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Antidumping duties, undertakings, and foreign direct investment in the EU

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Abstract

We study the effects of EU antidumping policy when foreign firms can ‘jump’ antidumping duties through foreign direct investment (FDI) in the EU. We show that duty jumping or duty pre-empting FDI occurs if the EU administration has broader objectives than protecting EU industry’s profitability and if cost advantages of foreign firms are transferable abroad. The (expectation of) price undertakings reduces the incentives to engage in FDI and may even discourage FDI as long as products are not too differentiated. The results are consistent with recent empirical findings on antidumping jumping FDI.

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1. Introduction

The tariff-jumping motive for FDI is well developed in the literature (Campa et al., 1998; Horstmann and Markusen, 1987; Motta, 1992; Smith, 1987, Collie and Vandenbussche, 2001). These studies show under which conditions foreign firms prefer to set up local production units over exporting when serving distant markets. The trade-off foreign firms typically face in these models is based on the level of the tariff when exporting versus the fixed cost associated with setting up a manufacturing plant abroad. Other studies (e.g. Konishi et al., 1999; Levinsohn, 1989; Hillman and Ursprung, 1988)

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compare the effects of tariffs with the effects of quota and voluntary export restraints (VERs) and have shown how the profit gain for foreign firms due to VERs lowers the propensity to engage in FDI.

While the use of tariffs, quota and VERs has been reduced as a result of multilateral trade negotiations, the use of other trade policy instruments, notably antidumping, has increased. Recent empirical work has confirmed that the FDI response to antidumping actions is certainly not uncommon, in particular in case of antidumping actions targeting Japanese firms (e.g. Barrell and Pain, 1999; Girma et al., 1999; Belderbos, 1997a; Blonigen and Feenstra, 1997; Azrak and Wynne, 1995). Blonigen (2000), in a recent study, analyses duty-jumping FDI by firms based in other countries than Japan.¹ The evidence suggests that EU firms show a comparable FDI response if they are targeted by US antidumping actions, but that antidumping jumping FDI is very limited in scale in case firms without international experience based in developing countries are targeted.

Given the demonstrated importance of FDI responses to antidumping actions, it is surprising that the theoretical literature on the effects of antidumping law have by and large ignored the issue of ‘antidumping jumping’. Theoretical work has dealt with the welfare and strategic effects of antidumping laws under alternative market structures (e.g. Anderson et al., 1995; Prusa, 1994; Reitzes, 1993; Leidy and Hoekman, 1990; Webb, 1992; Staiger and Wolak, 1992; Fischer, 1992; Bernhofen, 1995), industries’ incentives to petition for antidumping (e.g. Feinberg and Hirsch, 1989; Hoekman and Leidy, 1992; Sleuwaegen et al., 1998), and the potential effect of antidumping measures in strengthening collusive practices (e.g. Prusa, 1992a; Veugelers and Vandebussche, 1999). Two studies deal with the relationship between antidumping and FDI. Blonigen and Ohno (1998) focus on the strategic interactions between exporters from different countries facing the possibility of antidumping measures. In a two-period model, they show the possibility of a ‘protection building equilibrium’. A foreign firm that intends to engage in second period FDI increases its first period export in order to increase the level of protection faced by the rival foreign firm (which continues to export in the second period). Haaland and Wooton (1998) are concerned with the effects of economic integration involving the abolition of antidumping law. In a symmetric model of two countries considering reciprocal (anti-)dumping and reciprocal FDI, they find that producers in both countries would gain from the abolition of antidumping law from the WTO statute. This result is driven by the fact that reciprocal antidumping jumping FDI increases competition and reduces profits of domestic firms.

This paper examines antidumping jumping FDI in the context of EU antidumping practices. Incorporating the most particular features of EU antidumping law, we analyse the conditions under which antidumping jumping FDI occurs and the output and welfare effects of antidumping actions. An EU antidumping case can only be initiated when imports are dumped on the European market and cause material injury to the EU industry. All types of international price discrimination with the lower price charged in the EU can classify as dumping, at least for products for which there are close EU substitutes (‘like products’). We explicitly consider a clause in EU antidumping law that allows the

¹ In addition, Perrin (2001) found a positive impact of antidumping actions in the EU and the US on South Korean firms’ FDI.

EU administration to settle antidumping actions either by levying duties or by demanding price undertakings from the foreign exporting firms. While an antidumping duty is akin to a tariff, a price undertaking is a commitment by the foreign firm to raise its price and shares more features with a VER.² The conditions under which undertakings are allowed are not well articulated in EU antidumping law and the EU administration has considerable discretion in the choice which measures it takes (Tharakan, 1991). Our model shows that this decision will depend on the objective function of the EU administration, which may vary between protecting the interests of EU industry only (maximizing producer surplus) and also taking into account the interests of consumers and user industries (maximising EU social welfare). The former corresponds to the direct objective of antidumping law. Pursuing the latter is in line with the ‘public interest’ clause embedded in EU antidumping law by which the EU Commission is held to consider repercussions on consumers and user industries (e.g. Tharakan, 1999; Tharakan and Waelbroeck, 1994). A second aspect of EU antidumping incorporated in the model is that the level of duties and price undertakings is typically determined by the degree to which foreign firms undercut EU producers’ prices on the EU market (Vandenbussche, 1995). This rule is applied to ensure that antidumping measures remove the injury to EU industry. The rule limits the discretionary power of the EU administration in determining duty and price undertaking levels.

Contrary to the symmetric model of Haaland and Wooton (1998), we explicitly take on board cost asymmetries, viz. a cost advantage of the foreign firm. Such a cost advantage is a most likely reason for price undercutting by foreign exporters resulting in antidumping actions. We allow cost advantages to be either ‘firm-specific’, in which case they are internationally transferable through FDI, or ‘location specific’, in which case FDI implies that foreign firms relinquish their cost advantage and produce at the same marginal cost as those of EU producers. We show that the occurrence of duty jumping FDI in the EU requires that the foreign firm’s cost advantage is at least partly firm specific. The fact that location specific cost advantages (e.g. based on low local input costs or low labour cost) is often a feature of exporters based in developing countries relates to Blonigen’s (2000) finding of differences in FDI responses between firms from developed and developing countries.

The remainder of the paper is organised as follows. In the next section we present the model for the case of products which are sufficiently close substitutes (‘like’ products) and firm-specific cost advantages, assuming that the EU administration is able to commit to antidumping actions before the foreign firm’s investment decision, and allowing two alternative policy objectives (producer surplus and social welfare). In Section 3 we analyse a number of alternative cases: location specific cost advantages, the case in which the foreign firm is able to commit to FDI first, different EU objective functions involving positive spillovers of FDI to the EU economy, and the case of highly differentiated products. We offer concluding remarks in Section 4.

² In EU antidumping practice, a substantial number of cases are settled through price-undertakings. Among 249 EU AD-cases examined by the European Commission during 1985–1990, 21 percent were terminated without any measures, 30 percent ended in a price undertaking and 49 percent ended in duties (figures based on Official Journal of the EC, L-series, 1985–1995). See also Laird (1999).

2. A model of EU antidumping and FDI

2.1. *The model set-up*

We consider a three-stage model involving the EU administration, a domestic EU firm, and a foreign firm. In the first stage, the EU antidumping administration decides whether and what type of antidumping measures to take. In the second stage the foreign firm chooses between exports and FDI. In the third stage the foreign firm is engaged in Bertrand price competition with the EU firm on the European market. The sequence of moves analysed in this section implies that the FDI versus export decision is a response to the trade policy measure. Antidumping measures are only an option for the EU administration if the foreign firm is exporting such that dumping takes place initially. By solving the model through backward induction, we analyse how the option of FDI by the foreign firm in response to antidumping, with its effects on EU price competition and welfare, may induce the administration to adapt its choice of antidumping measure. In the extensions we consider the alternative order of moves with the foreign firm deciding on FDI versus export before the EU administration takes a decision.

As the EU antidumping law stipulates, activating the EU administration decision stage requires dumping on the European market and material injury to the EU industry. The most common form of what is regarded as dumping in EU antidumping practice is international price discrimination between countries where the price in the export market is lower than the price of a product in the home market. For ‘like products’ all types of international price discrimination with a lower price charged in the EU can classify as dumping. For simplicity, we ignore the foreign market and assume international price differentiation to prevail.

Our analysis focuses more on the second condition in EU antidumping law, namely the level of injury. Price undercutting in the EU market is considered to be ‘injurious’ to the EU industry. The level of antidumping duties and price undertakings is determined to eliminate the injury and hence price undercutting, thus ensuring equal prices for the European and the foreign products in the EU.³ To enforce this price commitment by the foreign firms, the EU can impose stiff penalties on those exporters that do not maintain the price equality.⁴ In our model, price undercutting by the foreign firm on the EU market is due to a cost advantage of the foreign firm. This cost advantage determines the level of injury and consequently the level of the antidumping duty or price undertakings.

³ Case evidence has revealed that duty levels in EU antidumping cases are set at the level of the injury margin (Vermulst and Waer, 1992; Vandebussche et al., 2001). This practice contrasts with US antidumping rules, which stipulate that duties have to be set equal to the dumping margin.

⁴ The anti-absorption clause, included in 1988 in the EU antidumping law, ensures that further (retroactive) duties can be levied on exporters that ‘absorb’ the duty. For instance in Council Regulation (EC) 1952/97 of 7 October 1997, anti-absorption duties were imposed on television cameras from Japan, which were substantially higher than the original duties imposed in regulation (EC) 1015/94, Official journal L 276, 09/10/1997 pp. 20–28.

2.2. Antidumping and price competition in the EU market

We analyse the firms' profits in the four outcomes that can occur in the final stage of the model: exports under free trade, a duty or an undertaking, or FDI. In the EU output market, the foreign firm competes with the local EU firm in prices offering differentiated products.⁵ The direct linear demand functions for the European firm (q) and the foreign firm (q^*) in the EU market are given by

$$q = 1 - p + kp^*, \quad (1)$$

$$q^* = 1 - p^* + kp, \quad (2)$$

where p refers to the price of the European product and p^* to the price of the foreign product in the EU market.⁶

The parameter k ($0 \leq k < 1$) is a measure of the degree of product differentiation between the domestic and the foreign good. For $k = 0$, products are completely independent and competition is absent. With k close to 1, products are only marginally differentiated and price competition is intense.⁷ To trace the impact of the intensity of product differentiation, we let k vary. However, since antidumping actions can only legally be taken when foreign and domestic products are close substitutes (like products), we present the model results assuming the presence of close substitutes products, i.e. a sufficiently high level of k . In Section 3.4 we discuss the sensitivity of some of the results when products would be more differentiated. The level of k for which all reported results hold depends on the size of the cost disadvantage of the domestic firm but typically does not exceed 0.7.

The parameter c denotes the (constant) marginal cost of production for the EU firm and c^* the marginal cost of production for the foreign firm in its home market. If s denotes unit transport cost than the marginal cost of serving the EU market through exports for the foreign firm is $c^* + s$. The home firm and the foreign firm's profit functions under *free trade*, respectively, are

$$\pi_{FT} = (p_{FT} - c)q_{FT}, \quad (3)$$

$$\pi_{FT}^* = (p_{FT}^* - c^* - s)q_{FT}^*. \quad (4)$$

⁵ Bertrand rivalry in prices is the most obvious model to use in antidumping settings where the issue is the existence and removal of price undercutting. As compared to Cournot competition in quantities, Bertrand price rivalry allows for more intense product market competition in case of close substitutes, which is a natural setting given that antidumping actions require that foreign and domestic products are 'like products'. In Section 3.4 we discuss the equivalence of results under Cournot competition.

⁶ These direct demand functions can be derived from a representative consumer's utility maximizing behaviour given a quadratic and strictly concave utility function $U(q_1, q_2) = \alpha_1 q_1 + \alpha_2 q_2 - (\beta_1 q_1^2 + 2\gamma q_1 q_2 + \beta_2 q_2^2)$, as in Singh and Vives (1984). We assume symmetry between the two products and normalise the resulting intercept term $\alpha/(\beta + \gamma)$ and the coefficient to own prices $\beta/(\beta^2 - \gamma^2)$ in the resulting direct demand function to be equal to 1. The coefficient to rival prices k in (1) and (2) corresponds to $\sqrt{(\beta^2 - \beta)\beta}$, implying that $\beta \geq 1$, which is not a severe restriction.

⁷ The demand functions do not allow for the case of Bertrand competition with homogenous products ($k = 1$). See also Singh and Vives (1984).

We assume that the foreign firm has a cost advantage in the free trade case such that $c^* + s < c$.

In case the foreign firm is exporting with a duty t , or in case a *price undertaking* (und) applies, its profits are

$$\pi_{\text{duty}}^* = (p_{\text{duty}}^* - c^* - s - t)q_{\text{duty}}^*, \quad (5)$$

$$\pi_{\text{und}}^* = (p_{\text{und}}^* - c^* - s)q_{\text{und}}^*. \quad (6)$$

In accordance with EU antidumping practice we assume that both price undertakings and duties force the foreign firm to ‘meet’ the price set by the European producer of the ‘like product’ in the European market, thereby eliminating the ‘injury’. Hence, we assume that the duty level is set such that price equalisation ($p = p^*$) results ex post.⁸ The reduced forms of domestic and foreign equilibrium prices in the case of free trade, duties and undertakings can be found in Appendix A. Given the cost advantage of the foreign firm, the free trade equilibrium is characterised by price undercutting ($p_{\text{FT}}^* < p_{\text{FT}}$). The imposition of a duty can be seen as an upward shift of the foreign firm’s best response function. The antidumping duty is determined to eliminate price undercutting by the foreign firm. The duty that accomplishes this is equal to the cost difference between the two firms ($t = c - c^* - s$) and leads to higher prices ($p_{\text{duty}}^* > p_{\text{FT}}^*$).

In case of a price undertaking, the foreign firm is required to ‘meet the price’ set by the local firm such that its response function becomes $p^* = p$. With the home firm’s best response function unchanged, the undertaking equilibrium in price space equal to the duty equilibrium $p_{\text{duty}}^* = p_{\text{und}}^* = p_{\text{duty}} = p_{\text{und}}$.

Antidumping measures, duties or undertakings, raise the equilibrium prices of both firms. When comparing the profit expression in (5) and (6) we see that in the case of a duty (5), part of the foreign profits is shifted to the EU in terms of duty revenue (tq^*). In the case of price-undertakings (6), the foreign firm fully retains the benefits from higher prices. Hence the foreign firms will always prefer a price undertaking to a duty. The domestic firm profits are equal under a duty and an undertaking.

We now consider the price equilibrium in case of FDI. We discuss the case of a firm specific cost advantage of the foreign firm, based on a technological or organisational advantage that can be exploited in foreign plants.⁹ For simplicity we assume here that in case of firm specific cost advantages there is perfect transferability: the foreign firm under FDI maintains the same marginal costs of production (c^*) as under export but saves on transport costs (s). On the other hand, the foreign firm incurs fixed (plant) set-up costs in case of FDI. The case of (partly) location specific, non-transferable, cost advantages based for instance on access to low cost labour in the home market, is discussed in Section 3.1.

⁸ Although the foreign firm could (partly) absorb the tariff, duty levels can be adjusted as long as there is no price equalisation, as the anti-absorption legislation of 1988 stipulates.

⁹ The theory of the multinational firm suggests that an important element in firms’ decisions to move abroad is the extent to which firms possess intangible, firm-specific assets that are transferable abroad (e.g. Caves, 1995).

The foreign firm’s profits under FDI in case of a firm specific (transferable) cost advantage are

$$\pi_{\text{FDI}}^* = (p_{\text{FDI}}^* - c^*)q_{\text{FDI}}^* - F, \tag{7}$$

where F represents the fixed costs of setting up a plant in the EU and subscript FDI denotes the FDI equilibrium. Since the foreign firm saves on transport cost (s), its marginal costs are reduced, resulting in a downward shift of its reaction function. The foreign firm increases its marginal cost advantage, which ensures that in the FDI equilibrium the foreign firm’s price remains below the price set by the EU firm ($p_{\text{FDI}}^* < p_{\text{FDI}}$). Prices of both firms in the case of FDI are lower than in the case of free trade, because the price reduction by the foreign firm is partly matched by the EU firm ($p_{\text{FDI}}^* < p_{\text{FT}}^*$ and $p_{\text{FDI}} < p_{\text{FT}}$).

Using (1)–(7) we can establish a full ranking of equilibrium prices and output in the four possible outcomes

$$p_{\text{FDI}} < p_{\text{FT}} < p_{\text{duty}} = p_{\text{und}}, \tag{R.1}$$

$$q_{\text{FDI}} > q_{\text{FT}} > q_{\text{duty}} = q_{\text{und}}, \tag{R.2}$$

$$p_{\text{FDI}}^* < p_{\text{FT}}^* < p_{\text{duty}}^* = p_{\text{und}}^*, \tag{R.3}$$

$$q_{\text{FDI}}^* > q_{\text{FT}}^* > q_{\text{duty}}^* = q_{\text{und}}^*. \tag{R.4}$$

2.3. The foreign firm’s choice between exports and FDI under firm specific cost advantages

We now analyse under which conditions the foreign firm will choose FDI, given the antidumping measure imposed. The foreign firm compares the relevant profits under Eqs. (4)–(6) with profits under FDI in (7). In the case of free trade, the foreign firm prefers to export if the fixed cost F is large relative to the transport cost s , as can be seen by comparing the foreign firm’s profit function in (4) and (7). We denote the *critical level of fixed costs* that induces a switch from exports to FDI under free trade by F_{FT}^* . With $F > F_{\text{FT}}^*$ the foreign firm prefers to export under Free Trade. In the case of a price-undertaking, the foreign firm faces a similar trade off between transport costs s and fixed FDI costs F . This can be seen by comparing Eqs. (6) and (7). Exporting under a price-undertaking leads to higher prices and profits than under free trade (R.3) such that the critical fixed cost that will induce a switch from exports to FDI, noted by F_{und}^* , is smaller than under free trade: $F_{\text{und}}^* < F_{\text{FT}}^*$. Hence, there is a range of fixed cost levels under which the foreign firm would not engage in FDI in case of an undertaking, but would invest under free trade.¹⁰ In case of a duty, marginal costs under exports include the duty t in addition to transport costs s . In view of this higher marginal costs of exporting, the foreign firm can only be dissuaded from engaging in FDI by higher

¹⁰ This result requires that the products of the EU and foreign firm are sufficiently close substitutes (‘like’ products). In Section 3.4 the case of highly differentiated products is discussed.

Table 1
The export versus FDI decision of the foreign firm as a function of critical levels of fixed FDI costs

	$F < F_{und}^*$	$F_{und}^* < F < F_{FT}^*$	$F_{FT}^* < F < F_{duty}^*$	$F > F_{duty}^*$
	(1)	(2)	(3)	(4)
Free Trade	FDI	FDI	Export	Export
Duty	(FDI)	(FDI)	FDI	Export
Undertaking	(FDI)	(Export)	Export	Export

Notes: Choices within brackets are hypothetical since antidumping actions cannot be taken in the absence of exports in the free trade case. The full specification of the critical fixed cost functions is provided in Appendix B.

levels of fixed costs: $F_{duty}^* > F_{FT}^*$. The above implies the following ranking of critical fixed costs:

$$F_{duty}^* > F_{FT}^* > F_{und}^* > 0. \tag{R.5}$$

Table 1 summarises the foreign firm’s decisions depending on the level of fixed costs and the presence or absence of antidumping measures. In case of high fixed costs (column 4), exporting is the dominant strategy, irrespective of the antidumping measure prevailing. For intermediate levels of fixed costs, in column (3), ‘antidumping jumping’ FDI arises when duties are imposed, but undertakings would maintain the export strategy. For lower levels of fixed cost (column 2) the foreign firm prefers FDI except when an undertaking would be imposed, in which case it would prefer to export. With levels of fixed costs below F_{und}^* , FDI is the dominant strategy. Note that in case the foreign firm would prefer FDI under free trade (FDI based on efficiency considerations rather than induced by antidumping measures), dumped exports are never observed and the EU administration is not able to take any measures. The antidumping outcomes in columns (1) and (2) are therefore hypothetical.¹¹

2.4. The EU antidumping decision

Taking into account the foreign firm’s FDI versus export choice and subsequent price equilibrium, the EU antidumping administration decides in the first stage of the model whether to take antidumping measures and if so, whether these take the form of a duty or a price undertaking. The administration in this section is considered to have two alternative objectives: it can pursue the interests of EU producers or the ‘public’ or ‘community’ interest. In Section 3.2 we also consider an EU welfare function that takes on board a positive externality of foreign FDI on EU welfare by including the wage bill generated by foreign employment. Community interest can be represented by EU social welfare (W), consisting of the sum of EU consumer surplus (CS), the EU

¹¹ These cases become potential outcomes when the foreign firm is able to choose first between export and FDI (see Section 3.3).

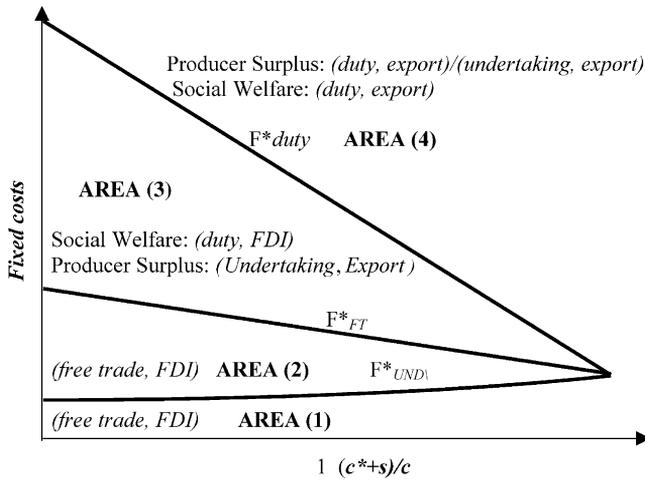


Fig. 1. Equilibria as a function of fixed FDI costs, the foreign firm’s cost advantage, and the EU objective function when the EU administration moves first.

Notes: Producer surplus and social welfare refer to the EU Administration’s objectives. F_{FT}^* , F_{und}^* , F_{duty}^* denote critical levels of fixed FDI costs that induce a switch from export to FDI under free trade, price undertakings, and duties, respectively. The parameter values used to draw the figure are: $c = 0.5$, $s = 0.1$ and $k = 0.7$.

firm’s producer surplus (π) and duty revenue (tq^*). Denoting the objective function of the EU administration by G , the social welfare objective implies maximising:

$$G = W = CS + \pi + tq^*. \tag{8}$$

In case the objective is to protect the local EU industry, the EU administration will aim to maximise domestic producer profits only, in which case its objective function becomes

$$G = \pi. \tag{9}$$

It is useful to note that from the full characterisation of prices and output over the various outcomes of the game (R.1–4) in case of sufficiently high levels of k , we can derive the ordering of local producer surplus and consumer surplus:

$$\pi_{FDI} < \pi_{FT} < \pi_{duty} = \pi_{und}, \tag{R.6}$$

$$CS_{FDI} > CS_{FT} > CS_{duty} = CS_{und}. \tag{R.7}$$

The different equilibria of the model for the two EU objective functions are illustrated in Fig. 1. It shows for close substitutes products ($k = 0.7$), the choice of the EU administration and the consequent response by the foreign firm as a function of critical fixed FDI costs and the degree of production cost asymmetry between the foreign and the EU producer. As we move to the right on the horizontal axis, the cost asymmetry $(c^* + s)/c$ between the EU and foreign firm becomes smaller.

2.4.1. Social welfare objective

We first consider the equilibria when the EU administration pursues the ‘Community’ interest and maximises social welfare ($G = W$). The top area (area 4) in Fig. 1 corresponds with column (4) in Table 1 and indicates the area where levels of fixed FDI costs are too high for the foreign firm to engage in FDI. The EU administration anticipates the foreign firm’s decision to export, and will prefer to levy an antidumping duty. EU welfare under a duty is higher than under free trade because the loss in consumer surplus from imposing a duty is more than compensated by the increase in the EU firm’s profits and the duty revenue (the proof is provided in Appendix C).¹² For a given level of fixed FDI costs, this outcome becomes more likely the smaller the cost advantage of the foreign firm because limited cost asymmetry leads to lower duties and decreased incentives for FDI.

In area 3 in Fig. 1, the fixed costs of FDI are between the critical values that induce a switch from exports to FDI under a duty and under Free Trade, respectively ($F_{FT}^* < F < F_{duty}^*$). The foreign firm will engage in FDI in case a duty is imposed, but will continue to export when an undertaking is imposed or when no measure is imposed (free trade). In this case it can be shown that the EU Administration, maximising EU welfare and correctly anticipating the foreign firm’s FDI vs. export decision, will impose a duty which is followed by ‘antidumping jumping’ FDI. The induced ‘antidumping jumping’ FDI reduces the marginal costs of the foreign firm, leads to lower prices in the EU and increases consumer surplus. Although the increased price competition reduces profits of the EU firm, this reduction is smaller than the increase in consumer surplus, and hence social welfare increases (the proof $W_{FDI} > W_{FT}$ is provided in Appendix C). The range of fixed costs for which this duty jumping FDI occurs becomes markedly smaller as the cost differential between the foreign and the domestic firm narrows. A smaller cost differential leads to a smaller duty level and makes the FDI decision resemble the decision under free trade.

In the bottom two areas of Fig. 1 (areas 1 and 2), FDI costs are small enough to induce FDI under free trade. No initial export takes place and antidumping law becomes inconsequential. The FDI that occurs is not of the antidumping jumping kind, since it also prevails in the absence of duties. Although the imposition of a price-undertaking could have prevented the foreign firm from engaging in FDI in the area where $F > F_{duty}^*$, antidumping actions cannot be initiated.

2.4.2. EU producer surplus objective

We now turn our attention to equilibria when the EU administration only takes into account local producer interests ($G = \pi$). The EU administration bases its decision on the ranking of local producer surplus levels in (R.6). In case of high fixed FDI costs and moderate or low cost asymmetries in area (4) of Fig. 1, the EU administration is indifferent between undertakings and duties, as they have equal effects on EU firm profits. In neither case FDI is observed. In area 3, the EU will impose price-undertakings and refrain from levying duties. Since a duty will induce FDI by the foreign firm,

¹² The superior welfare position of the duty outcome over free trade is critically due to the tariff revenues that the former generates.

imposing a duty would result in a reduction in local producer surplus due to the increased price competition. Imposing a price undertaking leads to an increase in both the home and the foreign firm's profits above the free trade level and dissuades the foreign firm from engaging in FDI. The conclusion is that antidumping duty jumping FDI will not occur if the EU administration's maximises EU producer surplus by imposing a price undertaking.¹³

We conclude that 'antidumping jumping' FDI can only occur when the EU administration adheres to the community interest ($G = W$), provided that the fixed FDI costs are in an intermediate range. The greater the cost advantage of the foreign firm, the more likely that antidumping jumping FDI occurs. In contrast, if only local producer interests are considered ($G = PS$), price-undertakings are the preferred measure and antidumping jumping FDI does not occur.

3. Alternative specifications and extensions

In this section we discuss a number of alternative formulations and extensions of the model. This allows us to indicate critical conditions necessary to observe antidumping jumping FDI beyond the level of fixed FDI set-up costs and the degree of cost asymmetry already identified. We discuss in turn the case of location specific cost advantages of the foreign firm (Section 3.1), alternative objective functions of the EU administration including positive employment and spillover effects of FDI (Section 3.2), the case in which the foreign firm moves first (Section 3.3), and the sensitivity of results with respect to the degree of product differentiation (Section 3.4).

3.1. Location specific cost advantages of the foreign firm

In case the cost advantage of the foreign firm is fully location-specific (e.g. based on lower labour costs in its home country), the foreign firm if it engages in FDI loses its cost advantage and produces at the same marginal cost c as its EU rival. We derive the EU administration's optimal antidumping policy given the FDI vs. export decision of the foreign firm and subsequent price competition in the EU market.

When the foreign firm engages in FDI, its profit function in case of a location specific cost advantage is

$$\pi_{\text{FDI}}^* = (p_{\text{FDI}}^* - c)q_{\text{FDI}}^* - F. \quad (10)$$

The increase in marginal costs, due to the fact that the foreign firm cannot transfer its cost advantage, shifts up its reaction curve in case of FDI. Given that the foreign firm under FDI has the same marginal costs of production as the domestic firm, prices in

¹³Note that when the EU would not have the option to impose undertakings, it would, when pursuing local producers interests, prefer not to take any antidumping measures at all in this area since imposing a duty would induce FDI jumping and lead to lower EU producer surplus. As such, the option to impose undertakings embedded in EU antidumping law could be seen as increasing the incidence of affirmative antidumping cases.

the EU market are equal ($p_{FDI}^* = p_{FDI}$). In addition, these prices are equal to the prices in the case of exports under antidumping duties or undertakings since the level of the duty and the price level under an undertakings are set to offset any price difference between the home and the foreign firm in the EU market. Hence we obtain in case of location specific cost advantages:

$$p_{FDI}^* = p_{duty}^* = p_{und}^* = p_{duty} = p_{und} = p_{FDI} > p_{FT}^* \tag{R.8}$$

Under free trade, the foreign firm clearly prefers exports over FDI since it faces higher marginal cost of production in the EU ($c > c^* + s$) and at the same time it has to incur a fixed FDI cost F . Using (R.8) in Eqs. (5) and (10) shows that variable profits under duties are equal to profits under FDI. But FDI implies incurring a fixed cost F , such that the foreign firm prefers to export. Similarly, by using (R.8) in Eqs. (6) and (10), it is clear that FDI also does not occur under a price undertaking. With an undertaking, prices are equal to the duty case but the foreign firm pockets the ‘duty revenue’. Hence, the foreign firm will see profits decline substantially if it would engage in FDI. The conclusion is that no ‘antidumping jumping’ FDI occurs with location specific cost advantages, because the avoidance of antidumping duties and price undertakings, as they are restricted by law to a level that eliminates price undercutting, can never compensate the cost increase associated with switching production to the EU.

Given the dominant export strategy of the foreign firm, it is straightforward to derive the EU administration’s optimal policies. If the EU’s objective is to maximise social welfare ($G = W$), a duty (which will not be jumped), will always be preferred because it generates duty revenues (see Appendix C). In case the EU administration only considers EU producer surplus, the EU administration is indifferent between imposing undertakings and levying duties. Whatever measures are imposed, the foreign firm will continue to export to the EU.

We have illustrated the importance of the type of cost advantage of the foreign firm by analysing the different outcomes of the game for the two polar cases of location-specific cost advantages versus perfectly transferable cost advantages. We now discuss the case of intermediate levels of transferability or location specificity.¹⁴ Let the marginal cost of the foreign firm in case of FDI be: $c_{FDI}^* = c^* + \gamma(c - c^*)$, where $0 \leq \gamma \leq 1$ measures the extent of location-specificity. A value of one implies a fully location specific cost advantage and a value of zero implies a fully transferable firm specific cost advantage. If γ is increased from zero, both the F_{duty}^* line and the F_{FT}^* line in Fig. 1 shift downwards while the slopes of the lines decrease, such that the area in which antidumping jumping FDI occurs decreases in size. The less transferable is the cost advantage of the foreign firm, the less likely it is that the foreign firm will engage in antidumping jumping FDI.

¹⁴ Reduced transferability may be the result of cost increasing local content rules imposed on foreign firm’s manufacturing plants in the EU. The ‘screwdriver plant’ amendment in 1987 allowed the EU administration to impose such local content requirements on foreign plants set up in response to antidumping actions (e.g. Belderbos, 1997b).

While the foreign firm is less likely to prefer FDI when cost advantages are less transferable, the welfare implications in the cases in which it does choose for FDI also alter. With the cost advantages less transferable through FDI, the pro-competitive effect of FDI with its associated increase in consumer surplus is smaller, but the negative impact of FDI on the EU firm's producer surplus is also reduced. As long as FDI reduces the marginal costs of the foreign firm ($c_{\text{FDI}}^* < c^* + s$), the positive consumer surplus effect dominates the reduction in EU producer surplus, and FDI increases social welfare.¹⁵ The EU administration adopting a social welfare objective still prefers duties that are subsequently jumped to free trade.

A special case arises if FDI leads to an increase in the marginal costs of the foreign firm ($c^* + s < c_{\text{FDI}}^* < c$). FDI can still be beneficial for the foreign firm under these circumstances since the firm avoids the cost of paying the antidumping duty t . However, the social welfare effects of duty jumping FDI are no longer positive. The marginal cost increase of the foreign firm in comparison with the free trade situation leads to an increase in the foreign firm's price. This allows the EU producer to raise its own price and to increase its profits, but these price increases also lead to a decline in consumer surplus. The social welfare effects of duty jumping FDI depend on the relative weight of these two opposing forces, with the negative consumer surplus effect dominating.¹⁶ Hence, if the EU administration maximises social welfare ($G = W$) it refrains from imposing a duty that would be jumped through FDI and no duty jumping FDI will be observed. Cost increasing FDI can only occur if the administration factors in potential other contributions of FDI to the EU economy that offset the negative effects of cost and price increases.

3.2. Employment effects and spillovers of FDI

Governments may want to attract FDI because of the positive externalities it creates for the domestic economy. In Section 2 we already discussed the lower domestic prices as a result of FDI in case of transferable firm specific advantages. In addition, FDI may generate improved technical efficiency in the local industry through technological spillovers (e.g. Blomstrom and Kokko, 1998; Wang and Blomstrom, 1992). Another effect that the administration may take into account is the domestic output and employment generating effect of FDI. We analyse the latter case by adding the wage bill paid by the foreign firm in case of FDI to the EU administration's social welfare function. For simplicity, we assume that the only input into the manufacturing process is labour, and that the EU firm requires exactly one unit of labour (L) to produce one unit of output. The unit costs of the EU firm consist only of the market wage w ($w = c$) such that the wage bill of the EU firm wL equals cq . The foreign firm investing in the EU pays the same market wage, w , as the EU firm, but its transferable firm-specific cost advantage gives it a productivity advantage such that it only requires c^*/c units of

¹⁵ As long as marginal costs under free trade ($c^* + s$) exceed marginal costs under FDI, the result of inequality C.2 (Appendix C) holds.

¹⁶ The effect on social welfare of an increase in the marginal cost of the foreign firm due to FDI is equivalent to the effect of a marginal cost increase due to a duty when abstracting from duty revenue. Since the latter effect is negative, as shown in Appendix C, cost increasing FDI also reduces social welfare.

labour to produce one unit. Given the market wage w , the extra wage bill generated through FDI is $w(c^*/c)q_{\text{FDI}}^* = c^*q_{\text{FDI}}^*$. Including the wage bill into the EUs objective function, we get

$$G = W + c^*q_{\text{FDI}}^*. \quad (11)$$

This specification also encompasses other forms of benefit to the local economy due to FDI as long as these depend on the scale of the foreign firm's output, such as increased local revenues from taxes, or technological spillovers to suppliers or customers.

The model only changes in the first stage of the game, when the EU-administration has to decide on antidumping measures. The outcomes of the model are unaffected in case the foreign firm's cost advantage is location specific, since FDI does not arise. In the case of a firm specific cost advantage, the benefits of duty jumping FDI as perceived by the EU administration in (11) are larger in case of a social welfare objective ($G = W$). However, given the level of fixed FDI costs and the duty rule ($t = c - c^* - s$), the equilibrium outcomes are unchanged. This can be seen by examining Fig. 1. In area 3, the EU administration as before levies duties that are subsequently jumped. For higher levels of fixed costs in area 4, although FDI would now provide greater benefits to the EU, the duty that eliminates only injury is not high enough to induce FDI and the equilibrium outcome remains (duty, export).

The outcome of the model does change if the EU administration only takes producer interests into account and adds the wage bill associated with FDI:

$$G = \pi + c^*q_{\text{FDI}}^*. \quad (12)$$

In this case, the undertaking equilibrium that prevailed in area 3 of Fig. 1 may no longer hold, as FDI is perceived relatively more beneficial. This equilibrium will only be maintained if $\pi_{\text{FDI}} + c^*q_{\text{FDI}}^* < \pi_{\text{und}}$. In our stylised case, numerical analysis shows that for a large range of parameter values FDI no longer yields large enough benefits to the administration compared to undertakings.¹⁷ Hence, if the administration's objective is to maximise the producer surplus while factoring in potential spillovers from FDI in the form of general spillovers, employment generation, or increased taxes, we are less likely to observe undertakings and more likely to observe duties that are subsequently jumped through FDI.¹⁸

3.3. The foreign firm as first mover: Strategic investments

Another extension of the model concerns the order of moves. In the model in Section 2, we assumed that the foreign firm decides on exports versus FDI after the EU administration has decided on its antidumping policy. In this paragraph we analyse the changes in the outcomes of the game if we allow the foreign firm to use its FDI

¹⁷ It can be shown that the benefits of FDI exceed the benefits of undertakings for all but very large levels of the foreign firm's cost advantage (a sufficient condition is $c < 2c^*$).

¹⁸ This direction of change in the results would be even greater if FDI spillovers allow the EU firm to reduce its costs, as in Wang and Blomstrom (1992). On the other hand, spillovers to the EU firm reduce the relative attractiveness of FDI to the foreign firm as it is less able to maintain its cost advantage (area 3 in Fig. 1 becomes smaller), reducing the likelihood of FDI.

choice strategically, being able to commit first to its choice of foreign market entry mode, taking into account the antidumping rules followed by the EU administration.¹⁹ We assume that the foreign firm has complete information concerning the objectives of the EU administration. Table 1 shows that there are two cases where the profit maximising foreign firm prefers to change its strategy depending on the antidumping measures taken. In column 3 with intermediate levels of fixed costs ($F_{FT}^* < F < F_{duty}^*$) the foreign firm chooses FDI under duties, but exports under free trade and undertakings. In column 2, with lower levels of fixed costs, the foreign firm chooses FDI under free trade and a duty, but exports under an undertaking. In other cases there is no impact of EU antidumping policy: in column (1) with low fixed costs ($F < F_{und}^*$), FDI is a dominant strategy for the foreign firm, and in column (4) with high fixed costs ($F > F_{duty}^*$), an export strategy is dominant.²⁰

We discuss the two cases in which the foreign firm moving first can alter the equilibrium outcome of the game compared to the case of a first moving EU administration discussed in Section 2. First, in the case of intermediate fixed FDI costs ($F_{FT}^* < F < F_{duty}^*$), the model predicts FDI in *anticipation* of the imposition of antidumping duties. If the foreign firm moves first, it prefers to engage in FDI and pre-empt antidumping actions. This FDI occurs to avoid antidumping procedures, which the firm correctly anticipates to lead to duties that would have to be jumped.²¹ In the absence of dumped exports, antidumping law becomes inconsequential and we observe ‘antidumping jumping’ FDI in the absence of any actual duties being imposed. This outcome only occurs if the EU administration is known to adopt an objective function based on social welfare (area 3 in Fig. 1).

The foreign firm’s preference for price undertakings leads to the second case of changed outcomes under strategic behaviour by the foreign firm. In column 2 of Table 1 with lower levels of fixed FDI costs ($F_{und}^* < F < F_{FT}^*$), a price undertaking is more profitable for the foreign firm than FDI. Under free trade conditions the foreign firm would engage in FDI. However, if the foreign firm expects that exporting induces antidumping actions resulting in a price-undertaking, it pays off to refrain from FDI and continue exporting. The undertaking equilibrium arrived at by refraining from FDI can only arise if undertakings are in the interest of the EU administration. A necessary condition is therefore that the EU has a producer surplus objective. Under a social welfare objective function, the EU would prefer not to take any measures as $W_{FDI} > W_{und}$ (see Proofs C.2 and C.3 in Appendix C).

¹⁹ Since the number of firms is given in the model, the entry-detering motive for FDI (e.g. Smith, 1987) is not considered. Another instrument that foreign firms anticipating antidumping measures may consider, but which is ignored here, is strategic pricing. For analysis of strategic pricing effects of antidumping law, see Reitzes (1993), Webb (1992), Prusa (1994), and Fischer (1992).

²⁰ Equilibrium outcomes of the game with location specific cost advantage are also unaffected as exporting is the dominant strategy of the foreign firm.

²¹ FDI in anticipation of antidumping actions avoids the costs of legal representation in antidumping cases and any possible negative reputation effect in the EU market stemming from ‘dumping’ charges. Blonigen and Feenstra (1997) and Azrak and Wynne (1995) estimate a significant impact of anticipated (but not necessarily materializing) antidumping measures on Japanese FDI in the US. Salvatore (1989), Leipziger and Shin (1991), Prusa (1992b), Herander and Schwartz (1984) estimate empirically the propensity to initiate antidumping actions.

We conclude that strategic behaviour by the foreign firm can alter the observed antidumping measures chosen by the EU administration. This strategic behaviour does not necessarily involve strategic FDI. It may also involve a commitment *not* to engage in FDI for a range of fixed costs ($F_{\text{und}}^* < F < F_{\text{FT}}^*$) and given a local producer surplus objective adopted by the EU administration. In the latter case, the presence of antidumping law and specifically the possibility of price undertakings *discourages* FDI. This result is akin to the results of Motta (1992) and Smith (1987) that there need not be an unequivocal positive relationship between trade restraints and FDI once the possibility of strategic behaviour is taken into account.

3.4. Equilibria with highly differentiated products and Cournot rivalry

The analysis in this paper has assumed that the EU and the foreign firm produce close substitutes and compete on price in a Bertrand fashion. Although this is the most natural setting to examine antidumping actions where the issue is the existence and removal of price undercutting by foreign importers selling ‘like’ products, we examine the sensitivity of the results to higher levels of product differentiation as well as quantity competition.

If we allow the products of the EU and foreign firm to be more differentiated, a limited change in equilibrium outcomes is possible due to a reversal in profit rankings of the foreign firm: price undertakings imposed on the foreign firm can reduce the foreign firm’s profits compared to the free trade case. This profit ranking reversal does not occur if products are closer substitutes (values of k higher than 0.7), but can occur under the combined circumstances of a higher degree of product differentiation and a large cost disadvantage of the EU firm. The critical levels of k and cost asymmetry are provided in Appendix D. The intuition behind a reversal in profit rankings, given a situation of highly differentiated products, is that a more segmented nature of the market leads to production and price equilibria closer to the monopoly level. Hence, further price increases can reduce the foreign firm’s profits, the more so if the price increase required to equalise the foreign and EU firms’ prices is large due to a strong cost disadvantage of the EU firm.²²

The implications for the equilibrium outcomes of the model under these circumstances are relatively limited and mainly suggest a more frequent occurrence of antidumping jumping FDI. The profit ranking reversal implies that in Fig. 1, the critical fixed cost line for undertakings shifts upwards to a level between the free trade and duty levels: $F_{\text{FT}}^* < F_{\text{und}}^* < F_{\text{duty}}^*$. The first implication is that undertakings induce FDI and that antidumping jumping FDI will be the equilibrium outcome with a social welfare objective and within the range of fixed costs $F_{\text{FT}}^* < F < F_{\text{und}}^*$. In case of a producer surplus objective, on the other hand, the EU administration would not take antidumping

²² Further sensitivity analysis shows that there is one other theoretically possible but in practice unlikely change in equilibrium outcomes. Duties can reduce domestic welfare under a specific parameter configuration, such that duties are not an equilibrium outcome under a social welfare objective. But for this equilibrium to occur, the level of product differentiation has to be close to the situation of separate markets ($k < 0.2$) for non-extreme cost differences between the EU and the foreign firm.

measures in this range. The second implication is that anticipated antidumping (undertaking) actions when the foreign firm move first (Section 3.3) no longer discourage FDI.

The results of our analysis are robust in case of quantity (Cournot) competition. Given the assumption of differentiated products, the distinction between Bertrand and Cournot competition is less important, as shown by [Singh and Vives \(1984\)](#). Equivalent equilibria can be derived under quantity competition by identical normalisation on the demand parameter. A similar reversal of the foreign firm's profit ranking is also possible under quantity competition but the conditions under which this occurs are even stricter than under price competition (see Appendix D).

4. Conclusions and implications

In this paper we have analysed the incentives for foreign firms to engage in FDI under European antidumping practice. For this purpose we used a three-stage model. In the first stage, the EU administration decides whether to take antidumping measures, and if so, whether to levy a duty or allow a price undertaking. In the second stage the foreign firm decides whether to serve the EU market through export or FDI. In the third stage, the foreign firm is engaged in price competition with a local firm on the EU market, which offers close substitute products. Injury arises from a production cost advantage of the foreign firm, which may either be location specific (e.g. based on lower foreign wages) or firm specific (e.g. based on a transferable technological advantage). In the latter case, the foreign firm maintains its production cost advantage in case it produces abroad. We examined the effect of antidumping when the EU administration adopts two alternative objective functions: maximising EU producer surplus or maximising EU social welfare (taking into account consumer and user interests). Our findings suggest that in case cost advantages are location specific, duty levels set on the basis of injury margins (the rule followed in the majority of EU antidumping cases) are not high enough to create incentives for FDI. Only if the foreign firm is able to transfer at least part of its cost advantage abroad, 'antidumping jumping' FDI can be observed. Necessary conditions are that fixed set-up costs of FDI are not too high and that the "Community Interest Clause" applies, i.e. the EU administration maximises EU social welfare.

In case the EU administration acts in the interest of EU producers only and maximises local producer surplus, it is far more likely to negotiate price-undertakings with the foreign firm rather than imposing duties. Because a price undertaking is a price fixing agreement with effects similar to a VER, it makes exporting more attractive for the foreign firm. Since FDI toughens the price competition for the EU firm as the foreign firm can transfer its cost advantage, the EU administration may opt for a price undertaking that persuades the foreign firm not to engage in FDI. This result is comparable with earlier work on the different impacts of tariffs vs. VERs. The undertaking equilibrium is less likely to occur if the EU also takes into account the positive effect of inward FDI on employment and EU wages, or other benefits from EU production by the foreign firm.

If the set-up of the model is altered to allow the foreign firm to commit to its FDI vs. export choice before the EU administration decides on antidumping measures, two additional outcomes can arise. First, ‘antidumping jumping’ FDI can occur in *anticipation* of antidumping measures. The substitution of FDI for exports pre-empts antidumping actions as measures cannot be imposed in the absence of exports. Hence we observe ‘antidumping jumping’ FDI in the absence of antidumping measures. Second, there is a case in which the foreign firm would wish to commit *not* to engage in FDI but to an exporting strategy instead. This situation occurs if the foreign firm prefers FDI under free trade conditions, but realises the largest profits if it can raise its export price under a price undertaking. In that case, the foreign firm refrains from FDI if an EU decision to settle antidumping actions through price undertakings can be anticipated. Such an undertaking decision can indeed be anticipated if the EU administration is known to maximise EU producer surplus. The presence of antidumping law under these circumstances *discourages* FDI that would have taken place under free trade conditions. This effect is conditional on the presence of ‘like products’, i.e. the presence of sufficiently close substitutability between the EU and foreign firm’s products as required by antidumping law. For higher degrees of product differentiation and large cost asymmetry between the EU and foreign firm, the negative output reducing effect of undertakings can dominate over the positive price increasing effect, and foreign firm profits can decline. In such cases, FDI can be triggered by the motive to jump (anticipated) undertakings, depending on the level fixed of FDI set-up costs.

Our findings can be linked to the frequent occurrence of FDI in EU antidumping cases targeting Japanese firms. Indeed, our model seems to suggest that the EU administration in a number of cases had broader objectives than simply protecting the profitability of EU firms. This may involve consumer interests, but political imperatives may also imply explicit consideration of positive effects of FDI on the scale and productivity of EU manufacturing activities in the industries affected, along with the impact on suppliers and downstream industries.

The findings also shed new light on the empirical evidence with respect to ‘antidumping-jumping’ FDI. *Blonigen’s* (2000) finding that duty jumping FDI in the US is primarily observed for firms based in developed economies, but much less so for firms based in developing countries, can be related to differences in transferability of cost advantages. Exporters from developing countries lose their wage cost advantages if they jump antidumping duties. Duty jumping is a more profitable option for firms based in developed economies competing on technological advantages that are transferable to foreign plants. In the context of EU antidumping, all empirical work on FDI has focused on Japanese firms. These firms in most cases possessed transferable competitive advantages and at the same time have been unsuccessful in negotiating undertakings with the EU administration (Belderbos, 1997b; Tharakan, 1991). Our findings suggest that extending the empirical analysis to exports from non-market economies and low-wage countries where cost advantages are more location specific is likely to show a much smaller FDI response to antidumping actions. Likewise FDI responses are predicted to be much more muted in case antidumping actions take the form of price undertakings.

Our results concerning the difference between undertakings and duties also connect to an observed smaller incidence of FDI in US antidumping duty cases (Belderbos, 1997a). The more limited occurrence of ‘antidumping jumping’ in the US can be explained from foreign firms’ ability to obtain lower antidumping duties through a system of administrative reviews by the Department of Commerce. If the exporter can show that it has increased its export price such that dumping no longer occurs, duty payments are not required.²³ The administrative review system adopted by the US can be characterised as a system in which voluntary price undertakings by foreign firms allow them to avoid duty payments. The major difference with EU antidumping law and practice is that such ‘undertakings’ are automatic, while the EU administration has a high degree of discretion whether to grant undertakings or not. Since in the US case foreign firms can choose freely whether to raise prices ex post, the initiative lies with the foreign firms, and US antidumping is more akin to a situation in which the foreign firm ‘moves first’. This implies that in US antidumping practice the ‘strategic export’ scenario, in which the foreign firm induces antidumping actions in order to benefit from price undertakings, is a conceivable course of events. This kind of ‘protection building’ trade is rather different from the case described in Blonigen and Ohno (1998). In the latter analysis, foreign firms planning to invest in the US increase their export in order to induce imposition of antidumping duties that hurt competing exporters. Our results suggest that it is also conceivable that foreign firms maintain high export levels and do not implement FDI plans that would be profitable in the free trade case. They do so in order to ‘build protection’ inducing price fixing arrangements. The antidumping order allows the firms to increase prices without the threat of legal actions under competition law, as shown by Prusa (1992a). This strategic interaction between US antidumping law and FDI decisions could be an additional explanatory factor for the observed limited investment response in case of US antidumping actions.

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²³ The US system is therefore often characterised as a ‘duty avoidance’ system while the EU antidumping practice is characterised as a ‘duty payment’ system (Belderbos, 1997a; Van Bael and Bellis, 1990).

Appendix A

Equilibrium prices and quantities for all outcomes are given in Table 2.

Appendix B. Critical fixed costs

The critical fixed costs that induce a switch for the foreign firm from exports to FDI are derived by comparing the foreign firm’s profits under exports and profits under FDI with the fixed costs incurred in case of FDI (the expressions between parentheses refer to expressions in the basic model in Section 2).

$$F_{\text{duty}}^* = (7) + F - (5) = \frac{\psi(2 - k^2)(4 + 2\psi + 2(1 + c)k - \psi k^2)}{(4 - k^2)^2},$$

$$F_{\text{FT}}^* = (7) + F - (4) = \frac{(2 - k^2)(2\delta - 2s + k^2s)}{(4 - k^2)^2},$$

$$F_{\text{und}}^* = (7) + F - (6) = \frac{\delta^2}{(4 - k^2)^2} - \frac{\xi[1 + c - (c^* + s)(2 - k)]}{(-2 + k)^2},$$

where $\psi = c - c^*$ and $\delta = ck + 2 + k - c^*(2 - k^2)$ and $\xi = 1 - c - ck$.

Appendix C. Welfare ranking proofs

Proof. $W_{\text{duty}} > W_{\text{FT}}$.

We start from the hypothetical case of no export cost advantage for the foreign firm ($c^* + s = c$). In that case, the duty t is zero and social welfare under free trade and antidumping duties are equal ($W_{\text{duty}} = W_{\text{FT}}$). If we introduce a cost advantage of the foreign firm, by reducing c^* or s and keeping c constant, social welfare under a duty rises more strongly than welfare under free trade. Using the expressions in Appendix A and differentiating with respect to $c^* + s$ gives

$$\left. \frac{\partial(W_{\text{duty}} - W_{\text{FT}})}{\partial(c^* + s)} \right|_{c^*+s=c} = \frac{1 + ck - c}{k - 2} - \frac{1 + ck - c^* - s}{(k - 2)(k + 2)} < 0. \tag{C.1}$$

A decrease in $c^* + s$ evaluated at the cost equality point ($c^* + s = c$) increases the difference $W_{\text{duty}} - W_{\text{FT}}$, and $W_{\text{duty}} > W_{\text{FT}}$ holds.

Proof. $W_{\text{FDI}} > W_{\text{FT}}$.

Given a firm-specific cost advantage, the difference in social welfare under FDI and free trade is solely determined by the level of transport cost (see Appendix A). Hence, in the absence of transport cost ($s = 0$) social welfare under FDI and free trade are equal. Introducing a positive transport cost does not affect social welfare under FDI,

Table 2

	p	p^*	q	q^*	
Exports Free trade	$\frac{2(1+c)+k(1+c^*+s)}{4-k^2}$	$\frac{2(1+c^*+s)+k(1+c)}{4-k^2}$	$\frac{c(-2+k^2)+k(1+c^*+s)+2}{4-k^2}$	$\frac{(c^*+s)(-2+k^2)+k(1+c)+2}{4-k^2}$	(1)
Duty	$\frac{2(1+c)+k(1+c^*+s+t)}{4-k^2}$	$\frac{2(1+c^*+s+t)+k(1+c)}{4-k^2}$			(2)
For $p = p^* \Leftrightarrow t = c - c^* - s$	$\frac{1+c}{2-k}$	$\frac{1+c}{2-k}$	$\frac{1-c+ck}{2-k}$	$\frac{1-c+ck}{2-k}$	
Undertaking	$\frac{1+c}{2-k}$	$\frac{1+c}{2-k}$	$\frac{1-c+ck}{2-k}$	$\frac{1-c+ck}{2-k}$	(3)
FDI Firm specific	$\frac{2(1+c)+k(1+c^*)}{4-k^2}$	$\frac{2(1+c^*)+k(1+c)}{4-k^2}$	$\frac{c(-2+k^2)+k(1+c^*)+2}{4-k^2}$	$\frac{c^*(-2+k^2)+k(1+c)+2}{4-k^2}$	(4)
Cost advantage					
Location specific	$\frac{1+c}{2-k}$	$\frac{1+c}{2-k}$	$\frac{1-c+ck}{2-k}$	$\frac{1-c+ck}{2-k}$	(4)'
Cost advantage					
<i>Domestic social welfare components</i>					
Profits	Consumer surplus		Tariff revenue		Wage bill due to FDI
$\pi = (p - c)q$	$CS = [q^2 + q^{*2} + 2kqq^*] \frac{1}{2(1 - k^2)}$		TR = tq^* and $t = c - c^* - s$		WB = c^*q^*

but has a negative impact on social welfare under free trade. Using the expressions for consumer surplus and domestic firm profits in Appendix A and differentiating with respect to s gives

$$\left. \frac{\partial(W_{\text{FDI}} - W_{\text{FT}})}{\partial s} \right|_{s=0} = \frac{1 + ck - c^*}{(k - 2)(k + 2)} > 0. \quad (\text{C.2})$$

Expression C.1 is positive, hence evaluated at $s = 0$ $W_{\text{FDI}} > W_{\text{FT}}$ holds.

Proof. $W_{\text{FT}} > W_{\text{und}}$.

In the hypothetical case of the absence of an export cost advantage for the foreign firm ($c^* + s = c$), prices and social welfare are equal under free trade and an undertaking ($W_{\text{FT}} = W_{\text{und}}$). Introducing a cost advantage of the foreign firm, by reducing c^* or s and keeping c constant, has no effect on social welfare with an undertaking, as prices are determined by the domestic firm's cost level. On the other hand, a reduction in $c^* + s$ has a positive impact on social welfare under free trade through a beneficial effect on consumer surplus. Using the expressions in Appendix A and differentiating with respect to $c^* + s$ gives

$$\left. \frac{\partial(W_{\text{FT}} - W_{\text{und}})}{\partial(c^* + s)} \right|_{c^* + s = c} = \frac{1 + ck - c^* - s}{(k - 2)(k + 2)} < 0. \quad (\text{C.3})$$

A decrease in $c^* + s$ evaluated at the cost equality point ($c^* + s = c$) increases the difference $W_{\text{FT}} - W_{\text{und}}$, and $W_{\text{FT}} > W_{\text{und}}$ holds.

Appendix D

If we relax the assumption of 'like products', which we define as close substitutability between the EU and foreign firm's products, a reversal in profit rankings of the foreign firm may occur: the foreign firm may no longer benefit from undertakings in comparison with the free trade situation. Whether this profit ranking reversal occurs depends on the level of product differentiation (k) and on the degree of cost asymmetry ($c^* + s$)/ c between the EU and foreign firm. The exact conditions under which the ranking reverses are illustrated in Fig. 2. When cost asymmetries are small, the profit ranking reversal only occurs for highly differentiated products (low levels of k). Also, for closer substitutes ($k > 0.7$) undertaking profits exceed free trade profits for all levels of cost asymmetry.

We can derive equivalent equilibria under Cournot quantity competition through identical normalisation of the demand parameters as under price competition. The corresponding indirect demand functions under quantity competition starting from a representative consumer's utility function as in Singh and Vives (1984) are $p_i = 1/(1 - k) - q_i/(1 - k^2) - kq_j/(1 - k^2)$. In case of quantity competition a similar profit ranking reversal is observed, but its occurrence is less frequent: for similar levels of k , a

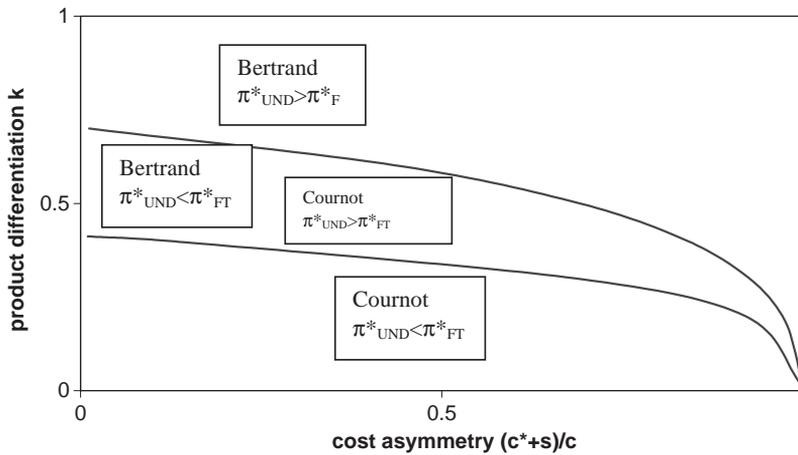


Fig. 2. Combinations of k and cost asymmetry for which the foreign firm benefits from price undertakings: Bertrand and Cournot competition.

Note: The parameter values used to draw the Fig. 2 are: $c = 0.5$, $s = 0.1$ and $k = 0.7$.

reversal occurs at higher levels of cost asymmetry compared with price competition, as illustrated in Fig. 2.²⁴

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²⁴ Note that given the normalisations imposed, the direct corresponding Cournot equilibrium cannot be calculated for closer substitutes ($k > 0.5$). Values of k closer to 1 lead to increasing values of the coefficients in the indirect demand function $1/(1-k^2)$, which in turn leads to a violation of the positive quantity condition.

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