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Structures and International
Trade. II: Optimal Trade
Policy**

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Endogenous Market Structures and International Trade. II: Optimal Trade Policy

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Abstract

I characterize the optimal unilateral trade policy for domestic firms competing in domestic or integrated markets with endogenous entry of foreign firms. Under conditions satisfied in most trade models (as with quasi-linear or Dixit-Stiglitz preferences), the analysis is simplified by a Neutrality Theorem: any policy affecting the profitability of the domestic firm is not going to affect consumers surplus and the strategies of the foreign firms, but changes their number and the profits of the domestic firm. In a domestic market with quantity competition the optimal tariff is positive with linear demand but negative with highly convex demand or Dixit-Stiglitz preferences. In an integrated market the optimal subsidy to domestic production is always positive, independent from the relative size of the domestic market and inversely related to the elasticity of demand.

Keywords

Import tariffs, Production Subsidies, Endogenous entry, Optimal Trade Policy

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What is the optimal unilateral trade policy for liberalized markets? Traditional theories emphasize the optimality of tariffs on imported goods and (typically) taxes on domestic exportable goods either to improve the terms of trade, by reducing the price of the imported goods relative to the exported ones (Lerner, 1934), or for profit shifting reasons, by turning the domestic firm into a leader in the domestic competition against an importer and softening price competition in the integrated market (Eaton and Grossman, 1986). The literature has often neglected the strategic role of trade policy in affecting the endogenous entry of international firms in domestic or integrated markets, which is actually a key element when domestic firms are facing international competition. This is quite surprising if we think of the crucial role of tariffs and other protectionist tools in markets that are liberalized and open to foreign entry. Moreover, it is not obvious how one should use trade policy in front of endogenous entry of foreign firms. The entry process is typically inefficient and often characterized by too many firms entering and adopting prices that are too high: as long as import tariffs and subsidies to domestic production have the effects of limiting foreign entry and increasing foreign prices at the same time, it is not clear how one should modify the traditional results on optimal trade policy.

In this work we characterize the optimal unilateral policy when a given number of domestic firms compete in the home market or in an integrated market with an endogenous market structure (EMS), that is with strategic interactions between firms and endogenous entry of foreign firms.¹ Under conditions satisfied in the most common trade models, such as those with homogenous goods based on quasilinear preferences *à la* Brander and Krugman (1983) or with imperfect substitutability based on CES preferences *à la* Krugman (1980), the analysis is simplified by a Neutrality Theorem: we show that, as long as there is endogenous entry of international firms, any policy (or structural shift) affecting the profitability of the domestic firm is not going to change consumer surplus and the strategies of the foreign firms, but is only going to attract entry or induce exit of foreign firms. Employing this simple but powerful result (which has also other potential applications), we can investigate the nature of the optimal trade policy for domestic and integrated markets. We do it in particular for the case of competition in quantities, which provides a general characterization of tariff incidence and optimal tariff rules.

In the domestic market, the production subsidy does not affect consumer

¹These assumptions are realistic when foreign firms face a fixed cost to export (as in Melitz, 2003, or Melitz and Ottaviano, 2008) and enter in the market only if this is profitable, while the number of domestic firms is given. Notice that Felbermayr, Jung and Larch (2013) have characterized the optimal trade policy in the Melitz model, but retaining monopolistic competition.

surplus according to our Neutrality Theorem, therefore, when available, it must be used only to shift profits from the foreign firms. When it is not available, the optimal tariff balances the costs of lower entry of foreign firms and related consumption of foreign varieties and the benefits of higher domestic profits and tariff revenues. However, one should notice that free trade already implies inefficient entry (due to the business stealing effect of Mankiw and Whinston, 1986) and the optimal policy must take this into account. Focusing on the case of homogenous goods, we obtain a general formula for the optimal tariff, which is positive except when demand is too convex. We also derive explicitly the optimal tariff for two interesting cases. Under linear demand, the tariff does not affect the production of the foreign firms, which remains the same as under free trade. Its main role is to reduce entry of foreign firms, which reduces the inefficiency associated with the free trade equilibrium. This creates space for increasing the market share and the profits of the domestic firm. In the limit case of perfect competition (zero fixed costs) or a small open economy (the domestic firm is too small with respect to the size of the market to affect the terms of trade) we obtain the traditional result for which the optimal tariff is zero. We then consider the case of hyperbolic demand, in which the optimal tariff is negative: since demand is highly convex, it is optimal to subsidize imports to expand production and substantially reduce the domestic price. The same tends to happen in case of imperfect substitutability under Dixit-Stiglitz preferences, in which case both a non-prohibitive production subsidy and an import subsidy must be jointly used to optimize entry and production.

In the integrated market, including domestic and international consumers, we focus our analysis only on the choice of the optimal production subsidy, that is a subsidy applied to domestic production sold both at home and abroad.² The general characterization of the optimal policy for an integrated market is complex because it is going to affect not only entry of international firms and profits of the domestic one (differently with different forms of competition), but also the number of goods provided in the domestic market and the relative prices, which has an ambiguous impact on domestic consumer surplus, so that either a subsidy or a tax may be optimal. However, under our assumptions, the Neutrality Theorem simplifies things by excluding any impact of the production subsidy on consumer surplus. The optimal subsidy is then always positive because aimed at expanding the domestic production: this is the case under any form of competition, namely under both quantity and price competition

²A first reason for this is that the introduction or the increase of export subsidies and import tariffs is forbidden under international trade agreements, and a second reason is that these tools would induce market segmentation of the domestic market and of the foreign market leading back to cases analyzed elsewhere.

(contrary to what happens with an exogenous number of firms). Moreover, the optimal subsidy is independent from the relative size of the domestic market. We can solve explicitly for the optimal subsidy in case of linear demand and of Dixit-Stiglitz demand with imperfect substitutability. In both cases, the optimal subsidy is decreasing in the ratio between entry costs and size of the integrated market: therefore free trade is again optimal under perfect competition or for a small open economy.

Trade policy in the presence of endogenous entry has been already analyzed in special cases such as monopolistic competition (Flam and Helpman, 1987; Gros, 1987; Venables, 1987; Helpman and Krugman, 1989) and Cournot competition with two goods (produced respectively by domestic and foreign firms) in a domestic market (Venables, 1985) and in an integrated market (Horstmann and Markusen, 1986). All these analyses have been focused on the long run impact of policies, with endogenous entry of both international and domestic firms. When the domestic firms end up with zero profits, any profit shifting rationale for protectionism disappears, and the optimal policy is only aimed at improving the terms of trade, exactly as in the neoclassical context: therefore the optimal policy requires an import tariff for a domestic market and a production tax on the exportable good for an integrated market. Contrary to this, our focus is on trade policies introduced to protect domestic firms from the endogenous entry of international firms. This case is important in the short/medium run when international firms may be already active abroad and their entry/exit in the domestic or integrated market is faster than the creation of new domestic firms, and trade policy is aimed at shifting profits toward the existing domestic firms.

Our research is complementary to recent investigations on EMSs in trade.³ Bernard *et al.* (2003), Eckel and Neary (2010) and Eaton *et al.* (2012) and the companion paper Etro (2012) have analyzed imperfect competition in trade models, but without analyzing trade policy. De Santis and Stähler (2004) and Markusen and Stähler (2011) have analyzed EMSs under quantity competition but their focus has been on the entry of multinationals in foreign markets and on FDIs. Stähler and Upmann (2008) have investigated EMSs in a game between two governments that can regulate entry. Finally Etro (2011) has studied optimal strategic trade policy with EMSs, focusing on a third market and applying the analysis to equilibrium trade policies of multiple countries and to other policies such as R&D policy and competitive devaluations. As far as we know, the neutrality result presented here is derived and applied to trade policy

³The present work contributes also to the recent literature emphasizing the importance of EMSs in different fields such as growth theory (Peretto, 2003), international finance (Ghironi and Melitz, 2005), business cycle (Etro and Colciago, 2010), taxation (Žigić, 2012; Cato and Matsumura, 2012) and market concentration (Ino and Matsumura, 2012).

for the first time. Analogous neutrality results made their first appearance in models with strategic commitments and endogenous entry (Etro, 2006, 2008).

The paper is organized as follows. Section 1 introduces general models of EMSs and derives a general result on the role of trade policy. Section 2 is about trade policy for the domestic market. Section 3 is about trade policy for an integrated market. Section 4 concludes.

1 A General Model

We start analyzing EMSs that belong to a general class of aggregative games introduced in Etro (2006). Consider a market with demand from L identical agents and supply from n firms. Each firm $i = 1, \dots, n$ bears a fixed cost F and chooses a strategic variable x_i to maximize a profit function that depends also on the strategies of all the other firms, the market size, and a firm specific variable μ_i , which may be a policy variable. The following assumption summarizes its properties:

A.1.: *Net profits are given by:*

$$\pi_i = \Pi[x_i, \xi_{-i}, \mu_i, L] - F$$

where the gross profit function Π is quasiconcave in x_i , decreasing in an aggregate statistic of the strategies of the other firms $\xi_{-i} = \sum_{j \neq i} h(x_j)$ for a positive and increasing function $h(x)$, increasing in the size of the market L , and dependent on a firm specific variable μ_i .

This amounts to assume Π_x unimodal with $\Pi_{xx} < 0$ and $\Pi_\xi < 0$, where we denote derivatives with subscripts. We do not impose anything on the cross derivative, allowing for models with strategic substitutability ($\Pi_{x\xi} < 0$) or complementarity ($\Pi_{x\xi} > 0$). Models of quantity competition typically satisfy A.1. This is the case of models with homogenous goods and inverse demand $p_i = p(X)$, where $X \equiv \sum_{j=1}^n x_j$ is total sales per consumer, or general models with product differentiation and inverse demand such as $p_i = p\left[x_i + \sum_{j \neq i} h(x_j)\right]$, where the strategies x_j can be interpreted as sales per consumer of firm j . Since there are L identical agents, in these applications, we will refer to $q_i = x_i L$ as the associated total production of firm i and to $Q \equiv \sum_{j=1}^n q_j = XL$ as the total production in the market. Common models of price competition satisfy A.1 as well.⁴

⁴Models of price competition characterized by a demand per consumer with constant ex-

Under free trade ($\mu_i = 0$ for any i) in a market of size L , a general characterization of the EMS is straightforward. In symmetric equilibrium, a first order condition and an endogenous entry condition define the equilibrium strategy of each firm x and the number of firms n as follows:⁵

$$\Pi_x[x, (n-1)h(x), 0, L] = 0 \text{ and } \Pi[x, (n-1)h(x), 0, L] = F \quad (1)$$

To evaluate welfare, we need to introduce additional assumptions. Let us assume the following:

A.2.: The surplus of each consumer is an increasing function of the aggregate statistic $\sum_{j=1}^n h(x_j)$ as follows:

$$U = U \left[\sum_{j=1}^n h(x_j) \right] \quad (2)$$

This functional form may appear as quite restrictive, but it is relatively common in trade models. Consider a quasilinear utility:

$$U = u(X) + Y \quad (3)$$

for some increasing and concave function u , where $X = \sum_{j=1}^n x_j$ is total consumption of a homogenous good and Y is a *numeraire*. A consumer with income I facing a price p for the homogenous good has an inverse demand $p(X) \equiv u'(X)$ which is decreasing under concave subutility. Total utility becomes $U = u(X) - u'(X)X + I$, which is increasing in the aggregate statistic corresponding to total consumption. Also the Dixit and Stiglitz (1977) preferences satisfy this functional form. In such a case we have:

$$U = u \left[\left(\sum_{j=1}^n x_j^{\frac{\theta-1}{\theta}} \right)^{\frac{\theta}{\theta-1}} \right] \quad (4)$$

where $\theta > 1$ is the elasticity of substitution between goods. This is clearly a penditure are nested. This is the case of models with demand $D_i = g(p_i) / \sum_{j=1}^n g(p_j)$ for good i by a single consumer (with g decreasing function), as can be verified after the change of variable $x_i = 1/p_i$, which allows one to interpret the strategy as the inverse of the price: examples include the Logit demand, or isoelastic demand functions. See the companion paper (Etro, 2012).

⁵Additional standard assumptions such as $\Pi_{xx} < h'(x)\Pi_{x\xi}$ and $\Pi_{xx} + (n-1)h'(x)\Pi_{x\xi} < 0$ insure the stability of this equilibrium.

particular case of A.2. with $h(x) = x^{1-1/\theta}$,⁶ and leads to the inverse demand $p(x, \xi)$.⁷

In the companion paper Etro (2012) we show that A.1 and gross profits that are multiplicative in market size are sufficient to imply that an expansion of the market size increases always welfare under free trade. However, the decentralized market structure satisfying (1) is inefficient: firms adopt too accommodating strategies (too low x) under imperfect competition, and there is excess entry (too large n) due to the business stealing externality *à la* Mankiw and Whinston (1986). This opens up space for policy intervention, and in particular for trade policy.

Let us consider a general market with a single domestic firm whose profitability is affected by a specific parameter μ , and $n - 1$ foreign firms where n is endogenous and possibly affected by a common parameter μ^* . Let us denote with a star the variables of the foreign firms. In the absence of prohibitive trade policies, the equilibrium strategies of the domestic firm x and of the foreign firms x^* , and the total number of active firms n must satisfy the optimality and endogenous entry conditions:⁸

$$\Pi_x[x, (n - 1)h(x^*), \mu, L] = 0 \quad (5)$$

$$\Pi_x[x^*, (n - 2)h(x^*) + h(x), \mu^*, L] = 0 \quad (6)$$

$$\Pi[x^*, (n - 2)h(x^*) + h(x), \mu^*, L] = F \quad (7)$$

Let us focus for a moment on the last two equations. Given μ^* , the market size L and the fixed cost F , equations (6) and (7) define the strategy of the foreign firms x^* and the aggregate statistic perceived by the foreign firms, $\xi^* \equiv (n - 2)h(x^*) + h(x)$. Indeed, they can be rewritten as a separate system of two equations in two unknowns:

$$\Pi_x[x^*, \xi^*, \mu^*, L] = 0 \quad \text{and} \quad \Pi[x^*, \xi^*, \mu^*, L] = F$$

Therefore the pair (x^*, ξ^*) depends on μ^* but not on μ . In other words, any policy (or structural shift) affecting the profitability of the domestic firm is not

⁶In general, however, additive preferences with subutilities $h(x)$ do not generate profit functions that can be expressed in terms of the same subutilities (unless these are isoelastic).

⁷Inverting the above condition to obtain the direct demand, one can also verify that the model of price competition based on the Dixit-Stiglitz preferences satisfies A.1, because demand is characterized by constant expenditure, and A.2, because consumer surplus depends on the usual price index.

⁸In what follows we assume that a unique interior equilibrium exists for this system. Corner solutions will be analyzed in the detailed applications of the subsequent sections.

going to affect the strategy of the foreign firms. Of course the parameter μ does affect the strategy of the domestic firm x through the optimality condition (5), which can be rewritten as:

$$\Pi_x[x, \xi^* + h(x^*) - h(x), \mu, L] = 0$$

As we will see, the impact of any change in the strategy of the domestic firm is entirely absorbed by the entry process.

Given this, we can obtain a second crucial conclusion on consumer surplus. Also this must be independent from μ . Such neutrality depends on our assumption that the consumer surplus is a function of the aggregate statistic defined in A.2. This allows one to rearrange equilibrium consumer surplus as follows:

$$U \left[\sum_{j=1}^n h(x_j) \right] = U [(n-1)h(x^*) + h(x)] = U [\xi^* + h(x^*)] \quad (8)$$

which depends on μ^* , but does not change with μ because the pair (x^*, ξ^*) is invariant in μ . Therefore, any policy (or structural shift) affecting the domestic firm is not going to affect total consumer surplus.⁹

If domestic policies do not affect foreign strategies and consumers surplus, one may wonder how do they affect the market structure. As mentioned, the answer is that any impact goes through the entry process. From our expression for ξ^* , this can be derived as:

$$n = 1 + \frac{\xi^* + h(x^*) - h(x)}{h(x^*)} \quad (9)$$

where only the strategy of the domestic firm is affected by the domestic policy, which implies $dn/dx = -h'(x)/h(x^*) < 0$. Any shock that makes the domestic firm more aggressive (increases x) is going to reduce the number of foreign firms and *vice versa*. The following theorem, proved in the Appendix, generalizes the results to the case of more than one domestic firm and heterogeneity between these domestic firms:¹⁰

⁹Once again, we need to remark that this applies to the most common trade models as those based on homogenous goods or on the isoelastic utility function *à la* Dixit-Stiglitz, but does not need to hold beyond these cases.

¹⁰In the short and medium run, it is reasonable to assume that entry and exit of international firms in a market can be quick (for instance because international firms are already active elsewhere). Only in the very long run, policy or structural shifts may also affect the number of domestic firms (for instance protectionism may induce the creation of new domestic firms) up to the elimination of any residual profits. Such a long run scenario has been examined by Venables (1985) and Horstmann and Markusen (1986) in special models of trade policy.

NEUTRALITY THEOREM. Under endogenous entry of international firms in a market structure satisfying A.1.-2., any small policy (or structural shift) affecting the profitability of anyone of a given number of domestic firms is not going to change consumers surplus and the strategies of the foreign firms, but affects their number and domestic profits.

This result can be applied to study a number of policy or technological shocks for different kinds of markets: a segmented domestic market, a segmented foreign market and an international integrated market (with both domestic and foreign consumers). The case of a foreign market is analyzed in Etro (2011) focusing on trade, R&D and exchange rate policy issues. The cases of the domestic market and of the integrated market are analyzed here, mainly with trade policy issues in mind.

Domestic market First of all, let us interpret the market above as a domestic market of size L where the government can choose an import tariff $\mu^* = t$ and a production subsidy $\mu = \tau$. Assuming that the subsidy is a pure transfer of domestic resources and imports per firm are a function $R(x^*, \xi^*)$,¹¹ welfare can be written as:

$$\begin{aligned}
 W(\tau, t) = & \underbrace{LU [\xi^* + h(x^*)]}_{\text{Consumer surplus}} + \\
 & + \underbrace{\Pi[x, \xi^* + h(x^*) - h(x), 0, L] - F}_{\text{Net domestic profits}} + t \underbrace{\left[\frac{\xi^* + h(x^*) - h(x)}{h(x^*)} \right] R(x^*, \xi^*)}_{\text{Tariff revenue}} \quad (10)
 \end{aligned}$$

where we used the number of firms in (9) and the endogenous variables x , x^* and ξ^* derive from the equilibrium characterized above and therefore from both policy tools t and τ . However, the production subsidy does not affect consumer surplus or the strategies of the importers in line with our Neutrality Theorem, and is a pure transfer of resources. When available, the optimal domestic subsidy must maximize only the domestic profits net of the costs of the subsidy. The optimal tariff must balance the benefits of profit shifting and tariff revenue with the costs of higher prices and less varieties (of course, if there were more domestic firms, the profit shifting effect would be more important

¹¹Of course, under competition in quantities $R(x^*, \xi^*) = x^*$, and under competition in prices defined as above $R(x^*, \xi^*) = g(1/x^*) / [g(1/x^*) + \xi^*]$ where $h(x^*) = g(1/x^*)$. Notice that quasilinear preferences generate the exact expression for welfare in the text, otherwise consumer surplus must be translated in monetary equivalents.

and the impact on tariff revenues would be less important). The optimality condition for the subsidy is $W_x = 0$, which simplifies the optimality condition for the tariff to $W_{x^*}(dx^*/dt) + W_{\xi^*}(d\xi^*/dt) = 0$. In the next section we will analyze in detail the case of quantity competition.

Integrated market Let us think of an integrated market of size L^W where the domestic country has size $L \in (0, L^W]$. A domestic firm competes against the international firms in the integrated market. The domestic government can only choose the subsidy $\mu = \tau$ to domestic production and the international firms face an exogenous and common policy normalized at $\mu^* = 0$. In general, the choice of the production subsidy should take into account the impact on domestic consumer surplus, which depends on the increased production of the domestic variety, the reduced production of foreign varieties and the smaller number of varieties available for consumption, and finally the impact on net domestic profits. In traditional models with exogenous entry, this typically leads to a negative production subsidy under price competition and to a positive one under quantity competition and strategic substitutability (Eaton and Grossman, 1986, Section VI); moreover, a smaller relative size of the domestic market L is going to increase the tax or reduce the subsidy. When the structure of the integrated market is endogenous, things change: for any model that satisfies A.1. – 2. the domestic subsidy does not affect the strategies of the international firms and consumer surplus, in line with our Neutrality Theorem. If the subsidy is a pure transfer of domestic resources, welfare can be written as:

$$W(\tau) = \underbrace{LU[\xi^* + h(x^*)]}_{\text{Consumer surplus}} + \underbrace{\Pi[x, \xi^* + h(x^*) - h(x), 0, L^W] - F}_{\text{Net domestic profits}} \quad (11)$$

The production subsidy τ for the integrated market does not affect the production or pricing strategies of the international entrants, but only reduces their number shifting profits to the domestic firm, and under our assumptions on the microfoundation of the model, the subsidy does not affect consumer surplus. Therefore, the optimal policy must take into account only the impact on foreign entry in the integrated market and its feedback on the domestic profits. This implies that it is always optimal to set a positive subsidy to domestic production, independent from the relative size of the domestic market. Since welfare (11) depends on trade policy only through x , the optimal policy must always satisfy a condition $\Pi_x = h'(x)\Pi_\xi$ which replicates the optimal commitment of the domestic firm (Etro, 2008). Notice that the optimality of positive production subsidies holds under both quantity and price competition, contrary to what happens with a fixed number of firms, and does not even change if we increase the number of domestic firms. Once again, one should keep in mind that this

holds in the most common models of trade with imperfect competition, but it does not need to hold when we depart from the assumptions $A.1 - 2$, because in such a case the production subsidy would affect both the strategies of the foreign firms and the domestic consumer surplus in an ambiguous way.

Other applications Other applications of our Neutrality Theorem emerge when we reinterpret the firm specific parameter as a productivity parameter, or a trade cost which can be affected by technological or policy change. First of all, consider the entry of new firms with a lower cost than the incumbents in a some market. We may even introduce cost heterogeneity between these efficient entrants, as often assumed in recent trade models started by Melitz (2003), Melitz and Ottaviano (2008) and others (that, however, neglect strategic interactions). In any case, this entry process is not going to affect consumer surplus as long as a competitive fringe of firms with the same less efficient technology remains active. For instance, in case of homogenous goods it is still the local competitive fringe that determines the price and total consumption, and the more efficient firms simply extract additional profits in the market (the companion paper Etro, 2012, analyzes this aspect in further detail).

As a second application, think of policies of indirect export promotion aimed at reducing export costs or promoting domestic production in integrated markets. The Neutrality Theorem suggests that they are not going to affect foreign strategies and domestic surplus, but they are going to provide a strategic advantage to the domestic firms which is always welfare enhancing. In such a framework, one can also analyze the role of lobbying on trade policy (Grossman and Helpman, 2002): this does not affect the neutrality result, therefore it simply leads to excessive export promotion.

Last, let us focus on the strategies of multinationals with higher productivity that decide the form of FDIs (foreign direct investments) to access an international market. To evaluate the impact of FDIs by efficient multinationals in a foreign market, we can apply our Neutrality Theorem, for which a difference in the profit function of a (multinational) firm is not going to affect the equilibrium strategies of all the other firms, but only their number. Accordingly, we can easily predict the consequences of the entry of a multinational firm in a foreign market through a greenfield investment, which requires to build a new factory producing at a lower marginal cost than the local competitors. Such an investment induces exit of other local firms. Contrary to this, the acquisition of a local firm (with the same cost structure of the other local competitors) does not induce such an exit process. Therefore, a cross-border acquisition is preferred to the direct investment only if the fixed cost of the latter is high enough or the synergies from the merger are high enough. In either case, the

best investment is profitable for the multinational firm, without changing the strategies of the other firms and without affecting consumer surplus. Markusen and Stahler (2011) have analyzed this issue looking at a linear Cournot model and comparing the results with exogenous and endogenous entry. They find that with an exogenous market structure, a greenfield investment implies an increase in aggregate output and a decrease in output and profits of the local firm, but in the long run, when the market structure can be regarded as endogenous, aggregate output does not change and some local firms exit from the market, generating larger profits for the multinational compared to the fixed market structure. Our results suggest that this findings generalize well beyond the linear Cournot case.¹²

2 Optimal Import Tariffs

In the theory of trade policy under imperfect competition, most of the investigations have been focused on the case of an exogenous number of domestic and foreign firms and on the incentives to adopt import tariffs for profit shifting reasons (Dixit, 1984; Cheng, 1988; Bhattacharjea, 1995, 2001). In this setup, one can derive the optimal import tariff (and possibly the optimal production subsidy) to balance the negative effects on consumer surplus, the positive ones on domestic profits due to the reduction of output of each foreign firm and the effects on tariff revenue. Endogenous entry has been considered only to study special cases and, in particular, the case of monopolistic competition in an integrated market (Flam and Helpman, 1987; Gros, 1987; Venables, 1987) and the case of Cournot competition, with domestic firms producing identical goods that are imperfectly substitutable for those produced by the foreign firms, either in a segmented market (Venables, 1985) or in an integrated market (Horstmann and Markusen, 1986). Since in all these models both the domestic and foreign firms end up with zero profits (a reasonable assumption only in the very long run), any profit shifting rationale for protectionism disappears, and the optimal policy is only aimed at improving the terms of trade (Helpman and Krugman, 1989) or reducing the domestic price index (Venables, 1987). Therefore, the optimal tariff is always positive in the mentioned models with monopolistic competition and with competition in quantities.¹³

¹²In the same spirit, Markusen and Stahler (2011) have also analyzed the choice between FDI and exports for the multinational. Their main finding is that greenfield entry and exporting options are more attractive relative to acquisition when the local market structure adjusts to foreign entry through local entry or exit than when it is fixed.

¹³See the general analysis of Markusen and Venables (1988). However, notice that, in the absence of transport costs and under perfect substitutability between domestic and foreign

A different situation emerges when we start from an equilibrium market structure where a domestic firm is competing with an endogenous number of international firms and we introduce policy tools that can affect entry of the foreign firms but not of the domestic ones. This is relevant when international firms are already active elsewhere and their endogenous entry/exit in the domestic market is relatively quick, while the creation of new domestic firms requires much more time (or is excluded by regulation). Alternatively we can think of the entry cost as a fixed cost to be active in the domestic market by international firms that are already active elsewhere.¹⁴ In such a case, a profit shifting rationale for trade policy remains and the optimal policy balances the impact on consumer surplus through entry and pricing, on domestic profits and on tariff revenues.

A tariff leads to an expansion of the domestic production, which increases domestic profits by reducing the average costs: this profit shifting effect is stronger when goods are highly substitutable. Moreover, the impact on consumer surplus is to increase prices and reduce the gains from variety due to the lower number of foreign firms active in the domestic market: the last effect is weaker when goods are highly substitutable. Therefore, the best case for using import tariffs emerges when goods are homogenous and competition is in quantities, and on this case we will focus initially. Afterward, we will extend the analysis to imperfect substitutability. For simplicity we will limit the analysis to the case of one domestic firm.

2.1 Homogenous goods

Let us consider a domestic market with L consumers, each one with the inverse demand $p = p(X)$, where X is total production per consumer. We assume that the marginal cost is constant at the level c for every firm. We assume that there is a single domestic firm producing $q \equiv xL$. Each foreign firm produces $q_i^* \equiv x_i^*L$ and total production is $Q = XL$. The profit function of the domestic firm is:

$$\pi = (p(X) + \tau - c)xL - F \quad (12)$$

goods, any small tariff would drive completely out the foreign industry leaving domestic (zero) profits, consumer surplus and welfare unchanged compared to free trade.

¹⁴To appreciate how realistic is our analysis notice that tariffs induce only the exit of foreign firms, which is probably faster than entry, and free entry of domestic firms would drive out foreign firms and dissipate any domestic profits, therefore it may be in the same interest of the home country to limit domestic entry.

where x is its own production per consumer and τ is the production subsidy. The profit function of a foreign firm i is:

$$\pi_i^* = (p(X) - t - c)x_i^*L - F \quad (13)$$

where x_i^* is its production per consumer and τ is the import tariff. The EMS is characterized by the following optimality and free entry conditions:

$$p(X) + xp'(X) = c - \tau$$

$$p(X) + x^*p'(X) = c + t$$

$$[p(X) - c - t]x^*L = F$$

under the second order conditions $E < 2/v$ and $E < 2/v^*$ where $v \equiv x/X$, $v^* \equiv x^*/X$ and we defined the elasticity of the slope of the inverse demand as $E = Xp''(X)/p'(X)$. Welfare can be written as:

$$W(\tau, t) = L \left[\int_0^X p(s)ds - p(X)X \right] + L[p(X) - c]x - F + tL(X - x) \quad (14)$$

By the Neutrality Theorem, the pair (x^*, X) does not depend on the subsidy τ . Therefore, differentiation of welfare with respect to τ provides:

$$\frac{\partial W}{\partial \tau} = L[p(X) - c - t] \frac{dx}{d\tau} = \frac{F}{x^*[-p'(X)]} > 0 \quad (15)$$

where $dx/d\tau = -p'(X)^{-1} > 0$ derives from the equilibrium system. Welfare is always increasing in the subsidy as long as there is entry of foreign firms. Therefore, whenever the subsidy is available the optimal trade policy is prohibitive, and there is no need of a tariff.

Let us assume that the subsidy is not available. Differentiation of welfare with respect to t delivers:

$$\frac{\partial W}{\partial t} = L \left[[p(X) - c - t] \frac{dx}{dt} - [p'(X)(X - x) - t] \frac{dX}{dt} + (X - x) \right] \quad (16)$$

The equilibrium system provides $[p(X) - c - t]^2 = -p'(X)F/L$, whose total differentiation is:

$$\frac{dX}{dt} = \frac{2[p(X) - c - t]}{2[p(X) - c - t]Lp'(X) + Fp''(X)} = \frac{2p'(X)}{2 - v^*E} < 0 \quad (17)$$

where we used repeatedly the equilibrium conditions and the sign derives from the second order condition of the foreign firms: the tariff reduces always total

production and therefore it increases the price and reduces consumer surplus. Moreover, the equilibrium system provides

$$x^* = \sqrt{\frac{F}{-p'(X)L}}$$

which implies that the production of the foreign firms is decreasing in the tariff if and only if the demand is convex:

$$\frac{dx^*}{dt} = \frac{dx^*}{dX} \frac{dX}{dt} = \frac{v^* p'(X) E}{2 - v^* E} \leq 0 \quad \text{iff} \quad E \geq 0 \quad (18)$$

Finally, the incidence of the tariff on the production of the domestic firm can be derived as:

$$\frac{dx}{dt} = \frac{dx}{dX} \frac{dX}{dt} = \left[\frac{p'(X) + x p''(X)}{-p'(X)} \right] \frac{dX}{dt} = \frac{2(1 - vE)}{[-p'(X)](2 - v^* E)} \quad (19)$$

whose sign is positive unless demand is extremely convex: the tariff increases domestic production as long as $E < 1/v$. Replacing these results on tariff incidence in (16), the welfare maximizing tariff can be obtained as:

$$t_H = -x^* [p'(X) + x p''(X)] - \frac{(X - x) x^* p''(X)}{2} = -x^* p'(X) \left(1 - \frac{1 + v}{2} E \right)$$

where $E < 2/v$ by the second order condition.¹⁵ Using the expressions for total production, we can also summarize the result as follows:

OPTIMAL IMPORT TARIFF. Under EMS in the home market with competition in quantities, homogenous goods and constant marginal costs, in the absence of a production subsidy the optimal import tariff is:

$$t_H = -\frac{q^* p'}{L} \left(1 - \frac{1 + v}{2} E \right) \quad (20)$$

¹⁵To verify when a positive tariff is optimal, let us evaluate the optimality condition for the import tariff at free trade:

$$\begin{aligned} \frac{\partial W}{\partial t} \big|_{\tau=t=0} &= L[p(X) - c] \frac{dx}{dt} \big|_{\tau=t=0} + \frac{(n-1)XL}{n} \left[1 - p'(X) \frac{dX}{dt} \big|_{\tau=t=0} \right] = \\ &= \frac{(p-c)^2 [E(n+1) - 2n] L}{[2(p-c)p'(X) - F p''(X)] n} \geq 0 \quad \text{iff} \quad E \leq \bar{E} \equiv \frac{2n}{n+1} \end{aligned}$$

where we used the comparative statics results at free trade and n is endogenous. Notice that $n \rightarrow \infty$ implies $\bar{E} \rightarrow 2$ and $n = 2$ implies $\bar{E} = 4/3$. Since $\bar{E}$ depends on the number of firms in free trade, it depends on exogenous parameters as the fixed cost and the size of the market and we can conclude that for a given $\bar{E} \in [4/3; 2)$, the condition $E < \bar{E}$ is a sufficient condition for a small tariff to be welfare improving and $E \geq 2$ is a sufficient condition for a small tariff to be welfare reducing.

which is positive if the elasticity of the slope of the inverse demand E is smaller than a positive cut-off, and is always negative if $E \geq 2$.

The optimal import tariff differs from the optimal rule obtained by Dixit (1984) and Cheng (1988) for the case of a single domestic firm facing a fixed number of foreign firms, because we now consider the negative impact of the tariff on entry. However, similarly to that case, a positive tariff requires the elasticity of the slope of demand to be small enough, here $E < 2/(1 + v)$.¹⁶ Below we discuss the optimal policy in two examples with homogenous goods: the linear case and the hyperbolic case. In the former case $E = 0$, therefore we will derive a positive optimal tariff. In the latter case $E = 2$ and we will obtain an optimal import subsidy.

2.1.1 Linear demand

Let us study the traditional model with linear demand and homogenous goods. Consider L consumers with the following preferences:

$$U = aX - \frac{X^2}{2} + Y \quad (21)$$

which is a particular case of (3). The demand of the good produced under imperfect competition is $X = a - p$ where the price can be inverted to derive the inverse demand $p(X) = a - X$ with $X = Q/L$ as production per consumer and Q total production in the market. In Cournot equilibrium with n firms the production levels are:

$$q^* = \frac{[a - c - 2t - \tau] L}{n + 1} \quad \text{and} \quad q = \frac{[a - c + (n - 1)t + n\tau] L}{n + 1}$$

with profits $\pi^* = q^{*2}/L - F$ and $\pi = q^2/L - F$. Welfare is:

$$W(\tau, t) = \frac{Q^2}{2L} + \left(\frac{q^2}{L} - F \right) + t(Q - q) - \tau q \quad (22)$$

¹⁶The optimal tariff with a fixed number of international firms can be derived as $t_H = -(q^* p' / L) [1 - (1 - v)E]$ (see Wong, 1995, p. 533). A last comment is due on the case in which a long run commitment to an import tariff is possible and endogenous entry of domestic firms can take place as a consequence. Such a case has been analyzed by Venables (1985) and Markusen and Venables (1988), under the assumption that all domestic firms produce the same good and all foreign firms produce the same or a different good, showing that domestic entry dissipates any profit shifting rationale for trade policy, whose only aim can be to affect the terms of trade. However, in case of homogenous goods (without transport costs) any tariff or subsidy eliminates the entire production in one of the two countries (with specialization in the residual perfectly competitive sector), without affecting welfare relative to free trade. In contrast to this, we have shown that a country can always gain from a production subsidy or an import tariff as long as entry of domestic firms in the market is limited: protectionism and entry regulation are complementary unilateral policies.

It is standard to verify that the optimal subsidy is prohibitive, but in its absence the welfare maximizing tariff is:

$$t_H = \frac{3(a-c)}{7+n} \quad (23)$$

The role of this tariff is to reduce foreign production while shifting profits toward the domestic firm and collecting some revenue, whose marginal benefits are balanced against the social marginal cost of the price increase. Notice that the optimal tariff is invariant in the size of the domestic market.¹⁷

Now, imagine that entry of foreign firms in the domestic market is endogenous. As long as there are foreign firms in the market and $t + \tau > 0$, the zero profit condition $\pi = 0$ must be binding on them, which implies the following number of firms:

$$n = (a - c - 2t - \tau) \sqrt{L/F} - 1$$

with a production:

$$q^* = \sqrt{LF}$$

which is independent from the subsidy in line with our Neutrality Theorem and also from the tariff in line with the incidence result in (18). The production of the domestic firm is:

$$q = \sqrt{LF} + (\tau + t) L$$

therefore total production can be derived as $Q = (a - c - t) L - LF$. Such an equilibrium is consistent with entry of two or more firms for $t \leq (a - c - \tau - 3\sqrt{F/L})/2$. If this is the case, welfare becomes:

$$\begin{aligned} W(\tau, t) = & \frac{\left[(a - c - t) \sqrt{L} - \sqrt{F} \right]^2}{2} + \left((\tau + t)^2 L + 2(\tau + t) \sqrt{LF} \right) + \\ & + t \left[(a - c - \tau - 2t) L - 2\sqrt{LF} \right] - \tau \left[\sqrt{LF} + (\tau + t) L \right] \end{aligned} \quad (24)$$

where the four terms are respectively consumer surplus, domestic profits, tariff revenue and the cost of the subsidy. Here, the subsidy does not affect consumer surplus, in line with our main Theorem, but the import tariff affects all the components of welfare. The latter turns out to be a linearly increasing function of the subsidy: therefore, if both the instruments are available, the first best can be obtained by setting $\tau_H = a - c$, which excludes entry of foreign firms.

¹⁷See Bhattacharjea (1995, 2001) for further details and extensions to multiple domestic firms and different assumptions on the timing of entry.

Consider now the case in which the subsidy is not available. Maximizing welfare, the optimal unilateral tariff can be easily derived as:¹⁸

$$t_H = \sqrt{\frac{F}{L}} \quad (25)$$

which is consistent with entry of some foreign firms as long as the fixed cost is small enough (otherwise, it is optimal to set the prohibitive tariff). The tariff does not affect the production of each foreign firm, which remains the same as under free trade: the main role of the tariff is to limit entry of these firms, which reduces the production inefficiency associated with the free trade equilibrium - due to the excessive prices and entry *à la* Mankiw and Whinston (1986). This creates space to increase the market share and the profits of the domestic firm (compared to the zero profits under free trade) and collect also some tariff revenues, while inducing a moderate increase of the equilibrium price. The benefits of the tariff are larger when the fixed cost is high relative to the size of the market because in this case the production inefficiency associated with free trade is high. In the limit case of perfect competition (zero fixed costs) free trade is optimal because we lose any profit shifting rationale.

Notice that the equilibrium production of the domestic firm is $q = 2\sqrt{LF}$, which is twice as the production of the other firms, and the domestic profits are $\pi = 3F$. Total imports are $IMP = (a - c)L - 4\sqrt{LF}$. It is important to remark that the same outcome could be obtained imposing a quota equal to IMP and auctioning the rights to sell at a price t_H : endogenous entry of foreign producers would deliver the same allocation of production as above.¹⁹ While the domestic economy gains from the positive profits of the domestic firm and from the revenue collected from the foreign firms, its consumers have to face a higher equilibrium price $p = c + 2\sqrt{F/L}$ compared to the one emerging under free trade, given by $p = c + \sqrt{F/L}$. When the size of the market becomes indefinitely large, the optimal tariff tends to zero, a result that is consistent with the traditional idea that a free trade policy is optimal when the domestic firms are too small to affect the terms of trade.

2.1.2 Hyperbolic demand

Let us consider the quasilinear utility:

$$U = \log X + Y \quad (26)$$

¹⁸Of course, the optimal tariff can be obtained directly from the general rule (20) setting $E = 0$, since $x^* = q^*/L = \sqrt{F/L}$ and the slope of the inverse demand is $p'(X) = -1$.

¹⁹A smaller quota would ask a higher bidding price for the rights to sell, and would deliver a different equilibrium: the domestic firm would also reduce its production. However, it is immediate to verify that the optimal quota reproduces the equilibrium with the optimal tariff.

which is also a particular case of (3). Under unitary income, the demand of the first good $X = 1/p$ can be inverted to obtain $p(X) = 1/X$ where $X = Q/L$. Notice that the elasticity of the slope of the inverse demand is $E = 2$ in this case, therefore we expect welfare to be decreasing with the introduction of a small tariff.

In Cournot equilibrium with endogenous entry total production can be easily derived as $Q = \sqrt{L}(\sqrt{L} - \sqrt{F})/(c + t)$ with a production of the foreign firms given by:

$$q^* = \frac{\sqrt{LF} - F}{c + t}$$

Both are independent from the subsidy τ in line with the Neutrality Theorem, but they decrease in the import tariff. The production of the domestic firm is:

$$q = \frac{(c\sqrt{F} + t\sqrt{L})(\sqrt{L} - \sqrt{F})}{(c + t)^2} + \frac{\tau}{(c + t)\sqrt{L}}$$

which is increasing in both the tariff and the subsidy. Welfare becomes:

$$W(\tau, t) = L \log \left(\frac{Q}{L} \right) + \left[\left(\frac{L}{Q} - c \right) q - F \right] + t[Q - q] \quad (27)$$

where again the subsidy does not affect consumer surplus, but the import tariff affects all the components of welfare. One can verify that the optimal subsidy is prohibitive also in this case. When such a subsidy is not available, welfare can be expressed as:

$$W(0, t) = L \log \frac{\sqrt{L} - \sqrt{F}}{\sqrt{L}(c + t)} + \frac{(t\sqrt{L} + c\sqrt{F})^2}{(c + t)^2} - F + \frac{tc(\sqrt{L} - \sqrt{F})^2}{(c + t)^2}$$

The derivative with respect to the tariff is:

$$W_t(0, t) = -\frac{L}{c + t} + \frac{2tL + 2c\sqrt{LF} + tcL + tcF - 2tc\sqrt{LF}}{(c + t)^2} - \frac{2(t^2L + tcL + tcF + c^2F)}{(c + t)^3}$$

and it can be verified that the introduction of a small tariff is welfare reducing at free trade ($W_t(0, 0) < 0$). Moreover, welfare is maximized by the following policy:

$$t_H = -\frac{cF}{L} \quad (28)$$

which satisfies the second order condition $W_{tt}(0, t_H) < 0$. In this framework, a positive tariff, by reducing entry, would induce such a large price increase that

the loss in consumer surplus would never be compensated by the larger domestic profits and tariff revenues. The import subsidy is optimal because it attracts new foreign firms and reduces the price substantially, which sacrifices domestic profits and public funds but induces a much larger increase of consumer surplus. Notice that also in this case, the intervention is positively related to the size of the fixed costs: when the price distortion due to imperfect competition is large (few firms with a large entry cost), it is more convenient to subsidize entry and reduce the prices. To the contrary, when the size of the domestic market is large the subsidy is reduced and free entry is optimal in the limit, as we expect for a small open economy (with a domestic firm which is negligible compared to the size of the market).

2.2 Differentiated goods *à la* Dixit-Stiglitz

In the presence of product differentiation free trade may generate too many or too few varieties, and prohibitive policies are not optimal when preferences exhibit love for variety. However, the two traditional tools of trade policy (the import tariff and the production subsidy) are typically insufficient to target the three key elements of the domestic market structure, that is the number of firms, the domestic production and the production of each foreign firm. Therefore, the (second best) policy must use together an import tariff/subsidy and a production subsidy to optimize entry and production taking into account the usual trade-off. We could characterize the optimal trade policy under either Bertrand or Cournot competition, but for continuity with the previous analysis we focus on the case of competition in quantity.

We can make some progress focusing on the case of the Dixit and Stiglitz (1977) preferences (4). For simplicity, let us assume log-linear utility in the consumption index and a numeraire Y , with:

$$u\left(\Delta^{\frac{\theta-1}{\theta}}\right) = \log \Delta^{\frac{\theta}{\theta-1}} + Y \quad \text{where} \quad \Delta \equiv \sum_{j=1}^n x_j^{\frac{\theta-1}{\theta}}$$

This generates the inverse demand:²⁰

$$p(x, \xi) = \frac{x^{-1/\theta}}{x^{1-1/\theta} + \xi} \quad (29)$$

where $\theta \in (1, \infty)$ is the degree of substitutability between goods and $\xi = (n-1)h(x^*)$ with $h(x) = x^{1-1/\theta}$. The equilibrium conditions for given tariff t and

²⁰Notice that quasi-linearity in the consumption index allows one to express welfare as a linear function of domestic profits and revenues. Otherwise the welfare analysis can be easily adapted.

subsidy τ are:

$$p(x, \xi) + xp_1(x, \xi) = c - \tau \quad (30)$$

$$p(x^*, \xi^*) + x^* p_1(x^*, \xi^*) = c + t \quad (31)$$

$$[p(x^*, \xi^*) - c - t] x^* L = F \quad (32)$$

By the Neutrality Theorem, the subsidy does not affect the equilibrium pair (x^*, ξ^*) . We can actually solve the system (31)-(32) to obtain the price of the international firms:

$$p(x^*, \xi^*) = \frac{\theta(c+t)}{(\theta-1)(1-\Omega)} \quad \text{with } \Omega \equiv \frac{2\theta F/L}{1 + \sqrt{1 + 4\theta(\theta-1)F/L}} \quad (33)$$

and the respective production:

$$x^* = \frac{F(\theta-1)(1-\Omega)}{L[1 + \Omega(\theta-1)](c+t)} \quad (34)$$

This allows one to obtain consumer surplus as a function of $\Delta = x^{*-1/\theta}/p(x^*, \xi^*)$, that is:

$$\Delta = \frac{(\theta-1)(1-\Omega)}{\theta(c+t)^{\frac{\theta-1}{\theta}}} \left[\frac{L[1 + \Omega(\theta-1)]}{F(\theta-1)(1-\Omega)} \right]^{\frac{1}{\theta}}$$

Accordingly, the tariff increases the price, and reduces foreign production and consumer surplus, with:

$$\frac{\partial x^*}{\partial t} = \frac{-x^*}{c+t} \quad \text{and} \quad \frac{\partial \Delta}{\partial t} = \frac{-(\theta-1)\Delta}{\theta(c+t)}$$

The tariff revenue can be expressed as $t(n-1)x^*L = tx^{*\frac{1}{\theta}}L(\Delta - x^{*\frac{\theta-1}{\theta}})$ where we used the fact that $n-1 = [\Delta - h(x)]/h(x^*)$. Finally, the domestic production satisfies the first order condition $(\theta-1)(\Delta x^{\frac{-1}{\theta}} - x^{1-\frac{2}{\theta}})/\theta\Delta^2 = c - \tau$ with $dx/d\tau > 0$.

We are finally ready to examine the problem of optimal trade policy. First of all, notice that free trade generates excess entry under CES preferences - since markups are above those emerging under monopolistic competition, which Dixit and Stiglitz (1977) have shown to induce optimal entry. A non-prohibitive subsidy is useful for profit shifting reasons but does not affect the markups of the foreign firms and consumer surplus. An import tariff can then be used to limit excess entry of international firms with the additional benefit of raising revenue. However, the side effect of a tariff is that it actually increases the markups of the

foreign firms, which reduces consumer surplus. For this reason it is still unclear whether one should choose a positive or negative tariff. Domestic welfare can be expressed as:

$$\begin{aligned} W(\tau, t) &= L \log \Delta^{\frac{\theta}{\theta-1}} + [p(x, \xi) - c + \tau] xL - F + (n-1)x^* - \tau xL \\ &= L \left[\frac{\theta}{\theta-1} \log \Delta + \frac{x^{\frac{\theta-1}{\theta}}}{\Delta} - cx + tx^{*\frac{1}{\theta}} \left(\Delta - x^{\frac{\theta-1}{\theta}} \right) \right] - F \end{aligned} \quad (35)$$

Deriving welfare with respect to the subsidy and using the optimality condition of the domestic firm we have:

$$\begin{aligned} \frac{\partial W}{\partial \tau} &= \frac{\partial W}{\partial x} \frac{dx}{d\tau} = \left\{ \frac{\theta-1}{\theta} \frac{x^{\frac{-1}{\theta}}}{\Delta} - c + \frac{\theta-1}{\theta} tx^{*\frac{1}{\theta}} x^{\frac{-1}{\theta}} \right\} L \frac{dx}{d\tau} = \\ &= \left[-\tau + \frac{\theta-1}{\theta} \left(\frac{x^{1-\frac{2}{\theta}}}{\Delta^2} - tx^{*\frac{1}{\theta}} x^{\frac{-1}{\theta}} \right) \right] L \frac{dx}{d\tau} \end{aligned}$$

which is positive when evaluated at free trade: introducing a small subsidy is always beneficial. Rearranging the optimality condition $\partial W / \partial x = 0$ provides:

$$\tau = \frac{\theta-1}{\theta} \left[xp(x, \xi)^2 - \frac{tp(x, \xi)}{p(x^*, \xi^*)} \right] \quad (36)$$

If we replace the optimal subsidy in the first order condition of the domestic firm, we can express explicitly also the equilibrium price of the domestic firm:

$$p(x, \xi) = \frac{\theta c}{(\theta-1)} \frac{p(x^*, \xi^*)}{p(x^*, \xi^*) - t} \quad (37)$$

which is always increasing in the tariff. Finally, the domestic production can be derived from $\Delta = x^{-1/\theta} / p(x, \xi)$ as:

$$x = \frac{F(\theta-1)(c+t)^{\theta-1}}{L[1+\Omega(\theta-1)](1-\Omega)^{\theta-1}} \left[\frac{p(x^*, \xi^*) - t}{cp(x^*, \xi^*)} \right]^\theta$$

The price of the domestic firm is lower than the price of the international firms and increasing in the tariff. In the absence of a tariff the optimal subsidy induces the domestic firm to adopt the same price as under monopolistic competition, because this maximizes net domestic profits. When the tariff is positive, however, it is better to increase the equilibrium price of the domestic firm because this increases the sum of profits and tariff revenues. When the tariff is negative, instead, it is better to reduce the domestic price to increase profits and reduce

imports and the related spending for the subsidies. Accordingly, the optimal tariff is positive (negative) if its marginal impact on consumer surplus is lower (higher) than its positive impact on the tariff revenue.

More explicitly we can simplify the derivative of welfare with respect to the tariff by using the envelope theorem ($\partial W/\partial x = 0$). This gives:

$$\begin{aligned} \frac{1}{L} \frac{\partial W}{\partial t} &= \left[\frac{\theta}{(\theta-1)\Delta} - \frac{x^{\frac{\theta-1}{\theta}}}{\Delta^2} + tx^{*\frac{1}{\theta}} \right] \frac{d\Delta}{dt} + \frac{t \left(\Delta - x^{\frac{\theta-1}{\theta}} \right)}{\theta x^{*\frac{\theta-1}{\theta}}} \frac{dx^*}{dt} + x^{*\frac{1}{\theta}} \left(\Delta - x^{\frac{\theta-1}{\theta}} \right) = \\ &= \frac{-1}{c+t} + \frac{(\theta-1)x^{\frac{\theta-1}{\theta}}}{\theta(c+t)\Delta} + \\ &\quad - \frac{(\theta-1)\Delta tx^{*\frac{1}{\theta}}}{\theta(c+t)} - \frac{tx^{*\frac{1}{\theta}} \left(\Delta - x^{\frac{\theta-1}{\theta}} \right)}{\theta(c+t)} + x^{*\frac{1}{\theta}} \left(\Delta - x^{\frac{\theta-1}{\theta}} \right) \end{aligned} \quad (38)$$

where we used the comparative statics of Δ and x^* as derived above. The first negative term represents the marginal impact of a positive tariff on consumer surplus, the second term is the residual positive impact on domestic profits and the last three terms summarize the marginal impact on tariff revenues. Assuming that the second order condition is satisfied we obtain an implicit expression for the optimal policy:

$$t_H = -\frac{\theta\Omega c}{1 + \Omega(\theta-1)} + \frac{\theta(1-\Omega)[p(x^*, \xi^*) - c]}{[1 + \Omega(\theta-1)]xp(x, \xi)} \quad (39)$$

whose first term is negative and whose second term is positive. Numerical simulations (available from the author) can give further insights on the best policy. In particular, the optimal tariff is typically negative and therefore associated with a positive subsidy to domestic production. Consumer surplus is quite sensible to the tariff (notice that Δ is decreasing and also convex in t), and this makes it convenient to subsidize imports to reduce prices.²¹ The same happens when the subsidy is not available, in particular when goods are highly substitutable: this is not surprising since the model converges to the earlier example with hyperbolic demand for $\theta \rightarrow \infty$. However, the optimality of import subsidies is more surprising if compared with the general optimality of import tariffs found in the monopolistic competition model *à la* Dixit-Stiglitz to improve the terms of trade or counteract the monopolistic distortions - see Venables (1987), Helpman and Krugman (1989) and more recently Felbermayr, Jung and Larch

²¹Analogously, one can derive the optimal trade policy for the case of Bertrand competition under Dixit-Stiglitz preferences. Details are available from the author.

(2013). The difference depends on the fact that terms of trade effects are neutralized in our context and that there were no profit shifting effects in those models with endogenous entry also of domestic firms.

3 Optimal Trade Policy for Integrated Markets

We now move to the analysis of the optimal policy for an integrated market including domestic and international consumers. Our focus will be on the choice of the production subsidy, that is a subsidy to the sales of the domestic firm both at home and abroad. The main motivation is simply that the introduction or the increase of export subsidies or import tariffs is forbidden under international trade agreements (WTO). Besides this, these tools would induce market segmentation of the domestic market and of the foreign market, leading back to cases analyzed elsewhere.²²

Strategic trade policy in the presence of international oligopolies is usually associated with a profit shifting rationale: when part of the production for an integrated market is consumed domestically the optimal policy must take in consideration the impact on the domestic consumer surplus (Eaton and Grossman, 1986, Section VI): typically, this tends to bias the optimal policy toward lower taxes or higher subsidies to reduce the prices, and such a bias is stronger when the size of the domestic country is large relative to the rest of the integrated market. However, the nature of the optimal unilateral policy for an integrated market remains ambiguously dependent on the form of competition and it is complex because policy is going to affect not only entry of international firms and profits of the domestic one, but also the number of goods provided in the domestic market and the relative prices, which has an ambiguous impact on domestic consumer surplus.

In this section we analyze the optimal unilateral policy for an integrated market which is initially characterized by an endogenous structure and, for simplicity, by a single domestic firm. Our situation can be seen as the relevant one in the short/medium run when the subsidies are firm-specific or the number of domestic firms remains fixed by supply or regulatory constraints. The case of endogenous entry of both domestic and foreign firms has been already analyzed by Horstmann and Markusen (1986): in that case any profit shifting rationale for intervention disappears and the only rationale for trade policy (once again for a tax on domestic production) relies on the impact on the terms of trade in general equilibrium, just as in neoclassical theory. Indeed, Horstmann and

²²Indeed, the optimal tariff for a domestic market is analyzed in the previous section and the optimal export subsidy for a third market is analyzed in Etro (2011).

Markusen (1986) and Markusen and Venables (1986) have shown that a tax on domestic production is optimal.²³ In what follows, we will arrive at the opposite conclusion, analyzing first the case of homogenous goods and then the case of imperfect substitutability.

3.1 Homogenous goods

Let us consider an integrated market with L domestic consumers and $L^W - L$ foreign identical consumers. Let us assume that the inverse demand for the homogenous good is $p(X)$, and each firm faces a generic increasing and convex cost function $c(\cdot)$. The domestic firm obtains a specific production subsidy τ for each unit of good sold to domestic or foreign consumers. The profit function of the domestic firm is:

$$\pi = [p(X) + \tau]xL^W - c(xL^W) - F \quad (40)$$

and the profit function of a foreign firm i is:

$$\pi_i^* = p(X)x_i^*L^W - c(x_i^*L^W) - F \quad (41)$$

The symmetric first order and endogenous entry conditions in the competition stage are:

$$\begin{aligned} p(X) + xp'(X) &= c'(xL^W) - \tau \\ p(X) + x^*p'(X) &= c'(x_i^*L^W) \\ p(X)x^*L^W &= c(x^*L^W) + F \end{aligned}$$

The equilibrium system defines the output of each firm and the number of firms as functions of the subsidy τ . We know from our Neutrality Theorem that the production of the foreign firms x^* and total production X do not depend on the subsidy. While the domestic production is increasing in it:

$$\frac{dx}{d\tau} = \frac{1}{c''(xL^W)L^W - p'(X)} > 0$$

²³However, their model is highly specific, since it is based on competition in quantities with linear demand and perfect substitutability between the goods produced in each country. Moreover, when the goods produced in one country are also perfectly substitutable with the goods produced in the other country (the only case directly comparable to our model), any small tax or subsidy eliminates production in one country (with specialization in the residual perfectly competitive sector) without affecting welfare. In contrast, we will show that a country can always gain from production subsidies as long as domestic entry in the integrated market is limited.

We can write the domestic welfare as:

$$W(\tau) = L \left[\int_0^X p(s) ds - p(X)X \right] + p(X) xL^W - c(xL^W) - F \quad (42)$$

where the first term is policy-independent. The derivative of welfare with respect to the subsidy is:

$$\frac{\partial W}{\partial \tau} = \frac{p(X) - c'(xL^W)}{c''(xL^W) - \frac{p'(X)}{L^W}} \quad (43)$$

First of all, notice that, in case of marginal costs that are constant this is always positive, and the optimal policy must be a prohibitive subsidy that leads to monopolization of the integrated market by the domestic firm. However, if the marginal costs are increasing enough with the production level for the international market, welfare has an inverse-U shape. Using the first order condition for the domestic firm, we can rewrite its derivative as $\partial W/\partial \tau = -[\tau + xp'(X)]L^W(dx/d\tau)$. This allows one to derive an expression for the optimal production subsidy:

$$\tau_H = \frac{vp(X)}{\varepsilon} \quad (44)$$

where $\varepsilon \equiv -p(X)/Xp'(X)$ is the elasticity of demand and $v = x/X$ is the associated market share of the domestic firm. Notice that the optimal production subsidy is always positive, it may depend on the size of the integrated market L^W but does not depend on the size of the domestic country L : it is the same whether the firm is exporting its entire production or only a part of it.²⁴ Nevertheless, the optimal policy depends implicitly on the size of the global market, as we will verify in the examples below. The optimal production subsidy as a percentage of the price of the domestic firm is inversely related to the elasticity of the international demand to the price: the more elastic is demand the smaller is the optimal subsidy, and this tends to zero when demand becomes infinitely elastic. The role of trade policy is to turn the domestic firm into a leader that expands production relative to the rivals and obtain profits thanks to a more efficient scale of production (Etro, 2006, 2008). The gains are higher when the market is characterized by high mark ups (and excess entry), but markups and entry decrease with demand elasticity. We can summarize as follows:

OPTIMAL PRODUCTION SUBSIDIES. Under EMS in the integrated market with competition in quantities and homogenous goods, the op-

²⁴However, notice that when the size of the country is large, as we have seen in the previous section, there is an incentive to adopt an import tariff on foreign production.

timal non-prohibitive subsidy to domestic production is positive, inversely related to the elasticity of demand and independent from the relative size of the domestic market.

To exemplify this result, we now develop the example with linear demand. The case of hyperbolic demand is similar.

3.1.1 Linear demand with constant marginal cost

As an example of the homogenous goods case, consider a linear demand derived from the usual quadratic preferences (21). The inverse demand is $p = a - Q/L^W$ where the size of the integrated market is L^W .

Let us consider first the case of a constant marginal cost c . The Cournot equilibrium is given by:

$$q = \frac{(a - c + n\tau) L^W}{n + 1} \quad \text{and} \quad q^* = \frac{(a - c - \tau) L^W}{n + 1}$$

and foreign firms enter as long as $\tau < a - c - 3\sqrt{F/L^W}$. Total production is $Q = q + (n - 1)q^*$ and welfare is:

$$W(\tau) = \frac{L}{2} \left(\frac{Q}{L^W} \right)^2 + \left(a - \frac{Q}{L^W} \right) q - \frac{q^2}{2} - F \quad (45)$$

The production subsidy is going to reduce consumer surplus and increase net profits: the relative benefits on consumer surplus are clearly weighted by the size of the domestic country. The optimal trade policy can be derived as:

$$\tau_H = \frac{[n(L + L^W) - L^W] (a - c)}{2nL^W - L} \quad (46)$$

When $L = L^W$ we are back in the case of a closed economy in which it is optimal to implement the first best production with the domestic firm, and the optimal subsidy is $\tau_H = a - c$. When $L = 0$ we are in the case of a third market analyzed by Brander and Spencer (1985) and the optimal subsidy becomes $\tau_H = (n - 1)(a - c)/2n$. More generally, the optimal subsidy increases with the size of the domestic economy because the weight on domestic consumer surplus increases and this requires larger production.²⁵

Under endogenous entry of international firms it is immediate to verify that welfare is always increasing in the subsidy. Therefore, the optimal trade policy

²⁵Indeed, it is standard to verify that in a model of price competition it would be optimal to set a tax on domestic production when $L = 0$ (to soften international competition) and a subsidy when $L = L^W$ (to reduce the domestic price).

requires the prohibitive subsidy:

$$\tau_H = a - c - 3\sqrt{\frac{F}{L^W}} \quad (47)$$

In such a case, it is optimal to subsidize domestic production to induce monopolization of the integrated market.

3.1.2 Linear demand with quadratic cost

More interesting is the analysis under a convex cost function. Let us assume a quadratic one, $c(q) = q^2/2$. In this case a prohibitive subsidy is typically suboptimal because it induces inefficient production. Looking at the Cournot equilibrium with endogenous entry, we can easily obtain the equilibrium production of each international firm:

$$q^* = \sqrt{\frac{2L^W F}{2 + L^W}} \quad (48)$$

and the number of firms:

$$n = \left(a - \frac{\tau}{1 + L^W}\right) \sqrt{\frac{(2 + L^W)L^W}{2F}} - 1 - L^W$$

which imply a price:

$$p = (1 + L^W) \sqrt{\frac{2F}{(2 + L^W)L^W}}$$

The equilibrium production of the subsidized firm is:

$$q = q^* + \frac{\tau L^W}{1 + L^W}$$

The subsidy does not affect the individual production of the international firms, but decreases their number. Moreover, consumer surplus is now a function of the total production, which does not depend on policy. Domestic profits are $\pi_H = (2 + L^W)q^2/2L^W - F$. Domestic welfare is the sum of the consumer surplus of the L domestic agents plus the domestic profits net of the tax revenue necessary to finance the subsidies:

$$W(\tau) = \frac{L}{2} \left(\frac{Q}{L^W}\right)^2 + \left[q(p + \tau) - \frac{q^2}{2} - F\right] - \tau q \quad (49)$$

The optimality condition is simply $q = p$, which requires the following optimal subsidy:

$$\tau_H = \left(1 + \frac{1}{L^W}\right) \sqrt{\frac{2F}{(2 + L^W) L^W}} > 0 \quad (50)$$

This is approaching zero when the size of the market increases indefinitely. Notice also that when the fixed cost of entry decreases, the level of concentration in the market is reduced and the optimal subsidy goes down: in the limit case of perfect competition (zero fixed costs) we obtain the traditional result for which free trade is optimal.

3.2 Differentiated goods *à la* Dixit-Stiglitz

The rationale behind the optimal policy for homogenous goods extends immediately to the case of imperfect substitutability whenever the model satisfies the assumptions of our Neutrality Theorem, so that the subsidy does not affect domestic consumer surplus. In such a case, it is always optimal to turn the domestic firm into a leader in the integrated market, which requires an aggressive strategy and therefore a subsidy under both quantity and price competition. We could explicitly derive the optimal subsidy under Bertrand or Cournot competition, but for continuity with the previous analysis we focus on the case of competition in quantity.

Suppose that the population of L^W consumers in the integrated market is characterized by the usual Dixit and Stiglitz (1977) preferences (4). Under linear or quasilinear preferences, this generates the inverse demand (29). Let us consider a constant marginal cost. The equilibrium conditions for a given subsidy τ are:

$$\begin{aligned} p(x, \xi) + x p_1(x, \xi) &= c - \tau \\ p(x^*, \xi^*) + x^* p_1(x^*, \xi^*) &= c \\ [p(x^*, \xi^*) - c] x^* L^W &= F \end{aligned}$$

The Neutrality Theorem applies and the production subsidy does not affect the strategy of the international firms and consumer surplus at home (and also abroad). It only increases domestic production:

$$\frac{dx}{d\tau} = \frac{\theta^2}{(\theta - 1) [p(x, \xi)/x + (\theta - 2)p(x, \xi)^2]} > 0$$

Let us express domestic welfare as:

$$W(\tau) = LU [\xi^* + h(x^*)] + [p(x, \xi) - c] x L^W - F \quad (51)$$

Notice that $\xi = \xi^* + h(x^*) - h(x)$, where only the last term $h(x)$ depends on the production subsidy. Using this, the derivative with respect to the policy tool is:

$$\frac{\partial W}{\partial \tau} = \left\{ [p(x, \xi) - c] \frac{dx}{d\tau} + x [p_1(x, \xi) - p_2(x, \xi)h'(x)] \frac{dx}{d\tau} \right\} L^W \quad (52)$$

Using the first order condition of the domestic firm to simplify, the optimality condition for the optimal trade policy becomes $\tau_H = x [-p_2(x, \xi)h'(x)]$, which is always positive and clearly generalizes (44). Under our functional form, the optimal subsidy on the domestic production can be written as:

$$\tau_H = \frac{(\theta - 1)p^2 x}{\theta}$$

As can be verified replacing this in the optimality condition of the domestic firm, the optimal policy leads the latter to behave as a Stackelberg leader facing endogenous entry (Etro, 2008) and to sell its good at the following price:

$$p(x, \xi) = \frac{c\theta}{\theta - 1}$$

This is the monopolistically competitive price, which is lower than the equilibrium price emerging under free trade and still adopted here by all the international firms. It allows us to derive the equilibrium production of the domestic firm:

$$x = \frac{F(\theta - 1)(1 - \Omega^W)^{1-\theta}}{cL^W[1 + \Omega^W(\theta - 1)]} \quad \text{with } \Omega^W \equiv \frac{2\theta F/L^W}{1 + \sqrt{1 + 4\theta(\theta - 1)F/L^W}}$$

and obtain the final explicit formula for the optimal production subsidy:

$$\tau_H = \frac{cF\theta}{L^W[1 + \Omega^W(\theta - 1)](1 - \Omega^W)^{\theta-1}} \quad (53)$$

Once again the optimal production subsidy is positive and decreasing in the size of the integrated market. The domestic country gains from the subsidy only because of the larger profits for the domestic firm, and it is important to remark that foreign consumers are not even affected by this.²⁶

Finally, notice that beyond our assumptions, the characterization of the optimal policy for an integrated market becomes more complicated because production subsidies affect consumer surplus: on one side they reduce the number of varieties provided by the foreign firms and on the other side they increase the consumption of the domestic variety. Depending on the kind of preferences, this may increase or decrease consumer surplus. However, small departures from our analysis would not affect the general optimality of positive production subsidies.

²⁶Analogously, one can derive the optimal production subsidy for the case of Bertrand competition. This is again independent from the size of the domestic economy because the Dixit-Stiglitz preferences satisfy our assumptions. Details are available from the author.

4 Conclusion

We studied international trade policy in the presence of EMSs characterized by both strategic interactions and endogenous entry. A collateral outcome of this research was the characterization of the incidence of import tariffs and subsidies to domestic production in case of endogenous entry of international firms. In general, the subsidies do not affect the production of foreign firms, but they induce exit of them, while the tariffs reduce both foreign production and entry. The main question we asked was how this influences the optimal unilateral trade policy: should we limit or attract entry and foreign production? Focusing on competition in quantities, we found that, when the domestic demand is convex enough (as with hyperbolic or Dixit-Stiglitz demand) it is typically optimal to adopt an import subsidy, otherwise (as with a linear demand) the optimal tariff remains positive.

We have also analyzed the optimal subsidy to domestic production for an integrated market (when export subsidies are forebidden), and we have shown that positive subsidies to domestic production are always optimal to shift profits toward the domestic firm without affecting domestic consumer surplus. Future research should characterize the optimal unilateral trade policy beyond our assumptions, that neutralize any impact of the subsidy on domestic consumer surplus, and verify whether the quality of our results is robust. Finally, it would be interesting to consider equilibrium policies adopted by multiple countries, such as import tariffs and production subsidies of the domestic country and production subsidies of the foreign countries.

Appendix

NEUTRALITY THEOREM. Under endogenous entry of international firms in a market structure satisfying A.1.-2., any small policy or structural shift affecting the profitability of anyone of a given number of domestic firms is not going to change consumers surplus and the strategies of the foreign firms, but affects their number and domestic profits.

PROOF. We need to prove the Neutrality Theorem for the case of $m > 1$ domestic firms in case of a small change in μ such that there is always entry of foreign firms in equilibrium. First, let us consider the case of identical domestic firms, with firm specific parameter μ . The symmetric equilibrium strategies of the m domestic firms x and of the $n - m$ foreign firms x^* , and the total number of active firms n must satisfy

the following optimality and endogenous entry conditions:

$$\Pi_x[x, (n-m)h(x^*) + (m-1)h(x), \mu, L] = 0$$

$$\Pi_x^*[x^*, (n-m-1)h(x^*) + mh(x), \mu^*, L] = 0$$

$$\Pi^*[x^*, (n-m-1)h(x^*) + mh(x), \mu^*, L] = F$$

The last two equations of the system, define x^* and $\xi^* \equiv (n-m-1)h(x^*) + mh(x)$ as functions of μ^* , L and F . Indeed, they can be rewritten as a separate system of two equations in two unknowns:

$$\Pi_x^*[x^*, \xi^*, \mu^*, L] = 0 \quad \text{and} \quad \Pi^*[x^*, \xi^*, \mu^*, L] = F \quad (54)$$

This confirms the neutrality of the foreign strategies with respect to both μ and m . The first equation of the equilibrium system determines x . Replacing ξ^* defined above, it implies:

$$\Pi_x[x, \xi^* + h(x^*) - h(x), \mu, L] = 0$$

which is independent from the number of domestic firms. Therefore the equilibrium strategy of each domestic firm depends on μ but not on how many domestic firms are active. Again, any impact on the market structure of μ goes through the entry process:

$$n = 2 + \frac{\xi^* - mh(x)}{h(x^*)}$$

Finally, consumer surplus is:

$$U \left[\sum_{j=1}^n h(x_j) \right] = U [(n-m)h(x^*) + mh(x)] = U [\xi^* + h(x^*)]$$

which does not change with μ (and neither with m) because the pair (x^*, ξ^*) is invariant in μ (and in m).

Now, consider the case in which the domestic firms are characterized by different parameters μ_i for $i = 1, 2, \dots, m$ while the international firms are characterized by the same parameter μ^* . Each one of the domestic firms will choose its strategy x_i according to:

$$\Pi_x[x_i, (n-m)h(x^*) + \sum_{j=1, j \neq i}^m h(x_j), \mu_i, L] = 0$$

but the optimality and endogenous entry conditions of the international firms will be the same as in (54) with:

$$\xi^* \equiv (n-m-1)h(x^*) + \sum_{j=1}^m h(x_j)$$

This implies that the optimality condition for each domestic firm can be rewritten as:

$$\Pi_x[x_i, \xi^* + h(x^*) - h(x_i), \mu_i, L] = 0 \quad (55)$$

that implies that each domestic firm behaves independently from the number and strategies of the other firms. Again, the change of any μ_i is not going to change the pair (x^*, ξ^*) and consumers surplus, but affects only the total number of firms:

$$n = 1 + m + \frac{\xi^* - \sum_{j=1}^m h(x_j)}{h(x^*)} \quad (56)$$

This completes the proof. $\square$

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