Trade Policy in the Face of Price and Non-Price Strategies[1] †

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Abstract

When selling their products domestically or internationally firms rely on more than just price as a strategic variable. Any trade policy that affects or limits the use of one of these variables will likely have strategic consequences for the use of all the others. Using a Hotelling model with vertical differentiation we focus on *how* trade policy barriers alter price and non-price competition on the goods market. The main results are as follows: first, no matter whether the trade restriction (tariff) is placed on the non-price instrument or on the good itself, the foreign (home) firm prefers to increase (decrease) its use of its pricing tool and give up some of (increase) its use of the non-price instrument. Second, in the presence of a non-price instrument, tariffs do not always lead both firms to increase their price: it can lead the foreign firm to decrease its (final) price.

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1 Introduction

Worldwide, consumers base their purchasing decisions both on price and non-price characteristics such as advertising, R&D, quality, just to name a few. Accordingly, when selling their products domestically or internationally, firms rely on more than just price as a strategic variable and compete for market share using an ample set of non-price instruments.

In this richer strategic setting, many interesting questions naturally arise; How does the introduction of a tariff on the goods market affect the strategic behavior of domestic and foreign firms? Will both firms switch to using a non-price instrument (NPI) more aggressively? Equally, does a trade restriction on the use of a NPI mean that the foreign firm will be more or less aggressive on pricing? We expect that *any trade policy that affects or limits the use of one of these strategic variables will likely have consequences for the use of all the others.*

Our main objective is to study *how* trade restrictions on different markets (the goods market and the markets for non-price instruments) influence the optimal strategy mix of the protected and the foreign firm. Firms invest in the NPI because it changes the product's image, brand, technological specifications, design, or anything else that will change its perceived 'quality' in the eye of the consumer. We model this by introducing vertical differentiation in the Hotelling model (Economides (1989)) in which a domestic and a foreign firm compete not only through their pricing strategy but also through their NPI.

We first introduce a tariff on the goods market, a domestic intervention that affects the pricing tool, and show that this, interestingly, reduces the foreign firm's use of the NPI and has it price more aggressively than the home firm. The intuition behind this result is that a tariff leads to a lower margin for the foreign firm which subsequently reduces the marginal benefit of using the NPI and, other things equal, induces it to use her pricing tool more intensively. Moreover, for some parameter values, this effect is strong in the sense that the foreign firm's final price (including the tariff) is lower than its price before the introduction of the tariff. That is, tariffs can reduce the final price of the foreign good. As far as we now, this result is new in the trade literature where tariffs are known to increase prices and illustrates the main message of the paper: *when firms compete through more than one instrument one has to take into account how a restriction on one instrument influences the* *optimal strategic use of all of them.*

We subsequently introduce trade policy regarding non-price instruments. Domestic governments can increase the cost the foreign firm incurs when using its NPI. This can happen through the imposition of a tariff on imports of this 'sales input'. Equally, domestic governments can decrease the cost the home firm incurs when using its NPI. This can happen through subsidizing the domestic firm when it uses its NPI. The latter possibility is exemplified by R&D subsidies while the former by restrictions on the use of foreign advertising. In order to illustrate the results we will use the 'advertising' interpretation keeping in mind, however, that advertising is just a proxy for all possible NPIs.

A trade restriction on the NPI puts the foreign firm at a cost disadvantage with respect to the use of the NPI. We show that the effect on the pricing game is that it, not so surprisingly, leads the foreign firm to price more aggressively and invest less in the NPI. This result provides an alternative explanation for price-based dumping. The latter is most commonly attributed to differences in transportation costs (Brander and Krugman, 1983), but here dumping arises from differential costs of using one of many strategic variables. More importantly, though, note that *no matter whether the disadvantage is in pricing or in the NPI, the foreign firm will be tempted to use its pricing tool more intensively and its NPI less intensively.*

Our paper draws from both the industrial organization literature on horizontal and vertical product differentiation and the trade policy literature in the presence of an oligopoly. We draw from Matsumura and Matsushima (2009) when introducing tariffs which transforms the classic Hotelling model in one with asymmetric marginal costs. In the trade literature, the closest to our paper and, as far as we know, the only paper discussing the effect of trade and industrial policy on advertising and pricing is Ma and Ulph (2009). They study advertising in the context of differentiated duopoly and strategic, export oriented, industrial and trade policy. Ma and Ulph (2009) aim to study the robustness of industrial policy versus export subsidies/taxes in the tradition of Bagwell and Staiger (1994), Maggi (1996) and Leahy and Neary (2001). Our paper differs from theirs in at least two dimensions. First, they focus on the robustness of strategic trade policy à la Brander-Spencer (1985) on the goods market from the point of view of the exporting country, while we focus on tariff policies from the point of view of importing country. Second, our main objective is to study *how* trade restrictions on different markets (goods and/or services) influence the strategy mix of both the protected and the foreign firm. Although the issue of robustness is a very important one, it is beyond the scope of this paper.

The rest of paper is organized as follows. In section 2 we develop the baseline model after which we introduce a tariff on the goods market. Section 3 then adds trade restrictions on foreign advertising. Section 4 concludes.

2 The Model

2.1 Modelling Price and Non-Price Competition

We consider an international duopoly with a home and foreign firm (denoted by an asterisk) where, prior to engaging in price competition, firms have the opportunity to invest in a NPI to attract consumers. The game lasts for two stages. In the first stage, the two firms simultaneously choose their investment in the NPI and in the second stage they compete in prices. For simplicity[2], marginal production costs are assumed to be constant and equal to zero for both firms and there are no fixed costs.

The level of the NPI is denoted by I and I^*. Let $C(I)$ and $C^*(I)$ be the associated costs of investing in the NPI, assumed to be monotonically increasing and convex. More specifically, we assume a quadratic functional form[3] given by:

$$\begin{aligned} C(I) &= \frac{a}{2}I^2; \\ C^*(I^*) &= \frac{a}{2}I^{*2}. \end{aligned} \quad (1)$$

where parameter $a > 0$ is a measure of how costly it is to use the NPI. When a decreases, competition in the NPI increases because it becomes cheaper to invest in the NPI.

There is a continuum of consumers uniformly distributed on a line of unit length, with population size normalized to one. The two firms are located at the extreme ends of this line, say the home firm at point zero, and the foreign firm at point one. Each consumer is characterized by a location $x \in [0, 1]$, measuring its relative taste for the two products. There is a disutility, interpreted as a transportation cost, of x when purchasing the domestic product and of $1 - x$ when purchasing from the foreign firm. Consumers hence face a discrete choice of either buying the home or

[2] This assumption does not change the results.

[3] This is a common assumption in the literature, see for example Economides (1989).

the imported product. The reservation price of the consumers is α, assumed to be large enough so that the market is always covered. The utility of the consumer located at x buying the home or the foreign good is, respectively, given by:

$$\begin{aligned} U_x &= \alpha + I - x - p; \\ U_x^* &= \alpha + I^* - (1 - x) - p^*. \end{aligned}$$

If neither firm uses the NPI ($I = I^* = 0$), consumers will purchase from the firm with the best price-location combination, where p and p^* represent the domestic and foreign price of the product respectively.

Let us now define the consumer located at $\bar{x}$ who is indifferent between buying the domestic or the imported product. By definition, the utility procured by this consumer is the same for either good, that is:

$$\begin{aligned} U_{\bar{x}} &= U_{\bar{x}}^*; \\ \alpha + I - \bar{x} - p &= \alpha + I^* - (1 - \bar{x}) - p^*. \end{aligned}$$

By solving for $\bar{x}$, we can derive the demand functions, by posing $q = \bar{x}$ and $q^* = 1 - \bar{x}$, therefore:

$$q = \frac{1 + p^* - p + I - I^*}{2}; \qquad q^* = \frac{1 + p - p^* + I^* - I}{2}.$$

Since we assumed that the market is fully covered the total demand (output) is equal to one and hence quantities can be interpreted as market shares. Note that if the firms choose the same amount of NPI, then consumers will choose strictly on the basis of price and location. It is only when a firm uses its NPI more than its rival that it succeeds to increase its demand, ceteris paribus. It is more convenient to express quantities in terms net levels of the NPI: $\phi = I - I^*$ and $\phi^* = I^* - I$:

$$q = \frac{1 + p^* - p + \phi_i}{2}; \qquad q^* = \frac{1 + p - p^* + \phi_i^*}{2}. \tag{2}$$

2.2 Introducing a Tariff

In the second stage[4], when the home government imposes a tariff, the foreign firm has to pay a unit duty $t > 0$ on each unit it sells. Consequently, the optimization problem of the home and foreign firm is given, respectively, by

$$\max_p \ \pi = p \frac{1 + p^* - p + \phi}{2}$$

[4] We will solve the model by backward induction.

and

$$\max_{p^*} \ \pi^* = (p^* - t)\frac{1 + p - p^* + \phi^*}{2}.$$

From the first-order conditions (FOCs), given by

$$\begin{aligned} 1 + p^* - 2p + \phi &= 0; \\ 1 + p - 2p^* + \phi^* + t &= 0, \end{aligned}$$

we obtain the second-stage price equilibrium under a tariff regime $t > 0$. Equilibrium prices and quantities are:

$$\begin{aligned} p &= 1 + \frac{\phi + t}{3}; \\ p^* &= 1 + \frac{\phi^* + 2t}{3}; \end{aligned} \tag{3}$$

$$\begin{aligned} q &= \frac{1}{2} + \frac{\phi + t}{6}; \\ q^* &= \frac{1}{2} + \frac{\phi^* - t}{6}. \end{aligned} \tag{4}$$

By plugging the home and foreign equilibrium prices and quantities into the profit functions, respectively, the optimal second stage payoffs, π and π^*, become equal to:

$$\begin{aligned} \pi &= \frac{(3 + \phi + t)^2}{18}; \\ \pi^* &= \frac{(3 + \phi^* - t)^2}{18}. \end{aligned} \tag{5}$$

The results obtained here are fairly standard. *Given* the NPI levels, a tariff leads to an increase of the domestic price p and an even greater increase of the import price p^*. Hence a tariff $t > 0$ will decrease sales for the foreign firm, q^*, and therefore increase domestic output, q. But the firms will have the opportunity, in stage 1, to adjust their NPI levels. This allows us to study whether the NPI provides new insights to these standard results.

Focusing on the first-stage of the game the firms will maximize their payoffs with respect to NPI levels. The maximization problems for the home and foreign firm are given by

$$\begin{aligned} \max_{I} \ \Pi &= \pi - C(I); \\ \max_{I^*} \ \Pi^* &= \pi^* - C^*(I^*). \end{aligned} \tag{6}$$

If the second stage equilibrium is interiorn then the FOCs in the first stage game are:

$$\begin{aligned}\frac{\partial \Pi}{\partial I} &= \frac{3+(1-9a)I-I^*+t}{9}=0;\\ \frac{\partial \Pi^*}{\partial I^*} &= \frac{3+(1-9a)I^*-I-t}{9}=0.\end{aligned}\tag{7}$$

Note, in the case of an interior equilibrium in the second stage, the second order conditions of both firms are satisfied when $a>\frac{1}{9}$. Moreover, for any a such that $\frac{1}{9}<a\leqslant\frac{2}{9}$ the equilibrium is locally unstable[5]. We focus our attention on locally (and globally) stable equilibria; $a>\frac{2}{9}$. In this case the subgame perfect equilibrium NPI levels with a tariff (t) in the goods market are given by:

$$I=\begin{cases}\frac{1}{3a}+\frac{t}{9a-2} & \text{if } 0\leqslant t<\bar{t};\\ \frac{2}{3a} & \text{if } t\geqslant\bar{t},\end{cases}$$

$$I^*=\begin{cases}\frac{1}{3a}-\frac{t}{9a-2} & \text{if } 0\leqslant t<\bar{t};\\ 0 & \text{if } t\geqslant\bar{t}.\end{cases}\tag{8}$$

where $\bar{t}=\frac{9a-2}{3a}$ is the prohibitive tariff above which the foreign firm does not trade in the goods market. In terms of net NPI:

$$\phi=-\phi^*=\begin{cases}\frac{2t}{9a-2} & \text{if } 0\leqslant t<\bar{t};\\ \frac{2}{3a} & \text{if } t\geqslant\bar{t}.\end{cases}\tag{9}$$

Finally, plugging ϕ and ϕ^* into the second stage equilibrium prices (3) and quantities (4), we obtain:

$$p=\begin{cases}1+\frac{3at}{9a-2} & \text{if } 0\leqslant t<\bar{t};\\ 2 & \text{if } t\geqslant\bar{t},\end{cases}$$

$$p^*=\begin{cases}1+\frac{2(3a-1)t}{9a-2} & \text{if } 0\leqslant t<\bar{t};\\ \frac{9a-2}{3a} & \text{if } t\geqslant\bar{t}.\end{cases}\tag{10}$$

[5] For a proof see Appendix A.

and:

$$q = \begin{cases} \frac{1}{2}\left(1+\frac{3at}{9a-2}\right) & \text{if } 0 \leqslant t < \bar{t}; \\ \\ 1 & \text{if } t \geqslant \bar{t}, \end{cases}$$

$$q^* = \begin{cases} \frac{1}{2}\left(1-\frac{3at}{9a-2}\right) & \text{if } 0 \leqslant t < \bar{t}; \\ \\ 0 & \text{if } t \geqslant \bar{t}. \end{cases} \tag{11}$$

We refer the reader to the appendix for proofs of all our results.

We thus obtain that a tariff[6] leads to a decrease of the advertising level of the foreign firm and an increase of that of the domestic. In order to understand this, let us ignore for the moment the possibility of using the NPI. Then a tariff will lead to a lower margin and a lower demand for the foreign firm. Given this, and now allowing the firms to use its NPI we see that the marginal benefit of one unit of NPI for the foreign firm is lower than that of the domestic firm:

$$\frac{d\Pi^*}{dI^*}\mid_{I^*=I=0} < \frac{d\Pi}{dI}\mid_{I^*=I=0} .$$

That is, other things equal, the domestic firm has a stronger incentive to use its NPI. Alternatively, the effect of t on NPI levels can be addressed by totally differentiating the first order conditions of the firms and solving to yield:

$$\begin{aligned} \frac{dI}{dt} &= -\frac{\partial^2\Pi}{\partial I\partial t} \Big/ \frac{\partial^2\Pi}{\partial I^2} > 0; \\ \frac{dI^*}{dt} &= -\frac{\partial^2\Pi^*}{\partial I^*\partial t} \Big/ \frac{\partial^2\Pi^*}{\partial I^{*2}} < 0. \end{aligned}$$

[6]Note that when $t = 0$ (free trade in the goods market) the equilibrium is given by:

$$I = I^* = \frac{1}{3a},$$

$$p = p^* = 1$$

$$q = q^* = \frac{1}{2}$$

The prices are equal to the Hotelling model without a NPI. In terms of equilibrium profits, the firms are worse off compared to the Hotelling model without a NPI: $\Pi = \Pi^* = \frac{1}{2} - \frac{1}{18a}$ which is lower than the equilibrium without vertical differentiation given by $\Pi = \Pi^* = \frac{1}{2}$. Firms would prefer to cooperate in order to reduce the amount of NPI they use, but in a one shot game they cannot trust one another and are 'forced' to use the NPI 'excessively' in equilibrium.

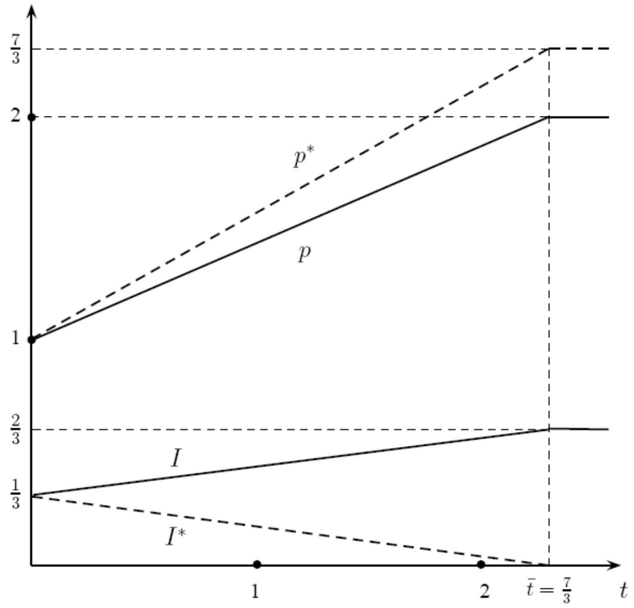

Figure 1: Pricing vs use of NPI when $a = 1$.

A tariff, imposed on the goods market, will result in a lower level of the NPI for the foreign firm and a higher level for the home firm, compared to free trade. This is because a tariff decreases (increases) the marginal benefit of using the NPI to the foreign (home) firm. We now turn our attention to the strategy mix between pricing and the NPI. Since using the NPI becomes less attractive in the foreign firm strategy mix, the firm prefers to use its pricing tool more intensively in order to keep its market share. Indeed, without a tariff, when the cost of using the NPI for both firms is relatively low (a low a), then they are using this tool rather intensively. When this is the case, a tariff will have a greater impact on price competition. In particular, note that for low levels of a, $\frac{2}{9} < a < \frac{1}{3}$, the initial price increase of a tariff will be completely washed away by the strategy mix switch from its non-price instrument to its price instrument[7]. Figures 1 and 2 illustrate this result.

[7] We can appreciate this by studying the limits of the foreign's equilibrium NPI level and price when $a \to \frac{2}{9}$:

$$\lim_{a \to \frac{2}{9}^+} \frac{dI_A^*}{dt} = -\frac{1}{9a-2} = -\infty,$$

$$\lim_{a \to \frac{2}{9}^+} \frac{dp^*}{dt} = 2\frac{3a-1}{9a-2} = -\infty.$$

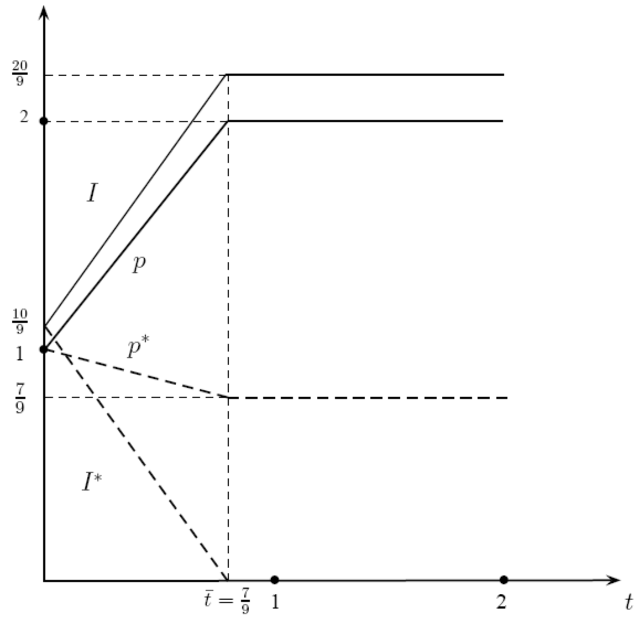

Figure 2: Pricing vs us of NPI when $a = \frac{3}{10}$.

These results provide an new insight in the trade literature with price competition, where specific tariffs are known to increase prices. This intuition behind it resides in the fact that in some markets firms compete intensively with other instruments than the price. In fact, the conventional result that tariffs increase (final) prices is reflected by the second-stage pricing equilibrium p and p^*. That is, for a given amount of NPI, the imposition of a tariff increases prices. Furthermore, the increase in price of the imported product is greater than that of the home product. The results change however, when firms are allowed to adjust their NPI in stage one. Once the NPI earns a lower benefit (because of the tariff) it becomes more advantageous for the foreign firm to use its pricing tool more intensively in order to regain a part of its market share, lost due to the tariff. In other words, it is cheaper for the foreign firm to lower its price than to use more its NPI to increase its profits. The more firms are competing through their NPI (low range of a), the more pronounced this effect.

We summarize[8] this key result in the following proposition:

Proposition 1. *For relatively high costs of using the NPI, $a \geqslant \frac{1}{3}$, the imposition of a specific tariff leads both firms to increase prices. However, for lower levels of a in*

[8] In the appendix we provide a detailed exposition of how the equlbrium is derived.

$\frac{2}{9} < a < \frac{1}{3}$, *the effect of the price increase for the foreign firm is completely washed away by the switch it makes in its strategy mix from its NPI to pricing. The foreign firm will find it optimal to become more aggressive on pricing.*

3 Pricing, advertising and trade policy

3.1 Advertising as an Non-Price Instrument

Domestic governments can increase the cost of the foreign firm to use its NPI by imposing a tariff on imports of this 'sales input' and/or subsidize the use of the NPI for the domestic firm. The latter possibility is exemplified by R&D subsidies while the former by restrictions on the use of foreign advertising. In order to highlight our results we will use the 'advertising' interpretation keeping in mind, however, that advertising restrictions is just a proxy for a trade restriction on all possible NPI's.

We first illustrate that foreign firms do face barriers to advertising in practice. First observe that there are good reasons why a foreign firm might wish to produce/purchase advertising in her own market, even if it is targeted to its export market. Firms usually have long-standing relationships with advertising companies in there own market which involve important set up costs. When this is the case, firms may prefer to continue to deal with 'their' publicity provider than to set up a new relationship with a 'domestic' advertiser. In addition, cultural and product information barriers may increase the cost of 'purchasing' advertising in the country to which they export. On the other hand, the domestic 'advertisers' will probably have better information about the local demand. If the latter effect dominates, the foreign firm will prefer to purchase advertising in its export market, but will face a higher cost than the local firm due a lack of information about local market conditions. In the event the other effects dominate, the foreign firm will prefer to use its 'own foreign' advertising company. Nonetheless, it is also possible to face higher costs due to the existence of barriers on the use of 'foreign' advertising, arising from restrictions on market access and national treatment (Daniels 1995). Indeed, many countries still greatly favor local advertisers over foreign advertising companies. The following two examples illustrate this (see USCIB, 2002).

In Brazil, an executive decree was signed in 2002 that would require the payment of US$ 28,000 importation fee for each foreign 30-second television commercial.

In Australia, imported commercials can not be used, except when a full Australian crew took part in production and no more than 20% of commercial footage may be of foreign places, persons, events, sounds, voices not available in Australia, but production must be an Australian company.

Either way, the costs of advertising will likely be higher for a foreign exporting firm than its local domestic rival for two reasons: cultural and informational barriers and/or trade restrictions on foreign advertising.

3.2 Solving the model with (trade) barriers to advertising

We now introduce these barriers on advertising in the model. To do so we assume that the foreign firm has to pay an additional constant cost ($\gamma > 0$) per unit of advertising. When the foreign firm uses local advertising then this cost difference stems mainly from information problems. When the foreign firm 'imports' advertising in its export market then we let this represent the trade barrier on advertising, which is thus a policy variable for the 'domestic' government.

The cost of using a given level of NPI (advertising), I^*, for the foreign firm is then given by

$$C^*(I^*) + \gamma I^*.$$

Hence γ can be interpreted as a tariff or non-tariff barriers on advertising[9].

The optimization program in the first stage for the case of advertising is given by equation (5). The FOCs are consequently

$$\begin{aligned} \frac{\partial \Pi}{\partial I} &= \frac{3 + (1 - 9a)I - I^* + t}{9} = 0; \\ \frac{\partial \Pi^*}{\partial I^*} &= \frac{3 + (1 - 9a)I^* - I + t}{9} - \gamma = 0. \end{aligned}$$

[9] If we were to model domestic subsidies to R&D at a rate of $\delta > 0$ per unit, the cost of using a given level of NPI (R&D outlay I) would then be

$$C(I) - \delta I.$$

We could then just replicate the analysis performed below, whithout qualitatively changing the obtained results.

For the same reasons as above we focus on the case where $a > \frac{2}{9}$. The Nash equilibrium advertising levels with a tariff (t) in the goods market and barriers in the advertising market (γ) are given by :

$$I = \begin{cases} \frac{1}{a}\left(\frac{1}{3} + \frac{at+\gamma}{9a-2}\right) & \text{if } 0 \leqslant t < t(\gamma); \\ \frac{3+t}{9a-1} & \text{if } t(\gamma) \leqslant t < \bar{t}; \\ \frac{2}{3a} & \text{if } t \geqslant \bar{t}, \end{cases} \tag{12}$$

$$I^* = \begin{cases} \frac{1}{a}\left[\frac{1}{3} - \frac{at+(9a-1)\gamma}{9a-2}\right] & \text{if } 0 \leqslant t < t(\gamma); \\ 0 & \text{if } t > t(\gamma). \end{cases} \tag{13}$$

where

$$t(\gamma) = \bar{t}\left(1 - \frac{\gamma}{\bar{\gamma}}\right), \quad \bar{t} = \frac{9a-2}{3a} \quad \text{and} \quad \bar{\gamma} = \frac{1}{3}\frac{9a-2}{9a-1}.$$

The amount $\bar{\gamma}$ is the prohibitive level of γ, given free trade in the goods market ($t = 0$), above which the foreign firm does not find it profitable to advertise. The amount $\bar{t}$ is the prohibitive tariff above which the foreign firm does not trade in the goods market. In terms of net advertising:

$$\phi = -\phi^* = \begin{cases} \frac{2t+9\gamma}{9a-2} & \text{if } 0 \leqslant t < t(\gamma); \\ \frac{3+t}{9a-1} & \text{if } t(\gamma) \leqslant t < \bar{t}; \\ \frac{2}{3a} & \text{if } t \geqslant \bar{t}. \end{cases} \tag{14}$$

Finally, plugging ϕ and ϕ^* into the second stage equilibrium prices (3) and quantities (4), we obtain:

$$p = \begin{cases} 1 + 3\frac{at+\gamma}{9a-2} & \text{if } 0 \leqslant t < t(\gamma); \\ 1 + \frac{1+3at}{9a-1} & \text{if } t(\gamma) \leqslant t < \bar{t}; \\ 2 & \text{if } t \geqslant \bar{t}, \end{cases}$$

$$p^* = \begin{cases} 1 + \frac{2(3a-1)t-3\gamma}{9a-2} & \text{if } 0 \leqslant t < t(\gamma); \\ 1 + \frac{(6a-1)t-1}{9a-1} & \text{if } t(\gamma) \leqslant t < \bar{t}; \\ \frac{9a-2}{3a} & \text{if } t \geqslant \bar{t}; \end{cases} \tag{15}$$

and:

$$q = \begin{cases} \frac{1}{2}\left(1 + 3\frac{at+\gamma}{9a-2}\right) & \text{if } 0 \leqslant t < t(\gamma); \\ \frac{1}{2}\left(1 + \frac{1+3at}{9a-1}\right) & \text{if } t(\gamma) \leqslant t < \bar{t}; \\ 1 & \text{if } t \geqslant \bar{t}, \end{cases}$$

$$q^* = \begin{cases} \frac{1}{2}\left(1 - 3\frac{at+\gamma}{9a-2}\right) & \text{if } 0 \leqslant t < t(\gamma); \\ \frac{1}{2}\left(1 - \frac{1+3at}{9a-1}\right) & \text{if } t(\gamma) \leqslant t < \bar{t}; \\ 0 & \text{if } t \geqslant \bar{t}. \end{cases} \tag{16}$$

3.3 Interpreting the equilibrium

3.3.1 Effect of barriers to advertising on the optimal strategy mix

How different does the presence of barriers in the advertising market ($\gamma > 0$) affect the pricing strategy of the foreign firm compared to the case where there are non ($\gamma = 0$)? Proposition 1 showed that for case where $\gamma = 0$ and low levels of advertising costs, $\frac{2}{9} < a < \frac{1}{3}$, a tariff has the effect of making the foreign firm switch from its advertising to pricing tool more aggressively. For the case of $0 < t < t(\gamma)$, inspection of the top equation of (15) reveals that for $\frac{2}{9} < a < \frac{1}{3}$ an increase in γ leads the foreign firm to use prices even more aggressively. The result is easy to understand, since the marginal cost of advertising is lower for the home firm than for the foreign firm when $\gamma > 0$. This will lead the home firm to advertise more and therefore drive the foreign firm to switch more toward its pricing strategy. Figures 3 and 4 illustrate this.

The above discussion leads to the following general proposition.

Proposition 2. *For any $\gamma \leqslant \bar{\gamma}$, the imposition of a specific tariff by the government leads to two results: either the government commits to a low level of tariff, $t < t(\gamma)$*

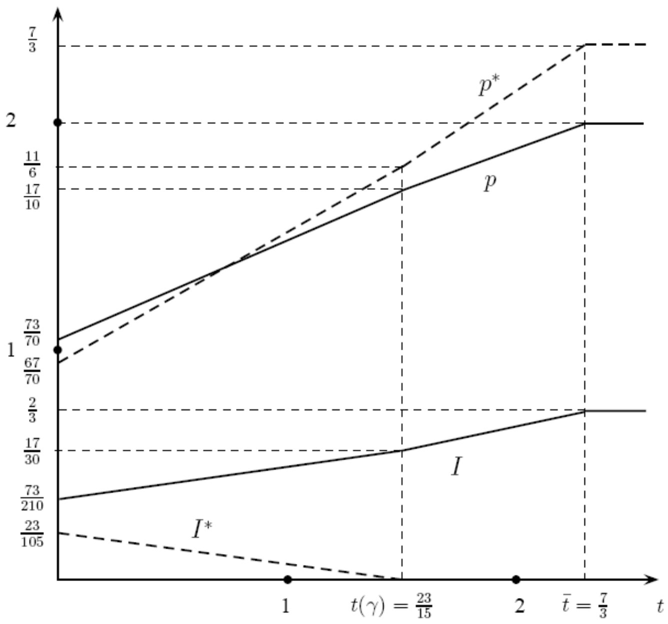

Figure 3: Pricing and Advertising when $a = 1$ and $\gamma = \frac{1}{10}$.

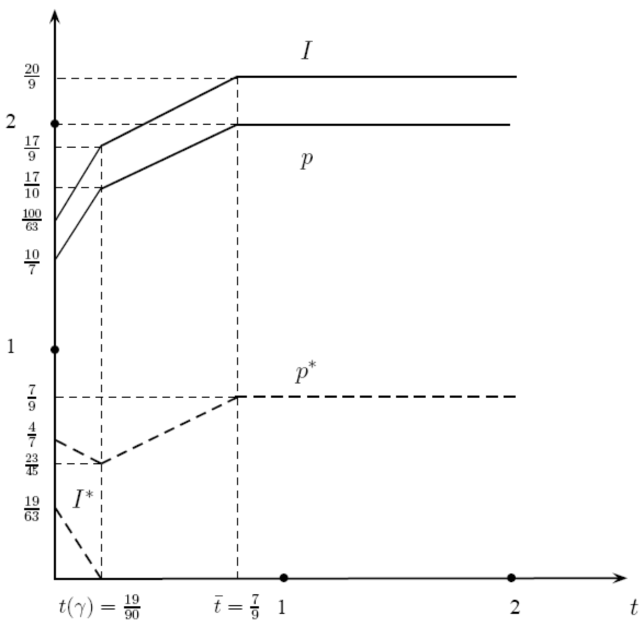

Figure 4: Pricing and Advertising when $a = \frac{3}{10}$ and $\gamma = \frac{1}{10}$.

in which case trade in advertising is not prohibited, or it imposes t*,* $t(\gamma) \leqslant t \leqslant \bar{t}$ *in which case it will prohibit the trade in advertising for the foreign firm.*

1. *For* $t < t(\gamma)$ *and low levels of* a*,* $\frac{2}{9} < a < \frac{1}{3}$*, the effect of the price increase for the foreign firm is washed away by the switch it makes in its strategy mix from advertising to pricing, becoming more aggressive on pricing.*

2. *For* $t(\gamma) \leqslant t$*, the effect of a tariff is to increase prices. This is because the foreign firm can no longer switch from one strategic tool to another and consequently increases its price.*

3.3.2 An important link between the market for goods and the market for advertising

The Nash equilibrium also allows us to shed some light on the link between the two markets. It can help us understand the amount of autonomy a government can have in using a tariff in the goods market when the services market is relatively protected (a high γ) and vice versa. It follows from

$$t(\gamma) = \bar{t}\left(1 - \frac{\gamma}{\bar{\gamma}}\right)$$

that for a given level of protection in the advertising market ($\gamma < \bar{\gamma}$), we obtain the range within which a government can choose its specific tariff without *forcing* the foreign firm not to use foreign advertising, i.e. $t < t(\gamma)$. However, for any specific tariff to be effective it needs to be positive and non prohibitive in the goods market. It can easily be seen, from the top equation of (16) that whenever $t < t(\gamma)$, trade policy does not prohibit trade in the goods market. We then study how this range is affected when protection increases in the services market. It follows that the higher the barrier in the advertising market (γ), the smaller the governments range $[0, t(\gamma)[$ over which the government can choose its tariff 'allowing' the foreign firm to export its own advertising to its export market. When the government chooses a tariff t above $t(\gamma)$ trade policy in the goods market 'prohibits' the use of advertising by foreign firm. Moreover, notice from the previous section and the middle equation of (12) that

$$\bar{t} = \frac{(9a - 2)}{3a} \tag{17}$$

is the prohibitive tariff above which $q^* = 0$. This leads to the following proposition:

Proposition 3. *For the services market, represented here by the advertising market, to liberalize, the home government needs to commit to a low level of tariff. Specifically, for a given level of* γ*, a tariff* t *must satisfy:*

$$t < t(\gamma) \equiv \bar{t}\left(1 - \frac{\gamma}{\bar{\gamma}}\right).$$

4 Conclusion

In this paper we presented a Hotelling model with vertical differentiation through the use of a non-price instrument (NPI) in order to study the strategic interaction between pricing and a NPI in the presence of trade restrictions. Trade restrictions can directly affect all strategic variables; a tariff on the goods market puts the foreign firm at a pricing disadvantage; a tariff on a service such as advertising increases the cost of using this service for the foreign firm and R&D subsidies to domestic firms decrease the cost of producing R&D, an NPI, for the home firm.

This model is a first attempt to focus on *how* such trade policy barriers alters price and non-price competition on the goods market. The main results of our paper are as follows: first, no matter whether the trade restriction (tariff) is placed on the NPI or on the good itself, the foreign (home) firm prefers to increase (decrease) its use of its pricing tool and give up some of (increase) its use of the NPI. Second, in the presence of the NPI, tariffs do not always lead both firms to increase their price: it can lead the foreign firm to decrease its price including the tariff. Although our basic model is rather simple, we believe it can serve as a benchmark which can be easily adapted to other environments.

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5 Appendix

A. The Stability of the Equilibirum

This proof shows that the Nash advertising Equilibria presented in this paper are (locally) stable if and only if $a > 2/9$. The corollary used is taken from Vives (2001): Consider a two-player game with one-dimensional strategy spaces. If set of strategies (I, I^*) is a regular Nash equilibrium, then it is locally stable if at (I, I^*):

$$\left| \frac{\partial^2 \Pi}{\partial I^2} \frac{\partial^2 \Pi^*}{\partial I^{*2}} \right| > \left| \frac{\partial^2 \Pi}{\partial I \partial I^*} \frac{\partial^2 \Pi^*}{\partial I \partial I^*} \right|.$$

The profit maximization programs are given by by (6). The focus here is only on the stability condition and not the optimal advertising levels. These will be derived in appendixes B and C. By computing the second order derivatives and cross derivatives, we obtain the following result:

$$\left| \left(\frac{1}{9} - a\right)\left(\frac{1}{9} - a\right) \right| > \left| \frac{1}{18} \right|,$$

$$\left| a\left(a - \frac{2}{9}\right) + \frac{1}{18} \right| > \left| \frac{1}{18} \right|.$$

This inequality is satisfied if and only if $a > \frac{2}{9}$.

□

B. Proof of Equations (8) to (11)

The first stage maximization programs of the home and foreign firm are the following:

$$\pi = \frac{(3 + I - I^* + t)^2}{18} - \frac{a}{2} I^2;$$

$$\pi^* = \frac{(3 + I^* - I - t)^2}{18} - \frac{a}{2} I^{*2}.$$

The FOCs lead to

$$\frac{\partial \Pi}{\partial I} = \frac{3 + (1 - 9a)I - I^* + t}{9} = 0;$$

$$\frac{\partial \Pi^*}{\partial I^*} = \frac{3 + (1 - 9a)I^* - I - t}{9} = 0.$$

Solving the above system of equations for all values of $a > 2/9$ leads to the following optimal NPI levels

$$I = \frac{1}{3a} + \frac{t}{9a - 2}$$

and

$$I^* = \frac{1}{3a} - \frac{t}{9a-2}.$$

From (B.1), note that $I^* > 0 \Leftrightarrow t < \frac{9a-2}{3a}$ and $I^* = 0 \Leftrightarrow t \geqslant \frac{9a-2}{3a}$. We consider the two cases separately.

Case 1: $t < \frac{9a-2}{3a}$**.** Having determined the optimal NPI level in the first stage, the subgame perfect prices and quantities can be determined. The net NPI levels:

$$\phi = -\phi^* = \frac{2t}{9a-2}. \tag{B.2}$$

Substituting (B.2) in the second stage pricing equilibrium given by (3), we obtain the subgame perfect Nash equilibrium prices given by

$$p = 1 + \frac{3at}{9a-2}$$

and

$$p^* = 1 + \frac{2(3a-1)t}{9a-2}. \tag{B.3}$$

The subgame perfect quantities are determined by substituting (B.2) in the equations given by (4) to obtain

$$q = \frac{1}{2}\left(1 + \frac{3at}{9a-2}\right)$$

and

$$q^* = \frac{1}{2}\left(1 - \frac{3at}{9a-2}\right). \tag{B.4}$$

Note from equation (B.4) that $q^* > 0 \Leftrightarrow t < \frac{9a-2}{3a}$. Thus, the prohibitive tariff above which the foreign firm ceases to produce is denoted by $\bar{t} = (9a-2)/3a$.

Case 2: $t \geqslant \frac{9a-2}{3a}$**.** For $t \geqslant \bar{t} \equiv (9a-2)/3a$, from (B.1) and (B.4) it can be seen that $I^* = 0$ and $q^* = 0$. The optimal NPI level of the home firm can be determined by using its first order condition:

$$\frac{\partial \Pi}{\partial I} = \frac{3 + (1-9a)I}{9} + \frac{9a-2}{27a} = 0$$

where $I^* = 0$ and $t = \bar{t}$. Solving for I leads to:

$$I = \frac{2}{3a}. \tag{B.5}$$

The net NPI levels are hence

$$\phi = -\phi^* = \frac{2}{3a} \tag{B.6}$$

Finally, replacing (B.6) in equation (3) and (4), we obtain the following equilibrium prices and quantities:

$$p = 2;$$
$$p^* = \frac{9a-2}{3a}; \tag{B.7}$$
$$q = 1;$$
$$q^* = 0. \tag{B.8}$$

Note that the foreign price $p^* > 0$ for all $a > 2/9$. Finally, putting equations (B.1) to (B.7) together we obtain the equilibrium NPI levels, net NPI levels, prices and outputs given by equations (8) to (11).

Remark: Note that for equation (8) to (11) to be an equilibrium, no deviations from the set of strategies (I, I^*) should be possible. A deviation, is a strategy in which one firm invests enough in advertising to throw its opponent out of the market. Checking for such strategies reveals that the firms have no incentive to preempt the market when $a > \frac{2}{15}$.

□

C. Proof of Equations (12) to (16)

The maximization program of the home and foreign firm are the following:

$$\pi = \frac{(3 + I - I^* + t)^2}{18} - \frac{a}{2}I^2;$$

$$\pi^* = \frac{(3 + I^* - I - t)^2}{18} - \frac{a}{2}I^{*2} - \gamma I^*.$$

The FOCs are

$$\frac{\partial \Pi}{\partial I} = \frac{3 + (1-9a)I - I^* + t}{9} = 0;$$

$$\frac{\partial \Pi^*}{\partial I^*} = \frac{3 + (1-9a)I^* - I - t - 9\gamma}{9} = 0.$$

Solving the FOCs simultaneously for I andI^* leads to the following optimal advertising levels

$$I = \frac{1}{a}\left(\frac{1}{3} + \frac{at + \gamma}{9a - 2}\right)$$

and

$$I^* = \frac{1}{a}\left[\frac{1}{3} - \frac{at + (9a-1)\gamma}{9a-2}\right]. \tag{C.1}$$

From (C.1), it can be seen that $I^* > 0 \Leftrightarrow t < t(\gamma) \equiv \frac{9a-2-3(9a-1)\gamma}{3a}$ and $I^* = 0 \Leftrightarrow t \geqslant t(\gamma)$. By rearranging $t(\gamma)$ we get

$$t(\gamma) = \bar{t}\left(1 - \frac{\gamma}{\bar{\gamma}}\right)$$

where $\bar{t} = \frac{9a-2}{3a}$ and $\bar{\gamma} = \frac{1}{3}\frac{9a-2}{9a-1}$. Like before, $\bar{t}$ is the prohibitive tariff in the goods market (c.f. case 3). The level $\bar{\gamma}$ is the prohibitive level of γ above which the foreign firm does not advertise when $t = 0$. Indeed, the level $\bar{\gamma}$ is derived from equation (C.1), when $t = 0$, then I^* when $\gamma = \bar{\gamma}$.

The rest of the proof is structured as follows. Case 1 considers the case where $t < t(\gamma)$ where $I^* > 0$ and $q^* > 0$. Case 2 deals with the case where $t(\gamma) \leqslant t < \bar{t}$ in which $I^* = 0$ and t is non prohibitive so that $q^* > 0$. Case 3. considers $t \geqslant \bar{t}$ where both I^* and q^* are equal to zero.

Case 1: $t < t(\gamma) \Rightarrow I^* > 0$. The optimal advertising level are given by (C.1). The net advertising levels hence

$$\phi = -\phi^* = \frac{2t + 9\gamma}{9a-2}. \tag{C.2}$$

Subsituting (C.2) in the second stage pricing equilibrium given by (3), we obtain the subgame perfect Nash equilibrium prices, given by

$$p = 1 + 3\frac{at + \gamma}{9a-2}$$

and

$$p^* = 1 + \frac{2(3a-1)t - 3\gamma}{9a-2}. \tag{C.3}$$

The subgame perfect quantities are determined in same way, we substitute (C.2) in (4) to obtain

$$q = \frac{1}{2}\left(1 + 3\frac{at + \gamma}{9a-2}\right)$$

and

$$q^* = \frac{1}{2}\left(1 - 3\frac{at + \gamma}{9a-2}\right). \tag{C.4}$$

Observed that $q^* = 0 \Leftrightarrow t \geqslant \frac{9a-2-3\gamma}{3a}$. It is easy to see that here $q^* > 0$ because $t(\gamma) < \frac{9a-2-3\gamma}{3a}$ for all $a > 2/9$.

Case 2: $t(\gamma) \leqslant t < \bar{t}$**.** This case arises if $\gamma \geqslant \bar{\gamma}$ and/or $t \leqslant \bar{t}$. The foreign advertising level is equal to zero, as can be seen from equation (C.1). The optimal advertising level of the home firm can be determined by its FOC given by

$$\frac{\partial \Pi}{\partial I} = \frac{3 + (1 - 9a)I + t}{9} = 0,$$

where $t < \bar{t}$. Solving for I gives

$$I = \frac{3 + t}{9a - 1}. \tag{C.5}$$

The net advertising level are hence

$$\phi = -\phi^* = \frac{3 + t}{9a - 1}. \tag{C.6}$$

By replacing (C.6) in equation (3) and (4), gives the equilibrium prices and quantities given by

$$p = 1 + \frac{1 + 3at}{9a - 1};$$
$$p^* = 1 + \frac{(6a - 1)t - 1}{9a - 1}; \tag{C.7}$$
$$q = \frac{1}{2}\left(1 + \frac{1 + 3at}{9a - 1}\right);$$
$$q^* = \frac{1}{2}\left(1 - \frac{1 + 3at}{9a - 1}\right). \tag{C.8}$$

Observe from (C.8) that $q^* > 0 \Leftrightarrow t < \bar{t}$.

Case 3. $t \geqslant \bar{t}$**.** The optimal advertising level of the home firm can be determined by its first order condition

$$\frac{\partial \Pi}{\partial I} = \frac{3 + (1 - 9a)I}{9} + \frac{9a - 2}{27a} = 0,$$

where $t = \bar{t}$ and $I^* = 0$. Solving for I leads to:

$$I = \frac{2}{3a}. \tag{C.9}$$

The net advertising level are therefore given by

$$\phi = -\phi^* = \frac{2}{3a}. \tag{C.10}$$

Finally, replacing (C.10) in equation (3) and (4), we obtain the equilibrium prices and quantities given by

$$p = 2;$$

$$p^* = 1 + 2\frac{3a-1}{3a}; \tag{C.11}$$

$$q = 1;$$

$$q^* = 0. \tag{C.12}$$

The foreign price is always positive $p^* > 0$ because of $a > 2/9$. Putting equation (C.1) to (C.11) together leads to equation (12) to (16) in the text.

Remark: Again as mentioned in Appendix B, there are no deviations from the set of strategies (I, I^*) for values of $a > \frac{2}{15}$.

□