, in their work on the semiconductor market, Baldwin and Krugman (1988) found that there is a great scope for government policy to alter the structure of production, but less scope to generate national welfare gains. Dixit (1989) similarly concludes that welfare gains from strategic trade policy are modest in the automobile industry, except

when the social values of the government revenue generated by tariffs is large, or when much of the payment to automobile workers is viewed as rent, rather than as opportunity costs. Baldwin and Krugman (1988) find that strategic trade subsidies to Airbus in support of their wide-bodied jet aircraft may have raised aggregate European welfare, although the gains are more from consumers' surplus resulting from earlier product introduction, rather than from shifting of excess profit. Baldwin and Flam's (1989) analysis of the world market of 30–40-seat commuter aircraft reveals that strategic trade intervention will yield a potential benefit. In contrast, Smith and Venables (1991) find substantial gains to Europe from further liberalization of its external trade in a variety of oligopolistic industries, particularly in the car market.

3.3 Import Protection as Export Promotion

One of the most important insights to come out of the recent literature on international trade is that of import protection as export promotion. Krugman (1984) demonstrates that in the presence of economies of scale, a model with oligopolistic and segmented markets can be used to formalize the intuitive notion. He considers several different scenarios with static and dynamic economies of scale (e.g., cost reduction based on R&D investment, learning by doing, etc.) and shows that the argument goes through for all these scenarios. He shows that with tariffs the local producer will expand its output for the home market. With increasing returns, this would lower the local firm's marginal costs of production, so that the firm would become an effective competitor in the foreign market as well, and hence exports would *increase*.

The basic argument is quite intuitive. Suppose that there is import protection. The effect is to make the home market more profitable. Thus, domestic production will expand. If there are economies of scale (either static or dynamic), then marginal costs will decline, so that firms in country 1 become more competitive in the foreign market. Hence exports will increase. With static economies of scale the formalization, however, appears to require, as Krugman (1984) himself points out, a heterodox assumption in the form of decreasing marginal costs. Moreover, Krugman (1984) does not provide any welfare analysis.

The objective of the present chapter is thus twofold. First, we want to extend the analysis by suggesting an alternative foundation for the import protection argument that does not require marginal costs to be decreasing.

In fact, we use a model with constant marginal costs of production. Secondly, we use our framework to derive some interesting welfare implications.

We consider a model with two countries, country 1 and country 2. The markets are segregated and trade takes the form of reciprocal dumping. For simplicity, we assume that the demand functions in the two countries are identical and that the demand and the cost functions are linear in the level of output. There is free entry in the product market. We consider three versions of the model in this discussion, first when there is free entry in country 1 alone, second when there is free entry in country 2 alone, and third when there is free entry in both countries.

We show that in all three cases import protection leads to export pro motion. This demonstrates that even in the absence of dynamic scale economies, the assumption that marginal costs are decreasing is not required to formalize the idea that import protection leads to export promotion.

The intuitions are somewhat different in the three cases. The effect of import protection by, say, country 1 is to make production in country 1 more profitable. With free entry in country 1 alone, this attracts a larger number of firms into the country 1 market, making country 1 as a whole more competitive. While this leads to a fall in exports by individual firms, aggregate exports increase as the increase in the number of firms is more than enough to make up for the decline in individual exports. With free entry in both countries, there is the additional effect that the number of firms in country 2 declines. In this case the relative increase in the number of firms in country 1 is even larger.

Notice that in the above two versions of our model it is country 1 that becomes more competitive as a whole, leading to increased exports. The export levels of individual firms are, in fact, adversely affected. This is in contrast to the result in Krugman (1984) where it was individual firms that became more competitive.

If there is free entry in country 2 alone, then with an increase in import protection the number of firms in country 2 decreases. In this case the export level of each firm in country 1increases, and hence so do the aggregate exports.

Finally, turning to the welfare analysis we find that the results are model specific. If there is free entry in country 1 alone, then import protection by country 1 reduces the welfare level in country 1, whereas if there is free entry in both countries, then import protection turns out to be welfare improving.

Given the free entry assumption, in both these cases it is sufficient to focus on consumers' surplus. There are two effects in operation here. Import protection leads to a decline in imports from country 2. This tends to reduce consumption in country 1. On the other hand, production in country 1 will increase. This will tend to increase consumption, and hence welfare. With free entry in country 1 alone, the first effect dominates, while with free entry in both countries the second effect dominates. In the case when there is free entry in country 2 alone, there is the additional effect that with an increase in import protection, aggregate profits in country 1 will go up. Hence, welfare may either increase or decrease.

We now briefly relate our basic contention with the existing literature. The framework is a simplified version of the work by Roy Chowdhury and Ray Chaudhuri (2003). The basic model adopted in this book is very similar to those developed by Brander (1981), Brander and Krugman (1983), Brander and Spencer (1983), and Venables (1985), all of whom consider trade models with Cournot competition in identical commodities. While Brander (1981) and Brander and Spencer (1983) all consider models where the number of firms is given exogenously given, Dixit and Norman (1980) and Brander and Krugman (1983) consider models where the number of firms is determined endogenously.

Our model is closest to Venables (1985) who considers a model of Cournot competition with free entry in both countries. In contrast, we consider three different cases, with free entry in country 1 alone, with free entry in country 2 alone, and with free entry in both countries. Moreover, Venables (1985) does not address the central concern of this discussion, that is, whether import protection leads to export promotion. The focus in Venables (1985) is on the welfare effect of various parameter changes such as technical progress, export subsidy, and so on. Of course, he also studies the welfare implications of an increase in import protection. One important contribution of our paper is to extend the analysis in Venables (1985) by examining the sensitivity of the welfare results to the nature of product market competition.

3.4 The Basic Model

There are two countries, country 1 and country 2 with n and n^* firms, respectively, all producing a single homogeneous product that they sell in both the countries. The inverse demand functions in the two countries are identical and linear. Let y_i and x_i denote the domestic sale and export of the

ith firm in country 1, an let y_j and x_j denote the domestic sale and export of the jth firm in country 2. The demand function in country 1 is given by

$$p^1 = a - b\left(\sum_{i=1}^{n} y_i + \sum_{j=1}^{n^*} x_j\right). \tag{3.1}$$

Similarly, the demand function in country 2 is given by

$$p^2 = a - b\left(\sum_{j=1}^{n^*} y_j + \sum_{i=1}^{n} x_i\right). \tag{3.2}$$

The cost function of all firms has two components—production costs and transport costs (in the case of exports). We assume that the production costs of all firms are identical and linear in the level of output, that is, marginal costs are constant. Furthermore, there is a fixed cost as well, so that the production cost displays increasing returns to scale. Thus, the production cost of the ith firm in country 1 is given by

$$C_i(q_i) = \begin{cases} F + cq_i, & \text{if } q_i > 0, \\ 0, & \text{otherwise,} \end{cases} \tag{3.3}$$

where $q_i = y_i + x_i$. We assume that for each unit of export, firms in country 1 bear a transport cost of t per unit. Thus, the total cost of the ith firm producing q_i and exporting x_i is given by $C_i(y_i + x_i) + tx_i$. Similarly, the production cost of the jth firm in country 2 is given by

$$C_j(q_j) = \begin{cases} F + cq_j, & \text{if } q_j > 0, \\ 0, & \text{otherwise,} \end{cases} \tag{3.4}$$

where $q_j = x_j + y_j$. Moreover, for each unit of export, a firm in country 2 bears a transport cost of t^* per unit. Thus, the total cost of the jth firm in country 2 producing q_j and exporting x_j is given by $C_j(x_j + y_j) + t^*x_j$.

We solve for the Cournot equilibrium of this model. Let π_i and π_j denote, respectively, the profit function of the ith firm in country 1 and the jth firm in country 2. Then

$$\pi_i = \left(a - b\left(\sum_{i=1}^{n} y_i + \sum_{j=1}^{n^*} x_j\right)\right) y_i + \left(a - b\left(\sum_{j=1}^{n^*} y_j + \sum_{i=1}^{n} x_i\right)\right) \times x_i - F - cy_i - cx_i - tx_i. \tag{3.5}$$

Similarly,

$$\pi_j = \left(a - b\left(\sum_{j=1}^{n^*} y_j + \sum_{i=1}^{n} x_i\right)\right) y_j + \left(a - b\left(\sum_{i=1}^{n} y_i + \sum_{j=1}^{n^*} x_j\right)\right) \times x_j - F - cy_j - cx_j - t^* x_j. \tag{3.6}$$

Thus, the first-order conditions of the ith firm in country 1 are:

$$\frac{\partial \pi_i}{\partial y_i} = a - b\left(\sum_{i=1}^{n} y_i + \sum_{j=1}^{n^*} x_j\right) - by_i - c = 0, \tag{3.7}$$

$$\text{and } \frac{\partial \pi_i}{\partial x_i} = a - b\left(\sum_{j=1}^{n^*} y_j + \sum_{i=1}^{n} x_i\right) - bx_i - c - t = 0. \tag{3.8}$$

Similarly, the first order conditions for the jth firm in country 2 are given by:

$$\frac{\partial \pi_j}{\partial y_j} = a - b\left(\sum_{j=1}^{n^*} y_j + \sum_{i=1}^{n} x_i\right) - by_j - c = 0, \tag{3.9}$$

$$\text{and } \frac{\partial \pi_j}{\partial x_j} = a - b\left(\sum_{i=1}^{n} y_i + \sum_{j=1}^{n^*} x_j\right) - bx_j - c - t^* = 0. \tag{3.10}$$

We then simultaneously solve Eqs. (3.7), (3.8), (3.9), and (3.10) for the variables y_i, x_i, x_j and y_j. Restricting attention to symmetric solutions we can write $y_i = y^1$ and $x_i = x^1$ for all i, and $y_j = y^2$ and $x_j = x^2$ for all j.[2] Using the symmetry assumption, Eqs. (3.7), (3.8), (3.9), and (3.10) can be rewritten as follows:

$$y^1 = \frac{a - c - n^* b x^2}{b(n+1)}, \tag{3.11}$$

$$x^1 = \frac{a - c - t - n^* b y^2}{b(n+1)}, \tag{3.12}$$

$$y^2 = \frac{a - c - nbx^1}{b(n^*+1)}, \tag{3.13}$$

$$\text{and } x^2 = \frac{a - c - t^* - nby^1}{b(n^*+1)}. \tag{3.14}$$

Notice that Eqs. (3.11) and (3.14) form a subsystem of two equations in the two variables y^1 and x^2. Solving Eqs. (3.11) and (3.14) simultaneously we find

$$y^1 = \frac{a - c + n^* t^*}{b(n + n^* + 1)}, \tag{3.15}$$

$$\text{and } x^2 = \frac{a - c - t^*(1+n)}{b(n + n^* + 1)}. \tag{3.16}$$

Similarly, solving Eqs. (3.12) and (3.13) simultaneously we obtain

$$x^1 = \frac{a - c - t(n^* + 1)}{b(n + n^* + 1)}, \tag{3.17}$$

$$\text{and } y^2 = \frac{a - c + nt}{b(n + n^* + 1)}. \tag{3.18}$$

Thus, Eqs. (3.15), (3.16), (3.17), and (3.18) solve for the production levels of the firms as functions of n and n^*. Letting X^1 denote the level of aggregate export by country 1 we have

$$X^1 = nx^1 = \frac{n[a - c - t(n^* + 1)]}{b(n + n^* + 1)}. \tag{3.19}$$

Clearly,

$$\frac{\partial X^1}{\partial n} = \frac{(1+n^*)[a-c-t(n^*+1)]}{b(n+n^*+1)^2} = \frac{(1+n^*)x^1}{n^*+n+1}, \tag{3.20}$$

$$\text{and} \quad \frac{\partial X^1}{\partial n^*} = -\frac{n[a-c-nt]}{b(n+n^*+1)^2} = -\frac{ny^2}{n^*+n+1}. \tag{3.21}$$

Thus, X^1 is increasing inn and decreasing in n^*.

We then describe the free entry conditions in country 1 and country 2. Under the symmetry assumption, the free entry condition in country 1 can be captured by the zero profit condition for country 1 firms[3]

$$\left(a - b\left(ny^1 + n^*x^2\right)\right)y^1 + \left(a - b\left(nx^1 + n^*y^2\right)\right)x^1 - F - cy^1 - cx^1 - tx^1 = 0, \tag{3.22}$$

that is,

$$b\left(y^1\right)^2 + b\left(x^1\right)^2 - F = 0. \tag{3.23}$$

Using Eqs. (3.15) and (3.17) to substitute the values of y^1 and x^1, respectively, in the above equation, we obtain

$$2(a-c)^2 + 2(a-c)n^*(t^*-t) - 2(a-c)t + n^{*2}\left(t^{*2}+t^2\right) + t^2 + 2t^2n^* = Fb(n+n^*+1). \tag{3.24}$$

We then consider the free entry condition in country 2. Under the symmetry assumption this can be written as:

$$\left(a - b\left(nx^1 + n^*y^2\right)\right)y^2 + \left(a - b\left(ny^1 + n^*x^2\right)\right)x^2 - F - cy^2 - cx^2 - t^*x^2 = 0. \tag{3.25}$$

Using Eqs. (3.15), (3.16), (3.17), and (3.18) we can simplify the above equation

$$2(a-c)^2 + 2(a-c)n(t-t^*) - 2(a-c)t^* + n^2(t^2+t^{*2}) + 2nt^{*2} + t^{*2} = Fb(n+n^*+1)^2. \tag{3.26}$$

We are now in a position to begin our analysis.

3.5 The Analysis

In this section, we analyze the impact of an increase in import protection on export and welfare.

3.5.1 *Free Entry in Country 1 Alone*

We first examine the case where there is free entry in country 1 alone, the number of firms in country 2 being exogenously given. The equilibrium conditions in this case are given by Eqs. (3.15), (3.16), (3.17), (3.18), and (3.22) and the condition that

$$n^* = \bar{n}^*. \tag{3.27}$$

For our purpose, it is more convenient to consider the reduced form representation consisting of Eqs. (3.24) and (3.27). Suppose that there is an increase in import protection by country 1, formalized as an increase in t^*. We can think of these protective measures as nontariff barriers. Let us now examine the effects of an increase in t^* on aggregate exports X^1. Totally differentiating Eq. (3.24) with respect to n and t^*, and collecting terms, we can write

$$\left.\frac{dn}{dt^*}\right|_{n^*=\bar{n}^*} = \frac{\bar{n}^*\left[a-c-\bar{n}^*t^*\right]}{Fb\left(n+\bar{n}^*+1\right)} = \frac{\bar{n}^*y^1}{F} > 0. \tag{3.28}$$

Notice that the above equation together with the result that X^1 is increasing in Eq. (3.24) implies that X^1 is increasing in t^*.

With an increase in t^*, exporting becomes more costly for firms in country 2, making the firms in country 1 more profitable. This attracts entry into the country **1** market, so that in equilibrium the number of firms in country 1 increases. While this leads to a decline in the export

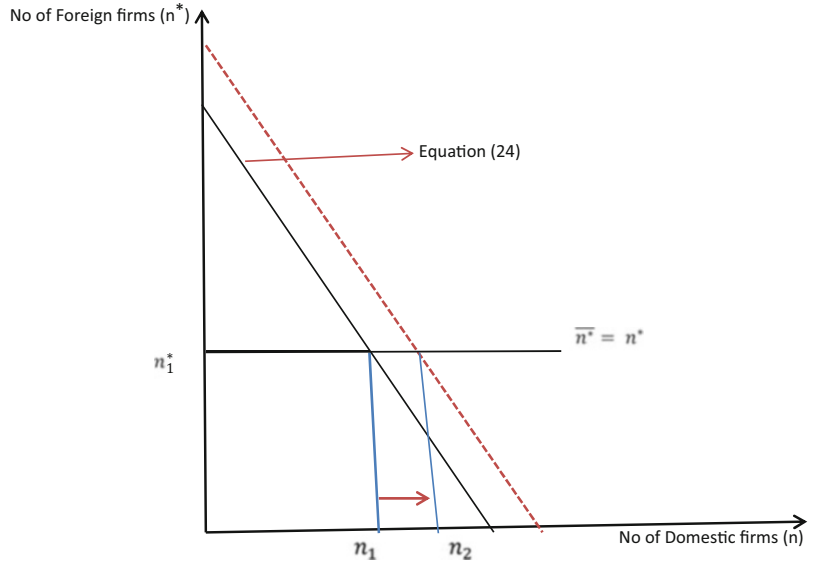

Fig. 3.1 Free entry in the country 1 alone

level of individual firms in country 1, aggregate exports increase as the increase in the number of firms more than makes up for the fall in individual exports. See Fig. 3.1 for the diagrammatic representation where the number of firms for country 2 is exogenously given and the justification is provided later in Sect. 3.6.

Summarizing the above discussion we obtain our first proposition.

Proposition 1 Suppose that there is free entry in country 1 alone. An increase in t leads to an increase in aggregate exports from country 1.*

We now examine the effect of an increase in t^* on the welfare level in country 1. Notice that because of the free entry condition, producers' surplus in country 1 is zero. It is thus sufficient to examine the changes in consumers' surplus, that is, in the total quantity sold in country 1. From Eqs. (3.15) and (3.16) we find that total consumption in country 1 is given by

$$S^1 = ny^1 + \bar{n}^* x^2 = \frac{(a-c)\left(n+\bar{n}^*\right) - t^*\bar{n}^*}{b\left(n+\bar{n}^*+1\right)}. \tag{3.29}$$

Differentiating S^1 with respect to t^* and then using Eq. (3.28) we can write

$$\begin{aligned}\frac{dS^1}{dt^*} &= \frac{(a-c)\left(n+\bar{n}^*+1\right) - (a-c)\left(n+\bar{n}^*\right) + \bar{n}^* t^*}{b\left(n+\bar{n}^*+1\right)^2}\frac{dn}{dt^*} - \frac{\bar{n}^*}{b\left(n+\bar{n}^*+1\right)} \\ &= \frac{\bar{n}^*\left[b(y^1)^2 - F\right]}{Fb\left(n+\bar{n}^*+1\right)}.\end{aligned} \tag{3.30}$$

We then use Eq. (3.23) to conclude that $b(y^1)^2 - F = -b(x^1)^2 < 0$. Hence, $\frac{dS^1}{dt^*} < 0$.

The intuition is as follows. With an increase in t^* there is a decline in imports of country 1, that is, $\bar{n}^* x^2$. This tends to reduce the consumption level in country 1. On the other hand, domestic production ny^1 increases. This tends to increase domestic consumption, and hence welfare. With free entry in country 1 alone the first effect dominates. Hence the result.

The welfare impact on country 2, however, is ambiguous. Note that the producers' surplus in country 2 is given by

$$\begin{aligned}\Pi^2 = \bar{n}^*\big[&\left(a - b\left(nx^1 + \bar{n}^* y^2\right)\right)y^2 \\ &+\left(a - b\left(ny^1 + \bar{n}^* x^2\right)\right)x^2 - F - cx^2 - cy^2 - t^* x^2\big].\end{aligned} \tag{3.31}$$

Differentiating with respect to t^* and using the envelope theorem we obtain

$$\begin{aligned}\frac{d\Pi^2}{dt^*} &= \frac{\partial \Pi^2}{\partial n}\frac{dn}{dt^*} + \frac{\partial \Pi^2}{\partial t^*} \\ &= -\frac{by^1 \bar{n}^{*2}\left[x^1 y^2 + y^1 x^2\right]}{F} - x^2 \bar{n}^* < 0.\end{aligned} \tag{3.32}$$

Thus, with an increase in t^*, the producers' surplus in country 2 declines.

As the number of firms in country 1 increases, however, this has a beneficial effect on the consumers' surplus in country 2.[4] This is because

with an increase in $n + \bar{n}^*$ there is greater competition in the market in country 2 so that the total quantity sold in country 2 increases.

These two effects, however, operate in opposite directions, making the final effect ambiguous.

Proposition 2 Suppose that there is free entry in country 1 alone. An increase in t^* leads to a decline in the welfare level in country 1. The welfare effect on country 2, however, is ambiguous.

3.5.2 Free Entry in Country 2 Alone

We now examine the case where there is free entry in country 2, but the number of firms in country 1 is exogenously given. The equilibrium conditions are given by Eqs. (3.15), (3.16), (3.17), (3.18), and (3.25), and the condition that

$$n = \bar{n}. \tag{3.33}$$

Again, it is more convenient to consider the reduced form representation consisting of Eqs. (3.26) and (3.33). We begin by examining the effect of a change in the level of import protection, that is, t^*, on the level of exports. Totally differentiating Eq. (3.26) with respect to n^* and t^* we obtain that

$$\begin{aligned} \left.\frac{dn^*}{dt^*}\right|_{n=\bar{n}} &= -\frac{(1+\bar{n})\left[a - c - t^*(1+\bar{n})\right]}{Fb(n^* + \bar{n} + 1)} \\ &= -\frac{(1+\bar{n})x^2}{F} < 0. \end{aligned} \tag{3.34}$$

Putting Eqs. (3.21) and (3.34) together we obtain our next proposition.

Proposition 3 Suppose that there is free entry in country 2 alone. An increase in t^* leads to an increase in aggregate exports by country 1.

In this case, with an increase in t^*, the profit level of firms in country 2 gets squeezed. Thus, in equilibrium the number of firms in country 2 declines, making country 1 more competitive vis-a-vis country 2. Hence, the export level of each firm in country 1 increases and the aggregate export increases as well. See Fig. 3.2 for a diagrammatic representation where the number of

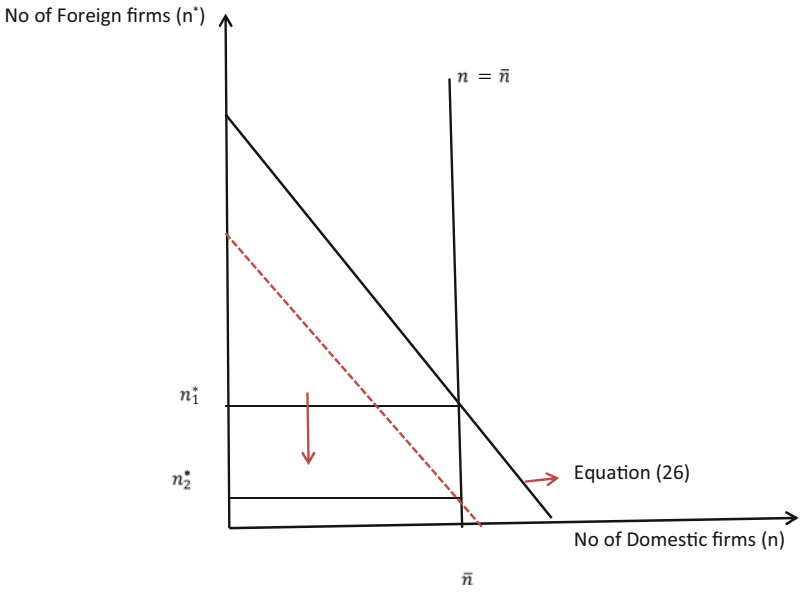

Fig. 3.2 Free entry in the country 2 alone

firms for country 1 is exogenously given and the justification is provided later in Sect. 3.6.

We now examine the impact of a change in t^* on the welfare level in country 1. First, consider the impact on consumers' surplus, that is, on aggregate consumption in country 1. Differentiating S^1 with respect to t^* we obtain

$$\frac{dS^1}{dt^*} = bx^2\frac{dn^*}{dt^*} - \frac{n^*}{b\left(\bar{n} + n^* + 1\right)}. \tag{3.35}$$

Given Eq. (3.34), $\frac{dS^1}{dt^*} < 0$. Thus, an increase in t^* leads to a decline in consumers' surplus.

However, the impact on Π^1, the producers' surplus in country 1, is positive. Note that

$$\Pi^1 = \bar{n}\left[\left(a - b\left(\bar{n}y^1 + n^*x^2\right)\right)y^1 + \left(a - b\left(\bar{n}x^1 + n^*y^2\right)\right)x^1 - F - cx^1 - cy^1 - tx^1\right]. \tag{3.36}$$

Differentiating Π^1 with respect to t^* using the envelope theorem, and then simplifying, we obtain

$$\frac{d\Pi^1}{dt^*} = \frac{\partial \Pi^1}{\partial n^*}\frac{dn^*}{dt^*} = \frac{b\left(1+\bar{n}\right)\bar{n}x^2\left[y^1x^2 + x^1y^2\right]}{F} > 0. \tag{3.37}$$

This is because of two reasons: first, the number of firms in country 2 becomes less, and second, these firms become less efficient in the export market. Hence, all firms in country 1 becomes more profitable. Thus, there are two opposing effects on the welfare level in country 1 and the net effect is ambiguous.

Finally, consider the impact of a change in t^* on the welfare level in country 2. Clearly, producers' surplus in country 2 is zero. With an increase in t^* the total number of firms in country 2, $\bar{n} + n^*$, declines (Eq. (3.34)). Thus, the aggregate output in country 2 declines. Hence, the welfare level in country 2 decreases in t^*.[5]

Proposition 4 Suppose that there is free entry in country 2 alone. The effect of an increase in t^* on the welfare level in country 1 is ambiguous. The welfare level in country 2, however, is decreasing in t^*.

3.5.3 Free Entry in Both Countries

We examine the cage where there is free entry in both countries. Note that the equilibrium conditions in this cage are given by Eqs. (3.15), (3.16), (3.17), (3.18), (3.22), and (3.25). The reduced form representation is given by Eqs. (3.24) and (3.26).

Consider the effect of a change in t^* on the level of export in country 1. We proceed diagrammatically. Let us plot Eqs. (3.24) and (3.26) in the $n - n^*$ space (see Fig. 3.1). We say that an equilibrium $(\bar{n}, \bar{n}^*)$ is *regular* if at this equilibrium the slope of Eq. (3.24) is steeper than that of Eq. (3.26), that is,

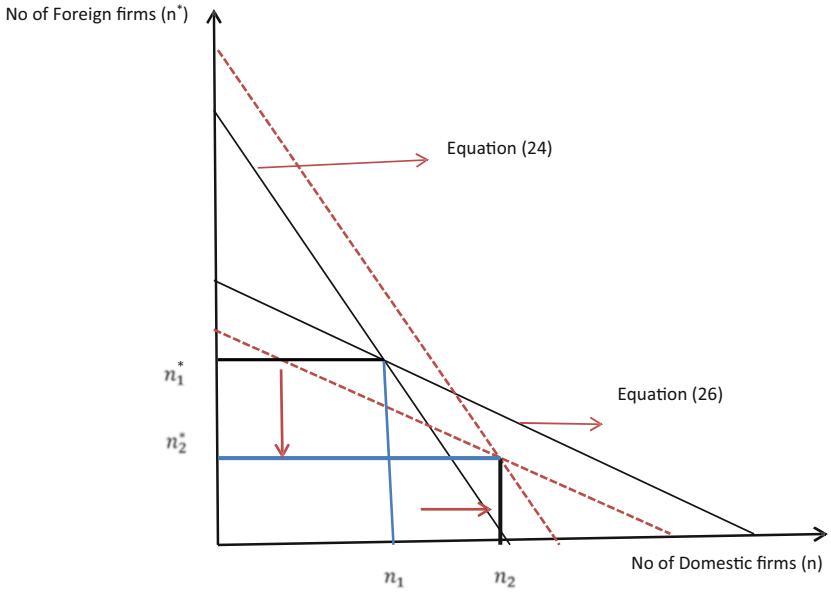

Fig. 3.3 Free entry in both countries

$$\left.\frac{dn^*}{dn}\right|_{24,\bar{n},\bar{n}^*} < \left.\frac{dn^*}{dn}\right|_{26,\bar{n},\bar{n}^*} \tag{3.38}$$

Now suppose that t^* increases. Then, from Eqs. (3.28) and (3.24) it shifts to the right, and from Eqs. (3.34) and (3.26) it shifts to the left. Clearly, if the equilibrium is unique and regular then in equilibrium n increases and n^* decreases (see Fig. 3.3). Hence, from Eqs. (3.20) and (3.21), aggregate exports increase in t^*.

We now provide a set of sufficient conditions for the existence of a regular and unique equilibrium. Note that

$$\left.\frac{dn^*}{dn}\right|_{(24)} = -\frac{Fb(1+n+n^*)}{Fb(1+n+n^*)-(a-c)(t^*-t)-t^2-n^*(t^2+t^{*2})}, \tag{3.39}$$

$$\left.\frac{dn^*}{dn}\right|_{(26)} = -\frac{Fb(1+n+n^*)-(a-c)(t-t^*)-t^{*2}-n(t^2+t^{*2})}{Fb(1+n+n^*)}. \quad (3.40)$$

Note that if t and t^* are both small, then Eqs. (3.24) and (3.26) are both negatively sloped. Moreover, the slope of Eq. (3.24) is strictly less than -1 and that of Eq. (3.26) is strictly greater than -1.[6] This implies that Eqs. (3.24) and (3.26) have a unique and regular intersection. In fact, if t and t^* are both small then existence is also ensured.[7]

Summarizing the above discussion we obtain Proposition 5.

Proposition 5 Suppose that there is free entry in both countries.

(i) *If the equilibrium is unique and regular, then an increase in t^* leads to an increase in aggregate exports.*
(ii) *There exists some $\varepsilon > 0$ such that whenever $t, t^* < \varepsilon$, there is a unique and regular equilibrium.*

We now examine the impact of a change in t^* on the welfare levels of the two countries. Note that for the case where there is free entry in both countries our model is a simplified version of that in Venables (1985). In particular, the demand function is weakly convex. Moreover, there is a home market bias in the sense that $y^1 > x^2$ and $y^2 > x^1$; see Eqs. (3.15), (3.16), (3.17) and (3.18)).[8] Thus, proposition 5 in Venables (1985) applies. Hence, we obtain our last proposition.

Proposition 6 Suppose that there is free entry in both countries. Then the welfare level in country 1 is increasing and that in country 2 is decreasing in t^*.

Propositions 2, 4, and 6 together demonstrate that the welfare implications of an increase in t^* depends on the nature of the product market competition, that is, whether there is free entry in only one of the countries or both of them. Thus, Propositions 2, 4, and 6 together provide an extension of Proposition 7 in Venables (1985).

3.6 Discussion

Finally, in this subsection we discuss some robustness issues. The assumption that the demand functions and production costs are identical across countries is essentially simplifying in nature. All the results should go through even if we allow these functions to vary across the two countries. The assumption that the demand function is linear is *also* mainly technical in nature.[9]

The assumption that production costs are linear is, however, much more basic. Recall that with static economies of scale, the result in Krugman (1984) is driven by the assumption that marginal costs are decreasing. Suppose instead that marginal costs are strictly increasing. Then with an increase in t^*, exports would decline if the number of firms were exogenously given. If one now allows for free entry, then there will be two opposing effects. The free-entry effect will tend to increase exports, while the marginal cost effect will tend to decrease them. In general, the results will be ambiguous.

Finally, note that we interpret the import restrictions as nontariff export barriers. Alternatively, one can consider tariff restrictions. Clearly, this alternative interpretation does not affect the result that import protection leads to export promotion. An increase in the level of tariffs essentially makes the firms in country 2 less competitive in the country 1 market. Because it is this feature that drives Propositions 1, 3, and 5, all three propositions should go through in case of tariff restrictions as well. The welfare analysis, however, may be sensitive to this alternative interpretation. In this case there would be an additional component of welfare in country 1, arising out of the tariff revenue accruing to the government. Recall that with free entry in country 1 alone, an increase in t^* leads to a decline in the welfare level in country 1 (Proposition 2). Under the alternative interpretation this result need not go through. The other welfare results are, however, qualitatively unaffected.

3.7 Conclusion

In this chapter we revisited Krugman's (1984) thesis that import protection leads to export promotion. Krugman (1984) argues that in the absence of dynamic scale economies, the formalization of this idea appears to require the "heterodox" assumption that marginal costs are decreasing. We seek to extend Krugman (1984) by providing an alternative foundation of the idea based on free entry and linear marginal costs. We also derive some interesting welfare conclusions.

The welfare results suggest that the fact that exports may be increasing in the level of import protection is not enough to justify a policy of import protection. Such a policy is necessarily welfare-improving provided there is free entry in both countries, and not otherwise. In fact, with free entry in country 1 alone, the welfare level in country 1 is decreasing in the level of import protection. Thus, care is required before resorting to this idea to justify a policy of import protection.

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Notes

1. The theoretical framework developed in Sects. 3.3 and 3.4 is a simplified version of Roy Chowdhury and Ray Chaudhuri (Import Protection as Export Promotion, *Keio Economic Studies* 15, 2003, 17–35 (International Academic Printing Co., Japan).
2. It is simple to use Eqs. (3.7), (3.8), (3.9), and (3.10) to argue that the solution is, in fact, symmetric and unique.
3. As usual we ignore the integer problem.
4. Note that consumers surplus in country 2 is given by

$$S^2 = \frac{(a-c)(n+\overline{n}^*) - nt}{b(n+\overline{n}^*+1)}.$$

Differentiating the above equation with respect to t^* and using Eq. (3.28) we obtain

$$\frac{dS^2}{dt^*} = \frac{\overline{n}^* y^1 x^1}{F(n+\overline{n}^*+1)} > 0.$$

5. Note that the consumers' surplus in country 2 is

$$S^2 = \overline{n}x^1 + n^* y^2 = \frac{(a-c)(n^*+\overline{n}) - \overline{n}t}{b(\overline{n}+n^*+1)}.$$

Differentiating the above equation with respect to t^* and using Eq. (3.34) we obtain

$$\frac{dS^2}{dt^*} = -\frac{x^2 y^2 (1+\overline{n})}{F(\overline{n}+n^*+1)} < 0.$$

6. The existence of the fixed coat F implies that the equilibrium n and n^* are bounded above even if t *and* t^* *are* small. Hence, if t and t^* become very small, then in Eqs. (3.39) and (3.40) all the terms associated with t and t^* go to zero.
7. This follows from the fact that if $t = t^* = 0$, then compared to Eqs. (3.26) and (3.24) has a strictly greater intercept on the n^* axis and a strictly smaller intercept on the n axis (see Fig. 3.3).
8. See Venables (1985), Sect. 3.5, p. 9.
9. For a general demand function we shall have to impose conditions that ensure unique ness and stability, for example, the Hahn (1962) condition. Venables (1985) demonstrates that for the case where there is free entry in both the countries the comparative statics analysis also requires that the demand function be convex.

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