Public policy in vertically related markets:

a Cournot oligopoly-oligopsony model

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ABSTRACT

We use a partial equilibrium two-country model, with two vertically related markets, with perfect competition in the primary good sector and with a fixed number of processing firms in each country, characterized by a Cournot behavior upstream and downstream. In the first stage of the game, the government of the exporting country chooses the level of price instruments on both goods. The targeting principle is used to characterize optimal intervention in presence of a minimum revenue constraint towards primary producers.

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International trade in vertically related agricultural markets has already been the subject of various studies, where competition at the processing level is modelled either as perfect (e.g. Paarlberg, 1995), or as monopolistic competition (e.g. Lanclos and Hertel, 1996), or as oligopolistic (e.g. McCorriston and Sheldon, 1996). In this paper, we argue that market power may be exercised by the processing firms not only towards final consumers but also towards primary agricultural producers, i.e. that it is relevant to consider an oligopsonistic-oligopolistic structure.

In fact, the exercise of market power upstream by agri-food firms has probably not been a major concern until now, at least in the European Union (EU), as it has certainly been limited due to the existence of guaranteed prices on some bulk goods. However, the implementation of the Uruguay Round GATT agreements now tends to reduce the support given to farmers by means of guaranteed market prices, to the benefit of direct aids, and thus tends to diminish the protection of farmers from oligopsonistic pressures - a direction that should be reinforced by the forthcoming WTO negotiations.

The example of the cereals-poultry sectors in the EU has the main features of the framework evoked above. Cereals account for one third of poultry total production costs, and poultry can thus be considered as "processed cereals". The EU compound feed industry is concentrated, with 15 groups of more that 3Mt representing around 30% of the production, and 50 groups of more than 0.5Mt representing around 60% of the production (Janet and Roux, 1996). This suggests that market power could be exercised by compound feed industries when buying cereals. In the poultry industry, concentration is also high, with ten processors having a market share of 33% in Europe and with mainly two groups, Bourgoin and Doux, being involved in exports towards third countries (Dunn, 1997). This suggests imperfect competition behaviors on the poultry sales market. Thus, considering the activities of purchase of cereals / production of poultry / slaughtering and processing of poultry as an unique integrated activity, our model may be illustrated by the example of cereals - processed poultry, with imperfect competition present at both ends, and with trade on both products.

In the paper, we use a partial equilibrium two-country two-good model, with vertically related markets, one country exporting both goods towards the other. The sector producing the intermediate good is in perfect competition and the sector producing the final good has a fixed number of firms, in Cournot competition upstream and downstream. We consider the public policy in the exporting country, and we assume that there is no intervention in the foreign country. We assume that the government wishes to support primary agricultural income, and we account for this in our model with a redistribution constraint stating that the revenue of the agricultural sector must be at least equal to a target revenue. The government of the exporting country seeks to maximize the national welfare, under this redistributive constraint, using price policy instruments (i.e., production, consumption and export taxes/subsidies). Our objective is then to characterize the results for optimal intervention using the targeting principle (Bhagwati, 1971), which specifies that the government should use instruments correcting each distortion at its source.

The model has features of the "strategic trade policy" models (Brander and Spencer, 1985), where public intervention allows to shift the positive equilibrium rents on export markets to the domestic firms. As it is well-known, the results for intervention in this literature are very sensitive to the assumptions retained on the nature of the competition between firms (Eaton and Grossman, 1986). However, the use of the targeting principle allows us to separate the profit-shifting argument from the other rationales for intervention and to explain why the government intervenes in order to correct the various distortions.

Equilibrium equations of the model

The model is a partial equilibrium model with two countries, *H* and *F*, and two goods 1 and 2, with good 1 being an intermediate input for the production of good 2. Country *H* exports goods 1 and 2 towards country *F*. In each country, good 1 is produced with perfect competition, while there exists a fixed number of firms producing good 2, *m* (resp. m^*) firms in country *H* (resp. *F*). These firms exert market power upstream (producers of good 1) and downstream (final consumers of good 2). Thus, the processing firms of both countries compete for the purchases of good 1 in country *H* and the sales of good 2 in country *F* ; the processing firms of country *H* are in oligopolistic competition for selling good 2 in country *H* ; and the processing firms of country *F* are in oligopsonistic competition for buying good 1 in country *F*. The technology of production of good 2 is assumed Leontief with respect to good 1, one unit of good 1 being used for the production of one unit of good 2. We consider the special case where the firms adopt a Cournot behavior on the upstream and downstream markets where they compete. Markets of goods 1 and 2 are assumed to be segmented (i.e., each firm sets its quantities independently in both countries). The equilibrium results from a two-stage game: in a first stage, the government of country *H* sets the level of the production, consumption and export taxes/subsidies ; in a second stage, each firm chooses its levels of purchases/sales in each market.

The producers of good 1 in country *H* are characterized by an inverse offer function $g(S_1)$, where S_1 is the production of good 1. Their profit function is noted $\Pi^1(S_1)$. The derivative of Π^1 with respect to S_1 is then: $\Pi^1{}' = S_1 g' > 0$. The inverse demand function for good 2 in country *H* is noted $d(D_2)$, and the surplus function of consumers of good 2 is noted $\Psi_c(D_2)$, where D_2 is the consumption of good 2. The derivative of Ψ_c with respect to D_2 is then: $\Psi_c{}' = -D_2 d' > 0$. Notations are similar in country *F*, denoting the variables with an asterisk.

The i[th] firm producing good 2 in country *H* consumes a quantity D_1^i of good 1 and produces a quantity S_2^i of good 2, of which D_2^i is consumed in the internal market and X_2^i is exported. The j[th] firm producing good 2 in country F consumes a total quantity D_1^{j*} of good 1, of which X_1^j is imported from country *H* and S_1^{j*} is produced locally. It produces a quantity S_2^{j*} of good 2 entirely consumed in country *F*. From the assumption of Leontief technology, $S_2^i = D_1^i$ and $S_2^{j*} = D_1^{j*}$. The definition of export offers and import demands and the equilibrium conditions of the world markets of goods 1 and 2 lead to the identities: $S_1 = D_1 + X_1$; $D_1^* = S_1^* + X_1$; $X_2 + D_2 = S_2$; $X_2 + S_2^* = D_2^*$ (where $A = \sum_{i=1}^{m} A^i$, $A = D_1, S_2, X_2, D_2$, and $B = \sum_{j=1}^{m^*} B^j$, for $B = S_1^*, D_1^*, S_2^*, X_1$).

In country *H*, let $ps_1 = g(S_1)$ be the offer price of good 1, pd_1 the internal demand price for good 1, $pd_2 = d(D_2)$ the final demand price for good 2, psi_2 the offer price of good 2 on the internal market and pse_2 the offer price of good 2 in country *F* (these last two prices being possibly different from the assumption of market segmentation). In country *F*, let p_1^* be the offer price of good 1, equal to the demand price for good 1 produced in country *F*, pe_1 the demand price for good 1 produced in country *H*, $p_2^* = d^*(D_2^*)$ the offer price of good 2 in *F*, equal to the demand price for good 2 in *F*. The unit production, consumption and export taxes/subsidies of good *i* in country *H* are called sp_i , sc_i and se_i respectively ($i = 1,2$).

Section 3 and section 4 present the resolution of the second and the first stage of the game, respectively.

Second stage of the game: determination of the equilibrium quantities

In the second stage of the game, the i[th] firm 2 of country *H* maximizes its profit with respect to its domestic sales, D_2^i, and its exports, X_2^i, taking as given the purchases of good 1 in *H* by the firms 2 of country *F*, X_1, the domestic sales of good 2 by the other firms 2 of country *H*,

D_2^{-i}, as well as the sales of good 2 in country *F* by the firms 2 of country *F* and by the other firms 2 of country *H*, S_2^* and X_2^{-i}, from the assumption of Cournot competition. The profit of the i[th] firm 2 in country *H* is:

(1) $\Pi^{2i}(D_2^i, X_2^i, S_2^*, X_1, D_2^{-i}, X_2^{-i}, q, h) = \hat{\Pi}^{2i}(D_2^i, X_2^i, S_2^*, X_1, D_2^{-i}, X_2^{-i}) + qD_2 + hX_2$

with $\hat{\Pi}^{2i} = d(D_2)D_2^i + d^*(X_2 + S_2^*)X_2^i - g(D_2 + X_2 + X_1)D_1^i - C_2^i(S_2^i)$,

$q = (sp_1 + sc_1) + (sp_2 + sc_2) = (ps_1 - pd_1) + (psi_2 - pd_2)$,

$h = (sp_1 + sc_1) + (se_2 + sc_2) = (ps_1 - pd_1) + (pse_2 - p_2^*)$,

where $\hat{\Pi}^{2i}$ is the profit net of budgetary transfers, $(qD_2 + hX_2)$ are the budgetary transfers, and $C_2^i(S_2^i)$ is the cost of the production factors except the cost of the intermediate good.

The two first order conditions of profit maximization are:

(2) $\hat{\Pi}^{2i}_{D_2^i}(D_2^i, X_2^i, X_1, D_2^{-i}, X_2^{-i}) + q = 0$ with $\hat{\Pi}^{2i}_{D_2^i} = d + d' D_2^i - g - g' D_1^i - c_2^i$

(3) $\hat{\Pi}^{2i}_{X_2^i}(D_2^i, X_2^i, S_2^*, X_1, D_2^{-i}, X_2^{-i}) + h = 0$ with $\hat{\Pi}^{2i}_{X_2^i} = d^* + d^{*\prime} X_2^i - g - g' D_1^i - c_2^i$

where $\hat{\Pi}^{2i}_{D_2^i}$ and $\hat{\Pi}^{2i}_{X_2^i}$ are the partial derivatives of $\hat{\Pi}^{2i}$ with respect to D_2^i and X_2^i, respectively, and where $c_2^i = c_2^i(S_2^i)$ is the marginal cost of production.

These two first orders conditions indicate that in the absence of intervention ($q = h = 0$), the i[th] firm 2 of country *H* equalizes the perceived marginal revenue of its sales on the internal market (i.e., the marginal revenue based on its Cournot behavior), $d + d' D_2^i$, as well as the perceived marginal revenue of its export sales, $d^* + d^{*\prime} X_2^i$, with its perceived marginal outlays, $g + g' D_1^i + c_2^i$. For the sales of good 2 on the internal market, optimality requires the equalization of the price and the marginal cost of production, and thus the correction of two distortions, i.e. the oligopsonistic distortion upstream and the oligopolistic distortion downstream. For the sales of good 2 on the export market, optimality requires the equalization of the real marginal outlay (taking into account the adjustment of the sales of firms 2 of *F* as well as the adjustment of the sales of the other firms 2 of country *H*) and of the production costs, thus the correction of three distortions, i.e. the oligopsonistic distortion upstream, and two distortions downstream: first, a "strategic distortion", because if acting as Stackelberg leaders, the home firms could attain a higher profit level in the competition with the foreign firms ; second, a terms of trade distortion, because each home firm 2 does not internalize the effects of its output decisions on the price faced by the other home firms 2[i].

In the same way, the j[th] firm 2 of country *F* maximizes its profit with respect to S_1^{j*} and X_1^j, taking as given the purchases of good 1 in *H* by the firms 2 of *H* and by the other firms 2 of *F*, D_1 and X_1^{-j}, the purchases of good 1 in country *F* by the other firms 2 of *F*, S_1^{-j*}, and the sales of the firms 2 of *H* in *F*, X_2. The profit of the j[th] firm 2 of *F* is:

(4) $\Pi^{2j*}(S_1^{j*}, X_1^j, D_1, X_2, S_1^{-j*}, X_1^{-j}) = \hat{\Pi}^{2j*}(S_1^{j*}, X_1^j, D_1, X_2, S_1^{-j*}, X_1^{-j}) + xX_1$

with $\hat{\Pi}^{2*} = d^*(S_1^* + X_1 + X_2)S_2^{j*} - g^*(S_1^*)S_1^{j*} - g(X_1 + D_1)X_1^j - C_2^{j*}(S_2^{j*})$

and $x = sp_1 + se_1 = ps_1 - pe_1$

where $C_2^{j*}(S_2^{j*})$ is the cost of the factors of production except good 1.

The first order conditions of the profit maximization are:

(5) $\hat{\Pi}^{2j*}_{S_1^{j*}}(S_1^{j*}, X_1^j, X_2, S_1^{-j*}, X_1^{-j}) = 0$ with $\hat{\Pi}^{2j*}_{S_1^{j*}} = d^* + d^{*}{}' S_2^{j*} - g^* - g^{*}{}' S_1^{j*} - c_2^{j*}$

(6) $\hat{\Pi}^{2j*}_{X_1^j}(S_1^{j*}, X_1^j, X_2, D_1, S_1^{-j*}, X_1^{-j}) + x = 0$ with $\hat{\Pi}^{2j*}_{X_1^j} = d^* + d^{*}{}' S_2^{j*} - g - g' X_1^j - c_2^{j*}$

where $\hat{\Pi}^{2j*}_{S_1^{j*}}$ and $\hat{\Pi}^{2j*}_{X_1^j}$ are the partial derivatives of $\hat{\Pi}^{2j*}$ with respect to S_1^{j*} and X_1^j, respectively, and where $c_2^{j*} = c_2^{j*}(S_2^{j*})$ is the marginal cost of production.

These two first order conditions indicate that in the absence of intervention ($x = 0$), the j[th] firm 2 of *F* equalizes the perceived marginal revenue of its sales on the internal market,

$d^* + d^{*}{}' S_2^{j*}$, with the perceived marginal outlay for imports of the intermediate good 1, $g + g' X_1^j + c_2^{j*}$, as well as with the perceived marginal outlay for local purchases of good 1, $g^* + g^{*}{}' S_1^{j*} + c_2^{j*}$. The introduction of $x < 0$ leads to an increase in the perceived marginal outlay for imports, from $g + g' X_1^j + c_2^{j*}$ to $g + g' X_1^j + c_2^{j*} - x$. In other words, it leads to a positive net marginal profitability of imports of good 1 by the firm of *F*, $\hat{\Pi}^{2j*}_{X_1^j}$, the profit $\hat{\Pi}^{2j*}_{X_1^j} X_1^j$ being captured as a budgetary revenue by the country *H*, and the total marginal profitability $\Pi^{2j*}_{X_1^j}$ being equal to zero. Thus, the use of a negative x allows country *H* to tax the profit of the foreign firms 2 via their imports of good 1.

From the assumption of a Leontief technology and from the market equilibrium equations it follows that $S_1^* = S_2^* - X_1$ and $D_1 = X_2 + D_2$. For a given level of intervention, the resolution of the system formed by these two equations and equations (2), (3), (5) and (6) determines the equilibrium level of D_2, X_2, X_1, S_2^*, S_1^* and D_1.

First stage of the game: determination of the level of the instruments

In the first stage of the game, the government chooses the level of the instruments q, h and x in order to maximize the national welfare (equal to the sum of the surplus levels of the producers of good 1, the *m* firms producing good 2 and the final consumers, less the cost of intervention), under the constraint of a minimum revenue $\overline{\Pi}^1$ for the producers of good 1. The lagrangean associated with this program is:

(7) $L = W + l(\Pi^1 - \overline{\Pi}^1)$, with $W = \Pi^1 + \sum_{i=1}^{m} \hat{\Pi}^{2i} + \Psi_c - xX_1$

where l is the multiplier of the redistributive constraint.

The solution for optimal intervention is found by totally differentiating this lagrangean. A convenient form for this total derivative is obtained using the two following relations. First, equation (5) implicitly defines $S_2^* = S_2^*(X_2, X_1)$, where $S_{2X_2}^*$ is negative and $S_{2X_1}^*$ is positive under the assumption of strategic substitutability between the purchases of good 1 and between the sales of good 2 for the different firms (see annex). Second, equation (6) implicitly defines $pe_1 = pe_1(D_1, X_1, X_2)$, where the partial derivatives pe_{1X_1} and pe_{2X_2} are negative under the assumption of strategic substitutability, if $g + g''.X_1 > 0$ and if the marginal cost is non decreasing ($c_2^*{}' \geq 0$), and where $pe_{1D_1} = -g''.X_1 / m$, which sign depends of the concavity /convexity of the inverse offer function of good 1 in country H (see annex). Using these both expressions, after rearrangement, yields:

$$
\begin{aligned}
& dL = [-q + \frac{1}{m} D_1 g' + X_1 pe_{1D_1} + lS_1 g' + \frac{1}{m} \Psi_c{}'] dD_2 \\
(8)\quad & + [-h + \frac{1}{m} D_1 g' + X_1 pe_{1D_1} + lS_1 g' + \frac{m-1}{m} d^*{}' X_2 + mS_{2X_2}^* \hat{\Pi}_{S_2^*}^{2i} + X_1 . pe_{1X_2}] dX_2 \\
& + [-x + mS_{2X_1}^* \hat{\Pi}_{S_2^*}^{2i} + X_1 pe_{1X_1} + lS_1 g'] dX_1
\end{aligned}
$$

Assuming an interior solution is obtained, the optimal intervention is found by equating to zero the partial derivatives of the lagrangean with respect to D_2, X_2 and X_1. This directly gives the optimal levels of the instruments q, h and x. The interpretation is made easier by re-writing the result in terms of optimal price differences. From equation (1), $(ps_1 - pd_1)$ intervenes in the both expressions of q and h, and thus there exists an infinity of solutions in terms of price differences. This characteristic follows from the assumption of Leontief technology of production of good 2 with respect to good 1. From equations (1) and (4), the optimal equilibrium can be obtained with the following price differences:

(9) $ps_1 - pd_1 = sp_1 + sc_1 = lS_1 g' + \frac{1}{m} D_1 g' + X_1 pe_{1D_1}$

(10) $ps_1 - pe_1 = sp_1 + se_1 = lS_1 g' + mS_{2X_1}^* \hat{\Pi}_{S_2^*}^{2i} + X_1 pe_{1X_1}$

(11) $psi_2 - pd_2 = sp_2 + sc_2 = \frac{1}{m} \Psi_c{}' = -\frac{1}{m} D_2 . d'$

(12) $pse_2 - p_2^* = sp_2 + se_2 = \frac{m-1}{m} d^{*}{}' X_2 + mS^*_{2X_2}.\hat{\Pi}^{2i}_{S_2^*} + X_1.pe_{1X_2}$

The results can be interpreted using the targeting principle. Four kinds of distortions are present here: the revenue redistribution towards primary producers ; the distortions resulting from the market power exerted by the domestic firms 2 on their internal markets, upstream and downstream ; the terms of trade distortion resulting from the excessive competition of the domestic firms 2 on their export market ; and the "strategic" distortions resulting from the non-competitive behavior of the foreign firms 2, upstream and downstream. According to the targeting principle, if only price instruments are at disposal, the least-distorting way to redistribute income towards producers of good 1 is a producer subsidy, $sp_1 = lS_1 g' > 0$.

The "strategic distortions" are of two kinds. First, in the presence of equilibrium oligopsony rents partly captured by the importing foreign firms 2 on the market of the good 1 in country *H*, country *H* can improve its terms of trade on this market[ii]. Second, in the presence of an oligopolistic rent on the foreign sales market of good 2, the home government can help the domestic firms 2 increasing their net export profit. Each of these distortions require a simultaneous intervention on the exports of both the primary and the processed goods.

Thus, the instrument on exports of the intermediate good, se_1, is used simultaneously to improve the terms of trade on this market ($X_1 pe_{1X_1} < 0$) ; and to diminish the imports of good 1 by the foreign firms 2, in order to reduce their total production, and thus increase the marginal revenue of exports by the domestic firms 2 ($mS^*_{2X_1}\hat{\Pi}^{2i}_{S_2^*} < 0$). The intervention thus corresponds to an export tax on good 1, $se_1 < 0$.

Assuming that the production subsidy sp_2 equals zero, the instrument on exports of the final good, se_2, is the sum of three terms: a negative term of improvement of the terms of trade on the market of good 1, $X_1 pe_{1X_2} < 0$, aimed at increasing the sales price on the foreign market 2, and thereby increase the import price of intermediate good ; a positive term of correction of the strategic distortion on the downstream foreign market, $mS^*_{2X_2}\hat{\Pi}^{2i}_{S^*_2} > 0$, aimed at increasing the marginal export revenue of the domestic firms 2 ; a negative terms of trade correction on market 2, $(m-1)d^{*\prime}X_2/m < 0$, intended to prevent the domestic firms from excessive competition in the foreign market. The instrument used may be an export tax or a subsidy depending on the relative values of these effects.

Still assuming that the production subsidy sp_2 is equal to zero, the correction of the oligopoly distortion on the internal market requires a consumption subsidy, $sc_2 = -D_2 d' > 0$. The instrument at the intermediate consumption of good 1, sc_1, is used simultaneously to correct the oligopsony distortion ($D_1 g'/m > 0$) and to improve the terms of trade on the market of good 1 ($X_1 pe_{1_{D1}}$, which sign depends on the concavity/convexity of the internal offer curve of good 1 in H). The sum of these two effects is necessarily positive if the offer function of sector 1 in H is concave. It may be negative in case of strong convexity of this offer function.

Table 1 sums up the instruments used at the equilibrium of optimal intervention, in the case where the production subsidy sp_2 equals zero.

Insert table 1

Conclusion

The results obtained here may be compared with the case of perfect competition in a similar context of vertically related markets. In this latter case, the optimal price policy consists in a production subsidy on the primary good aimed at redistributing revenue towards its producers, and export taxes on both goods aimed at improving the terms of trade in the large country case. Integrating an oligopolistic-oligopsonistic behavior of the processing firms in this framework, we find that the production subsidy on the primary good is still the best way to redistribute income towards its producers ; but intervention on the exports of both goods is now motivated by the strategic nature of the interaction between firms, and welfare maximization also requires intervention on the internal home markets, mainly because of the non-competitive behavior of the domestic firms. Thus this paper identifies new rationales for intervention arising in a context of vertically related markets, when taking into account imperfect competition.

However the signs of the instruments obtained here are specific to the assumption of Cournot competition with marginal substitutability between purchases and between sales of the different processing firms, segmented markets). Further research should investigate other assumptions on the competitive structure (e.g. Bertrand behavior of firms, integrated markets).

Moreover, assuming that the processing firm of the importing country is able to exert market power upstream and downstream may not be adequate in the countries importing agricultural goods from the UE. It would be interesting to extend our framework to a three-country model, where two countries showing imperfect competition in the processing sector would export towards a third country with markets in perfect competition.

Annex

Totally differentiating equation (5), after rearrangement, yields $S_2^* = S_2^*(X_2, X_1)$, with

$$S^*_{2X_2} = -\frac{m^*\hat{\Pi}^{2j*}_{S_1^{j*}X_2}}{\hat{\Pi}^{2j*}_{S_1^{j*}S_1^{j*}} + (m^*-1)\hat{\Pi}^{2j*}_{S_1^{j*}S_1^{-j*}}}, \text{ and } S^*_{2X_1} = \frac{(\hat{\Pi}^{2j*}_{S_1^{j*}S_1^{j*}} - \hat{\Pi}^{2j*}_{S_1^{j*}X_1^{j}}) + (m^*-1)(\hat{\Pi}^{2j*}_{S_1^{j*}S_1^{-j*}} - \hat{\Pi}^{2j*}_{S_1^{j*}X_1^{-j}})}{\hat{\Pi}^{2j*}_{S_1^{j*}S_1^{j*}} + (m^*-1)\hat{\Pi}^{2j*}_{S_1^{j*}S_1^{-j*}}}.$$

Totally differentiating equation (6), after rearrangement, yields $pe_1 = pe_1(D_1, X_1, X_2)$, with

$$pe_{1D_1} = -\frac{1}{m}g''.X_1, \qquad pe_{1X_1} = -\frac{1}{m^*}(g'+g''.X_1) + S^*_{2X_1}\frac{\hat{\Pi}^{2j*}_{X_1^jS_1^{j*}} + (m^*-1)\hat{\Pi}^{2j*}_{X_1^jS_1^{-j*}}}{m^*}, \qquad \text{and}$$

$$pe_{1X_2} = \hat{\Pi}^{2*}_{X_1X_2} + S^*_{2X_2}\frac{\hat{\Pi}^{2j*}_{X_1^jS_1^{j*}} + (m^*-1)\hat{\Pi}^{2j*}_{X_1^jS_1^{-j*}}}{m^*}.$$

The second order conditions for the profit maximization imply that $\Pi^{2j*}_{S_1^{j*}S_1^{j*}} < 0$. From the terminology of Bulow et al. (1985), the purchases of good 1 are strategic substitutes if the marginal profitability of purchases of the intermediate good by each firm 2 decreases with the purchases of the other firms 2: $\Pi^{2j*}_{X_1^j X_1^{-j}} < 0$, $\Pi^{2j*}_{S_1^{j*} S_1^{-j*}} < 0$, $\Pi^{2j*}_{X_1^j D_1} < 0$. This yields: $g' + g''.X_1^j > 0$ and $g^{*}{}' + g^{*}{}''.S_1^{j*} > 0$. In the same way, the assumption of strategic substitutability between the sales of good 2 leads to: $\Pi^{2j*}_{S_1^{j*} X_2} < 0$ and $\Pi^{2j*}_{X_1^j X_2} < 0$, which gives $d^{*}{}' + d^{*}{}''.S_2^{j*} < 0$. From the expressions of the second order derivatives, one shows that the numerator of $S^*_{2X_1}$ equals $-g^{*}{}' - m^*(g^{*}{}' + g^{*}{}''.S_1^{j*})$, that $\Pi^{2j*}_{X_1^j S_1^{-j*}} = d^{*}{}' + d^{*}{}''.S_2^{j*}$ and that $\Pi^{2j*}_{X_1^j S_1^{j*}} = 2d^{*}{}' + d^{*}{}''.S_2^{j*} - c_2^{j*}{}'$. These three expressions are negative under the previous restrictions and as long as the marginal cost is non decreasing. Assuming also $g + g''.X_1 > 0$ yields the signs given in the text for the partial derivatives of S_2^* and pe_1.

Table 1 : summing up of the instruments used

Optimal price differences	$ps_1 - pd_1$		$ps_1 - pe_1$		$psi_2 - pd_2$	$pse_2 - pe_2$
Instruments	sc_1	sp_1	se_1	sp_1	sc_2	se_2
Improvement of the terms of trade on market 1	+/-		-			-
Correction of the oligopsony distortion exerted by domestic firms 2 on the home market 1	+					
Correction of the strategic distortion on the foreign market 2			-			+
Correction of the oligopoly distortion exerted domestic firms 2 on the home market 2					+	
Correction of the terms of trade distortion due to the excessive competition between domestic firms 2 on their export market 2						-
Redistributive constraint towards producers of good 1		+		+		
Total	+/-		-	+	+	+/-

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[i] Details for the oligopolistic case can be found in Krishna and Thursby, 1991.

[ii] See Cheng (1988) for a similar argument in the case of imports on an oligopoly market.

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