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TRADE POLICY AND INTEGRATION AMONG FIRMS PRODUCING COMPLEMENTARY PRODUCTS

Abstract

This paper analyzes the role of an active trade or industrial policy on the relationships between firms producing goods that are perfect complements. Specifically, it studies the interaction between government and industry regarding an export or import policy on intermediate complementary goods and the decision of firms on whether or not to integrate. It differentiates between domestic and foreign firms. Furthermore, the paper defines a set of parameters that model the distribution of market power among firms and the level of integration. In this context, it shows that an active trade policy may create disincentives for integration. In fact, the optimal trade policy instruments and firm integration decisions depend on whether firms are domestically or foreign owned, how market power is distributed among firms, and the capacity of the government to establish and maintain its trade policy instruments.

Resumen

Este articulo estudia los efectos de una política comercial activa sobre las relaciones entre empresas productoras de bienes complementarios perfectos. Específicamente, estudia la interacción entre el gobierno y la industria con respecto a una política de fomento a las exportaciones de bienes intermedios y las decisiones de las empresas con respecto a integrarse o no integrarse. Considera que las empresas pueden ser nacionales o extranjeras. Adicionalmente, el artículo propone una parametrización de la distribución del poder de mercado entre las empresas y del nivel de integración. En este contexto, muestra que la intervención del gobierno a través de su política comercial puede crear incentivos a las empresas a no integrarse. De hecho, los instrumentos de política comercial y la decisión de las empresas entre integrarse o no integrarse dependen de sí las empresas son nacionales o extranjeros, de la distribución del poder de mercado entre las empresas, y de la capacidad del gobierno de comprometerse a una política comercial, independientemente de las decisiones de las empresas.

Introduction

The application of well-established assumptions in antitrust and strategic trade policy literature to vertically related markets results in a Stackelberg[1] solution for two reasons. First, an upstream monopoly or oligopoly industry produces an intermediate good and a downstream monopoly or oligopoly industry, purchases the intermediate good taking its prices as given to combine it with a complementary good to produce a final good. Second, a government establishes its trade or industrial policy, and policy-taker firms react by making their investment and production decisions.[2] The first assumption, that upstream producers set a single take-it-or-leave-it price, is an oversimplification of vertical relationships. As a result, some authors have relaxed the price-taker behavior in the antitrust literature. Tirole (1988), Economides and Salop (1992),[3] and Young (1991) assume that the rivalrous firms make pricing decision simultaneously and reach Nash equilibrium instead of the usual Stackelberg solution.[4] This literature shows that integration by complementary product firms raises welfare and profits, giving incentives to firms to integrate. However, in the strategic trade policy literature, Ishikawa and Spencer (1999) recognize the technical difficulties of relaxing the assumption of price-taker behavior in order to incorporate monopsony power by downstream firms.

With respect to the second assumption that firms take government policy as given, several authors[5] argue that firms facing an active trade policy make strategic movements designed to influence on government decisions, and that such movements can be justified by investment costs and by the bargaining power of multinationals in negotiating with developing country governments. Given high investment cost and the competition for foreign investment among developing countries, it is hoped that the decisions of firms are based on their expectations and/or influence on the government's trade policy. An example of an active government policy comes from the "maquiladora"[6] industry in developing countries. One can think of Mexico as the home country, the USA as the market, and of a firm

[1] Or a two stages game.

[2] See, for example, Salinger (1988), Spencer and Jones (1991, 1992), Rodrik and Yoon (1989), Ishikawa and Lee (1997), Bernhofen (1997), Spencer and Raubitschek (1996), Ishikawa (1998), Ishikawa and Spencer (1999) and the references therein.

[3] They cited Cournot's (1838) model of a complementary duopoly.

[4] Young (1991) questions the assertion that the case of complementary goods is "equivalent" to successive monopoly. If the upstream firm chooses the wholesale price and the downstream firm simultaneously sets the retail price, no Nash equilibrium is obtained. He assumes that firms choose simultaneously mark-ups over marginal cost instead of prices. Salinger (1989) overcomes several such obstacles by introducing conjectural variations.

[5] See Helpman and Krugman (1989), González (1993), Carmichael (1987), Gruenspecht (1988), Kleit (1992), and Dixit and Kyle (1985), among others.

[6] A maquiladora is an assembly or manufacturing operation in Mexico for export that may 100% foreign owned. A maquiladora utilizes competitively-priced Mexican labor in assembling and/or other manufacturing using temporarily imported components from the U.S. and other sources.

owned by residents of a third country. The Mexican government's policy has been to promote the maquiladora industry by giving advantages to Mexican and/or foreign firms, in order to encourage the production of goods with Mexican content for export to the USA. [7] We argue that when the government is actively intervening in a complementary goods industry and it is unable to commit itself to its trade instruments, the firms' incentives to integrate may change.

The main goal of this paper is to study strategic trade policies and their effects on the decisions of complementary product firms on whether to integrate. The main differences with existing literature are that we allow the distribution of market power[8] between two firms producing complementary products to vary, and that we relax the assumption that the government trade policy is unaffected by firms decisions. That is, we investigate how an active trade or industrial policy may be altered when a more realistic view of firms is considered. The results on optimal trade policy and integration depend strongly on the distribution of the market power among firms, the commitment capacity of government and the firms' nationality. We adopt the typical assumption in this literature that all the production of the domestic good is for export.[9]

We start by defining the parameters that model the distribution of market power between bilateral monopolists in the intermediate market as well as the integration level. We use this parameterization to show the standard result: that integration by complementary product firms raises welfare and profits independently of firms' market power. This result would predict full integration under the assumption that when firms decide to integrate, they take trade policy as given. However, the situation changes if we assume that government trade policy is affected by the firms' decision and that both firms are owned by residents of the home country. Then, the objective of trade policy is to maximize the profitability of the export industry. Under these assumptions, we find that when firms are fully integrated, government intervention is unnecessary for welfare maximization. On the other hand, when firms are not integrated, then the government has incentives to subsidize exports in order to achieve the integrated level of welfare. This subsidy means a transfer from government to firms, so non-integrated firms would be better off than integrated firms. So, firms prefer not to integrate.

The above result changes when one of the firms is domestically-owned and the other one is foreign. There are several possible outcomes depending on firms' market power. When the home firm has all the market power, i.e., it is the Stackelberg leader, then the optimal policy is non-intervention whether or not firms are integrated. Since the final output is exported, the goal of government policy remains the maximization of the net profits of the home firm. The home country

[7] Low interest loans to finance export, free advice for exporting firms and low income-tax rates for export profits are common forms of export subsidies.

[8] We will refer to market or bargaining power as the capacity of each firm to price its product above its marginal cost.

[9] This assumption was introduced by Brander and Spencer (1985) and Eaton and Grossman (1986) in order to isolate home consumption distortions.

may extract rents from two sources: the foreign consumer surplus and foreign firm's profits. When home firm has all market power, it can get all these rents by itself. Thus, the government has not incentives to intervene. Firms decide to integrate in order to avoid the intermediate market inefficiency.[10]

When both firms have the same market power or the foreign firm is the Stackelberg leader and firms are not integrated, then the government should subsidize or tax the home firm's production depending on whether the actions of foreign firms are strategic complements or substitutes.[11] The appropriate government policy causes the foreign firm to reduce its price and allows the domestic firm to obtain the Stackelberg leader rents. Then the price of the final good is reduced in the case of complements and increased in the case of substitutes. In the substitutes case, with the tax, the home country government achieves a higher price for the domestically-produced product. In other words, by taxing home production, it shifts some of pure profits (coming from imperfect markets) from the foreign to the domestic firm. The subsidy in the complements case is less intuitive. In order to explain the subsidy for this case, we argue that with complements the Stackelberg leader prices lower than the follower does. This is due to with a higher price the follower will also set a high price. So the final price would be too high causing an excessive reduction is sales. Then, in order to avoid a too high price the government subsidies domestic production. On the other hand, if firms decide to integrate, the optimal policy change from a subsidy to a tax in the case of complements, and implies a higher tax in the case of substitutes. Then firms decide not to integrate. This is due to the integration implies lower prices for the domestic product in world markets. The same results are obtained by subsiding or taxing imports of an intermediate good depending on home firm's actions are strategic complements or substitutes.

The paper is organized as follows. In the next section, we develop the basic model. In section three, we study the integration decision under a passive trade policy. In section four, we analyze the interaction between trade policy and firms' merger decisions. Section five concludes.

The Model

First, lets us suppose that there are two firms producing two perfect complement intermediate goods or components. Firm $i=1,2$ produces component Z_i at constant marginal cost c_i, and sells this component at price p_i. The two components are combined in fixed proportions (one unit of each) to produce a composite product or final good. Demand for the final good is denoted by $Z(p)$ and

[10] Following the literature, we call the non-integrated inefficiency "double marginalization". See Tirole (1988).

[11] Firm's actions are strategically complements (substitutes) when an increase in the price of the other firm (due, for example, to a tax) triggers an increase (reduction) in its own price. This terminology comes from Bulow, Geanakoplos and Klemperer (1985).

depends on the sum of the two component prices: $p=p_1+p_2$. We assume that the demand is twice-continuously differentiable and strictly downward sloping. If we re-interpret this model in terms of two vertically related firms, each producing an intermediate good,[12] then firm 1 produces an intermediate good and sells it at unit price $p_1=c_1+m_1$, where m_1 represents the mark-up over marginal cost. Firm 2 needs one unit of intermediate good to produce one unit of the final good, and sells the final product at price $p=p_1+c_2+m_2$, where m_2 represents the mark-up over firm 2 marginal cost. Then $p_2=c_2+m_2$. Profit of firms 1 and 2 are given, respectively, by:

$$\Pi_1 = (p_1 - c_1)Z(p_1 + p_2) \quad (1)$$

$$\Pi_2 = (p_2 - c_2)Z(p_1 + p_2) \quad (2)$$

Assume that firms 1 and 2 solve, respectively, the following problems:

$$Max_{p_1} A_1 = a\Pi_1 + (1-b)\Pi_2 \quad (3)$$

$$Max_{p_2} A_2 = (1-a)\Pi_1 + b\Pi_2 \quad (4)$$

These firms' objective functions can be understood as "generalized" objective functions. When firm i=1,2 chooses its own price, it takes the price of the complementary good as given. Thus, we solve for the Nash equilibrium in prices taking the generalized objective functions. We may adapt from literature several possible interpretations. Following Flat (1989, 1990, 1991), the parameters *a* and *b* may be shareholding interlocks. Flat assumes silent financial interests: "each firm's objective is to maximize the value of its assets, including equity holdings in other firms, but it controls only its own product". In a managerial incentive schemes context, each manager chooses the price of the product that the firm he runs produces. The owner would pay him according to the objective function defined in (3) or (4), plus a fixed salary.[13] We do not adopt any particular interpretation, but we just take problems (3) and (4) as a way to define a set of parameters that determine the structure of the industry. Our goal is to show that the solution of these problems covers most vertical relationships cases: non integration and integration, for any distribution of market or bargaining power between firms. FOCs from problems (3) and (4) are given, respectively, by:

$$a\{(p_1 - c_1)Z' + Z\} + (1-b)(p_2 - c_2)Z' = 0 \quad (5)$$

$$(1-a)(p_1 - c_1)Z' + b\{(p_2 - c_2)Z' + Z\} = 0 \quad (6)$$

Solving (5) and (6) for each firms' mark-up we obtain:

[12] See Young (1991).

[13] See Fershtman (1985), Fershtman and Judd (1987), Vickers (1985), and Sklivas (1987) for this kind of models.

$$(p_1 - c_1)Z' + bZ = 0 \quad (7)$$

$$(p_2 - c_2)Z' + aZ = 0 \quad (8)$$

From the sum of (7) and (8) we get:

$$(p - c)Z' + \delta Z = 0 \quad (9)$$

where $\delta=a+b$ and $c=c_1+c_2$.

Equations (7) and (8) also may be obtained from the solution of the following problem:

$$Max_{p_1,p_2} \Pi_1^b \Pi_2^a \quad (10)$$

This objective function comes from the Generalized Nash Bargaining Solution, where parameters a and b represent bargaining powers[14]. Specifically, letting be $a+b=\delta=1$ we characterize the outcome of a bargaining problem that fulfills the Nash Axioms.[15] In particular, the outcome may come from collusion, absorption, integration, or any other bargaining process. Although the Generalized Nash Bargaining Solution specifies $a+b=1$, we also let $a+b$ be different from one in order to include other vertical market structures.

From (7), (8) and (9) we obtain the following expression:

$$\frac{p-c}{p} = \frac{p_1 - c_1}{p} + \frac{p_2 - c_2}{p} \equiv \frac{b}{\varepsilon} + \frac{a}{\varepsilon} = \frac{\delta}{\varepsilon}$$

Therefore, we have get a decomposition of the Lerner Index in terms of firms' market powers. Note that the mark up of each firm is related directly to its bargaining power, and it does not depend on the market power of the other firm.

If both FOC's are satisfied, then the second-order condition for each firm's problem is $2-\Delta>0$, where $\Delta = ZZ''/Z'^2$ is a parameter that indicates the convexity of the demand. Assuming that demand function is not "too much convex", then the second-order condition for each firm problem is satisfied and the FOC given in (5) and (6) are sufficient for equilibrium. In particular, the second order condition is satisfied for linear demand ($\Delta=0$) and for constant-elasticity demand[16] ($\Delta=1+1/\varepsilon$), if $\varepsilon>1$, where ε is the price-elasticity of demand. Next, we will define the most common vertical market structures in terms of parameters a, b and δ.

[14] For example, when $a=1$ and $b=0$ then firm 2 has all the bargaining power.

[15] See Binmore (1994), Eichberger (1993).

[16] That is $Z=Ap^{-\varepsilon}$, where A is a positive constant.

Generalized Nash Bargaining Solution: As we have shown above, it is enough to set $a+b=1$.

Non-cooperative Stackelberg solution: The non-cooperative vertical relationship implements a Stackelberg solution. Assume that firm 1 is the Stackelberg leader and firm 2 is the follower, so firm 2 chooses p_2 to maximize its own profits taking p_1 as given. The FOC to this problem is given by (8) with $a=1$:

$$(p_2 - c_2)Z' + Z = 0 \tag{11}$$

The Second Order Condition, given by $2-\Delta>0$, ensures that the solution of (11) yields a local maximum. Solving (11) we get the "reaction function" which we denote by: $p_2=R_2(p_1)$. The sign of the slope of reaction function is obtained by differentiating firm 2's FOC (11) respect to p_1, which becomes:

$$R_2' = \frac{\Delta - 1}{2 - \Delta} \tag{12}$$

From the Second Order Condition, we thus have $sign(R_2') = sign(\Delta - 1)$. Following Bulow, Geanakoplos and Klemperer (1985), if $R_2'>0$ ($\Delta>1$) then firm 2's actions are strategic complements, and if $R_2'<0$ ($\Delta<1$) then the firm 2's actions are strategic substitutes. The sign of R_2' depends on the demand specification. For example, for linear demand $R_2'=-1/2<0$ and for constant-elasticity demand $R_2'=1/(\varepsilon-1)>0$. Following with the Stackelberg solution, firm 1 chooses p_1 to maximize:

$$\Pi_1 = (p_1 - c_1)Z(p_1 + R_2(p_1)) \tag{13}$$

The FOC for this problem is given by:

$$(p_1 - c_1)Z' + \frac{1}{1 + R_2'}Z = 0 \tag{14}$$

so defining in (7) and (8):

$$a=1 \text{ and } b = \frac{1}{1 + R_2'} = 2 - \Delta > 0 \tag{15}$$

we obtain the non-integrated Stackelberg equilibrium. Furthermore, from the second order condition, we have $b>0$ and $\delta=3-\Delta>1$. Note that when the follower's actions are strategic substitutes (complements) then $b>a$ ($b<a$). From (7) and (8) we get the following:

Proposition 1: *The Stackelberg leader sets a higher (lower) mark-up than the follower when follower's actions are strategic substitutes (complements).*

The intuition behind this proposition is simple. An increase in leader's price causes the follower to increase or reduce its price depending on whether its actions are strategic complements or substitutes. In the latter case, the leader may set a relatively higher price than in the former case without an important reduction in sales.

Non-cooperative Nash solution: The Nash solution assumes that each firm takes the price of the other firm as given, taking as objective its own profits. Then in (12), $R_2' = 0$. This implies that if we set $a=b=1$ *and* $\delta=2$, we recover the Nash Solution. The same condition is obtained using the Young (1991) approach.

Perfect Competition: Under perfect competition, $p_i=c_i$, $i=1,2$. Then, this case is recovered by setting $a=b=\delta=0$.

In general terms, we can state next proposition:

Proposition 2. *The solution to the problems (3) and (4) or (10), characterized by equations (7), (8) and (9) cover most kinds of vertical relationships:*

i) *If $a=b=\delta=0$, we have perfect competition:*

ii) *If $\delta=1$ we have the cooperative solution for any distribution of bargaining/market powers among firms.*

iii) *If $\delta>0$ there is some degree of market power.*

iv) *If $\delta>1$ there is some degree of non-cooperation.*

v) *If $a\neq b$ in cases ii), iii) and iv) above there is some degree of asymmetric bargaining power.*

This proposition allows us to define $\delta=a+b$ as an "integration index" or "integration level". If $\delta=1$ the firms are *fully* integrated. When $\delta>1$ the firms are not integrated at all. When $0<\delta<1$ firms do not have complete market power in final market.

Conjectural Variation: It is possible to rewrite this result in terms of conjectural variations by defining:

$$a=\frac{1}{1+\gamma_1},\ b=\frac{1}{1+\gamma_2}. \tag{16}$$

where the terms γ_i, $i=1,2$ represent the beliefs about how firm i optimal behavior changes as p_j changes. If $\gamma_i \to \infty$, (i=1,2) then we get competitive market. If $\gamma_1\gamma_2=1$

then we get the Nash Bargaining Solution. If $\gamma_i = 0$, $(i=1,2)$, then we get the Nash Equilibrium. If $\gamma_i = 0$ and $\gamma_j = R'_j$, $i,j=1,2$, $i \neq j$ then firm i is the Stackelberg leader and firm j is the follower.

Integration

In this section, we study the effect of integration decisions on prices and industry profits. The effects of integration on the final price is obtained from the implicit differentiation of equation (9) with respect to p.[17]

$$p_\delta = \frac{-Z}{(1+\delta(1-\Delta))Z'} > 0 \qquad (17)$$

Thus, an increase in the integration level (reduction in δ) reduces the final price. To study the effects of an increase of δ on profits, we compute the optimal value of δ, that is, the value of δ that maximizes the sum of profits (1) and (2), given by:

$$\Pi = (p-c)Z \qquad (18)$$

The FOC of this problem is:

$$(p-c)Z' + Z = 0 \qquad (19)$$

If we set $\delta = 1$ in equation (9), we get equation (19). Since we known that $\delta = 1$ implies full integration, equation (19) tell us that this is an optimum. Thus, we have the standard result that *integration by firms producing complementary products raises welfare and profits independently of the distribution of bargaining/market power among firms.* Nevertheless, it is possible to observe values of $\delta \neq 1$ due to factors not included in the present model. For example, the presence of substitutive products in market triggering some competition would explain values of $\delta < 1$. The cost of obtaining full cooperation due to imperfect information or bargaining process may trigger values of $\delta > 1$. Of course, it should be emphasized that $\delta = 1$ is a second best result from welfare viewpoint. The joint-ownership price exceeds the optimal price ($p=c$) that would be obtained by optimal regulation.

[17] The index denotes partial derivative.

Trade Policy

In this section, we analyze the effect of an active trade policy on the integration decision. To introduce trade policies into the model, we assume that the government taxes (subsidies) firm 1's production with a tax (subsidy) rate *t>0 (t<0)*. We redefine marginal costs as follows: $c_1 = \hat{c}_1 + t$ and $\hat{c} = \hat{c}_1 + c_2$. We will refer to the country that chooses the tax as the home country. The rest of the world's government trade policy is fixed. We assume that all the home production is for export.

The fully integration result in the previous section rests on the assumption that the tax rate is fixed when firms decide to integrate in some way (for example; bargaining, takeover, etc.). In game theory terms, in the first stage the government decides the tax rate, and in the second stage firms decide whether to integrate. This sequence implies that the government's choice of trade policy is taken independently of the firms decision about integration. However, as we argue in the introduction, firms make strategic movements designed to influence on the government decisions. To analyze how the full integration results in previous section changes when government policies are affected by firms' decisions; we change the sequence of the game. In the first stage firms decide to integrate or not to integrate. In the second stage, government chooses the tax rate to maximize welfare. We study the effects of this tax on prices, profits and vertical integration decision. Obviously, the tax depends on the industrial structure, or δ. The effect of an increase of the tax on prices is obtained by the implicit differentiation of (7), (8) and (9) with respect to the tax:

$$p_{1t} = \frac{1}{1+(1-\Delta)\delta} > 0 \tag{20}$$

$$p_{1t} = \frac{1+a(1-\Delta)}{1+(1-\Delta)\delta} > 0 \tag{21}$$

$$p_{2t} = \frac{-a(1-\Delta)}{1+(1-\Delta)\delta} \tag{22}$$

That is, the firm that must pay the tax (firm 1) increases its price and the final price rises. However, the direction of the change of the other firm price in response to an increase in the tax paid by firm 1 is ambiguous. When firms 2's actions are strategic complements (substitutes), then it increases (reduces) its price. For example, for linear demand: $p_{2t} = -a/(1+\delta) < 0$, and for constant-elasticity demand $p_{2t} = a/(\varepsilon - \delta) > 0$.

To analyze the effect of the tax on firms' integration decision, we compute the optimal tax for any degree of integration. We define the optimal tax as the value of t that maximizes home welfare, which due to there is not home consumption it is defined as follows:

$$W = \alpha_1 \Pi_1 + \alpha_2 \Pi_2 + tZ \tag{23}$$

where α_i, $i=1,2$ are weights on firms' profits and the last term in the right size represents tax revenues. By giving different values to α_i, $i=1,2$, we can analyze several typical cases in the literature of trade policy: firms may be owned by residents of the home country or be foreign. An implicit expression for the optimal tax is given in the next lemma:

Lemma 1: *The tax rate that maximizes welfare (23) is given by:*

$$t = \left(1 - \frac{\delta}{\Gamma}\right)(p - \hat{c}) = -(\Gamma - \delta)\frac{Z}{Z'} \tag{24}$$

where, $\Gamma = 1 + (2 - \Delta)(\delta - \alpha_1 b - \alpha_2 a)$.

Proof: See Appendix

From this lemma we see that the sign of t, that is whether a tax or a subsidy is optimal, depends on the parameters of the model.

In the first stage firms decide to integrate if the tax is lower (or the subsidy is higher) when they are integrated than when they are not integrated[18]. Then, we need to compare the optimal tax under the integrated structure and the non-integrated structure. In terms of the model, the integration decision results in a change of parameters a and b. Let da and db be the changes in a and b[19]. The change in t, denoted by dt, due to a change in a, and b is given by $dt = t_a da + t_b db$, where t_a *and* t_b denote partial derivatives. The sign of dt is given in next lemma:

Lemma 2. *The sign of dt is given by the sign of:*

$$(2 - \Delta)\{(1 - \Delta)(\alpha_1 - \alpha_2)(bda - adb) - \alpha_2 da - \alpha_1 db\}$$

[18] This comes from the envelope theorem.

[19] For example, if firm 1 has all market power, then $a=1$ *and* $b=2-\Delta$ under non-integrated structure, and $a=0$ *and* $b=1$ under integrated structure. Then, if firm decide to integrate $da=-1$ *and* $db=-(1-\Delta)$. We are assuming that firms maintain their Bargaining powers after integration.

where a, b are the non-integrated values.
Proof: See Appendix.

Next, we analyze the optimal tax (24) and the direction of the change in t due to the integration decision for different values for α_i, $i=1,2$.

Case 1. Assume that firms are domestically-owned, the tax is on the exports of the final good and there is no domestic consumption. We can analyze this case by setting $\alpha_1=\alpha_2=1$. The resulting welfare function is equivalent to the one used by Brander and Spencer (1985) and Eaton and Grossman (1986). The optimal tax becomes:

$$t=(1-\delta)(p-\hat{c}) \tag{25}$$

From lemma 2, the integration decision implies $dt>0$. Then, from this fact and (25) we conclude:

Proposition 3: *When firms are domestically-owned and production is for export, firms prefer not to integrate at all. The optimal policy is:*
i) to subsidize exports when firms are not integrated at all ($\delta>1$),
ii) not to intervene when firm are fully integrated ($\delta=1$) and
iii) to tax exports when firms have not all market power in final market ($\delta<1$).

The objective of government choosing t is to maximize the profitability of the industry. When ($\delta<1$) firms face some competition in the final market. Thus, the government has incentives to tax exports in order to avoid having home set too low a price[20]. When $\delta>1$, firms are not integrated at all. Then the government has should subsidize firms in order to achieve the integrated level of welfare. This subsidy means a transfer from government to firms, so non-integrated firms would benefit more than integrated firms. That is, firms obtain higher profits extracting resources by not integrating.

Case 2. Assume that the firm facing the tax is domestically-owned and that the other one is foreign, and that all final output is exported ($\alpha_1=1$, $\alpha_2=0$). The resulting welfare function is similar to the one used by Bernhofen (1997). An example of this industry structure comes from the maquiladoras industry. One can think of Mexico as home country with a Mexican and a Korean firm. The welfare-maximizing policy of the Mexican government may be to subsidize a maquiladoras industry exporting a

[20] This is the classical argument from international trade policy when home country has market power in world markets. See Krugman and Obsfeld (1995).

Mexican-Korean composite good to the USA. From lemma 1, the optimal tax becomes:

$$t = -(1 + (1 - \Delta)a - b)\frac{Z}{Z'} \tag{26}$$

There are several subcases depending on firms' marker power. If we assume that the home firm has all market power, then, from lemma 1 the optimal tax is equal to zero, whether or not firms are integrated. Then the optimal policy is not to intervene and firms decide to integrate in order to avoid the intermediate market inefficiency.

When both firms have the same market power or the foreign firm is the Stackelberg leader then $sign(t)=sign(1-\Delta)$. Thus the government subsidizes (taxes) domestic production when foreign firm's actions are strategic complements (substitutes). Furthermore, if firms decide to integrate, from lemma 2, $dt>0$, i.e. if firms are integrated the government sets a higher tax (lower subsidy) than if firms are not integrated. Then, it is better for the firms not to integrate. We summarized this in next proposition:

Proposition 4: *When one of the firms is domestically-owned, the other one is foreign and all the final output is exported to a third country, then:*

i) If home firm is Stackelberg leader, then the government does not intervene and firms decide to integrate.

ii) If both firms have the same market power or if the foreign firm is the Stackelberg leader, then the government subsidizes (taxes) exports when the foreign firm's actions are strategic complement (substitutes). Firms decide not to integrate at all.

Since the final output is exported, the goal of government is to maximize the profitability of the industry. There are two rent extraction sources: foreign consumer surplus and foreign firm profits. In case i), when home firm has all market power, it can get all the rents by itself. Then, government has not incentives to intervene. In case ii), when firms have the same market power or the foreign firm is the Stackelberg leader, then the government has incentives to intervene in order to transfer the Stackelberg rents to the home welfare. As we note in proposition 1, the Stackelberg leader sets its prices higher (lower) than the follower does, depending on whether the follower's actions are strategic substitutes (complements). Since the home firm does not make the first move, it needs the commitment capacity that government taxes (subsidies) gives. In this way, the home country firm produces the Stackelberg level of outcome.

Case 3. Assume that the firm facing the tax is foreign, that the other firm is domestically-owned and all final output is exported ($\alpha_1=0$, $\alpha_2=1$). Continuing with

the maquiladoras example, the foreign firm is a Korean firm using Mexican inputs to export to the USA. The tax would be a tariff on Korean intermediate products. The results of this case are quite similar to case two. We just have to eliminate the terms export tax or subsidy and replace them with the terms import tax or subsidy. The rest of the conditions and the results do not change.

Conclusions

In this paper, we review the traditional result that integration among firms producing complementary products improves economic efficiency. First, we define the parameters that define the integration structure for different distributions of bargaining power between firms and for different levels of integration. This parameterization gives us the classical result that integration by firms producing complementary products raises welfare and profits independently of firms' bargaining power. We use this model to study how an active trade policy may give incentives to firms to refrain from integrating. The decision on whether or not to do so depends on the optimal trade policy, which in turn depends on whether firms are foreign or domestically-owned and the bargaining power of home firm. It rests to consider a more complete trade policy in the sense of a wider array of trade policy instruments. For example, one could examine the effects of both a subsidy for domestic production and a tariff on imports of intermediate goods. Furthermore, since the results depend on functional forms, it is necessary to obtain econometric estimates of the parameters of the model for different industries.

Appendix

Proof of lemma 1:

The first order condition coming from maximization of the welfare function (25) is given by:

$$\alpha_1\{(p_1 - c_1)Z'p_t + (p_{1t} - 1)Z\} + \alpha_2\{(p_2 - c_2)Z'p_t + p_{2t}Z\} + tZ'p_t + Z = 0 \qquad \text{A1}$$

Substituting (7) and (8) into A1 we obtain:

$$\alpha_1\{bZp_t - (p_{1t} - 1)Z - \alpha_2\{aZp_t - p_{2t}Z\} + tZ'p_t + Z = 0$$

Using (20), (21) and (22) and solving for t we get:

$$t = \frac{Z}{Z'}\{\delta - 1 - (2 - \Lambda)(\delta - \alpha_1 b - \alpha_2 a)\}$$

Let be $\Gamma = 1 + (2 - \Delta)(\delta - \alpha_1 b - \alpha_2 a)$, then,

$$t = -\frac{Z}{Z'}\{\Gamma - \delta\}$$

From (9) we obtain:

$$\frac{\delta Z}{Z'} = -(p - \hat{c} - t) \qquad \text{(A2)}$$

Then, solving for t we have:

$$t = \left(1 - \frac{\delta}{\Gamma}\right)(p - \hat{c}) \qquad \text{QED.}$$

Proof of lemma 2:

The change in t due to a change in a and b is given by:

$$dt = t_a da + t_b db, \qquad \text{A3}$$

so, in order compute dt, we have to compute

$$t_a = \frac{\partial t}{\partial a}, \text{ and } t_b = \frac{\partial t}{\partial b}$$

We compute t_a by taking the implicit derivative of (24) with respect to a:

$$t_a = \left(1 - \frac{\delta}{\Gamma}\right)\frac{\partial p}{\partial a} - (p - \hat{c})\frac{\partial}{\partial a}\frac{\delta}{\Gamma} \qquad \text{A4}$$

The term t_b can be computed in the same way. Since we known that the price of the final good depends on $t(a,b)$ and on a and b, i.e.,

$$p(t(a,b), a+b)$$

Thus,

$$\frac{\partial p}{\partial a} = p_t t_a + p_\delta \qquad \text{A5}$$

From (17) and (A2) we get:

$$p_\delta = \frac{p - \hat{c}}{(1 + (1 - \Delta)\delta)\Gamma} \qquad \text{A6}$$

Then, substituting A4 and A6 into A5 we get:

$$\frac{\partial p}{\partial a} = \frac{\Gamma t_a + p - \hat{c}}{(1 + (1 - \Delta)\delta)\Gamma} \qquad \text{A7}$$

Now, to compute A4, we have also to compute the next:

$$\frac{\partial}{\partial a}\frac{\delta}{\Gamma} = \frac{1 - \frac{\delta}{\Gamma}(2 - \Delta)(1 - \alpha_2)}{\Gamma} \qquad \text{A8}$$

Substituting A7 and A8 into A4 and solving for t_a we obtain:

$$t_a = \left\{\frac{(2 \cdot\cdot \Delta)(1 - \alpha_2)(1 + (1 - \Delta)\delta)}{(1 - \Delta)\Gamma + 1} - 1\right\}\frac{(p - \hat{c})}{\Gamma} \qquad \text{A9}$$

Following the same steps for t_b, we obtain

$$t_b = \left\{\frac{(2 - \Delta)(1 - \alpha_1)(1 + (1 - \Lambda)\delta)}{(1 - \Delta)\Gamma + 1} - 1\right\}\frac{(p - \hat{c})}{\Gamma} \qquad \text{A10}$$

So, substituting A9 and A10 into A3, it results:

$$dt = K\{(1 - \Delta)(\alpha_1 - \alpha_2)(bda - adb) - \alpha_2 da - \alpha_1 db\}$$

where

$$K = \frac{(p - \hat{c})(2 - \Lambda)}{(1 + (1 - \Delta)\Gamma)\Gamma} \qquad \text{QED.}$$

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