

Effects of Adverse Selection on a Multinational Firm's Decision on Where to Subcontract

Rosa Forte¹ and António Brandão

CETE,² Faculty of Economics – University of Porto

July 27, 2006

¹Corresponding author. Address: Faculdade de Economia, R. Dr. Roberto Frias, 4200-464 Porto. Tel.: 351 225 571 257; fax: 351 225 505 050. E-mail address: rforte@fep.up.pt

²CETE - Research Center on Industrial, Labour and Managerial Economics - is supported by the Fundação para a Ciência e a Tecnologia, Programa de Financiamento Plurianual through the Programa Operacional Ciência, Tecnologia e Inovação (POCTI) of the Quadro Comunitário de Apoio III, which is financed by FEDER and Portuguese funds.

Abstract

This paper analyses the effects of adverse selection on a multinational firm's decision on where to subcontract. Adverse selection arises since subcontractor firms have more information than the multinational concerning their production costs. The results obtained show that adverse selection confers to subcontractor firms an advantage in their relationship with the multinational, inducing the multinational to subcontract in more than one country. In this way, adverse selection modelling outcomes justify, and are coherent with, the empirical evidence such as, the diversity of countries that multinational firms subcontract and the fast production relocation between countries.

JEL Classification: D82, F23, L24

Keywords: International subcontracting, adverse selection, location

1 Introduction

In order to remain competitive in the global market, firms must increasingly assume an international configuration concerning their production. Hence, many multinational firms (MNFs) locate production units in countries with lower wage costs, through engaging in foreign direct investment (FDI), or subcontract the production to foreign firms. With the same goal, many multinational firms (MNFs) have recently relocated production from developed and some Central East European countries to more attractive countries (e.g. China) (UNCTAD, 2003). Donaghu and Barff (1990), based on Nike's history, have already pointed out the relatively rapid relocation of production between countries.

In the present worldwide context, the choice of the country in which to install a production unit or in which to subcontract has crucial importance, for two reasons. First, the choice of location influences the firm's competitiveness (Porter, 1985). Second, as a result of a gradual trade liberalisation promoted by the World Trade Organisation (WTO), as well as a continuous liberalisation of the FDI regulation, the MNFs have currently more location possibilities than they did two decades ago (WTO, 1998, 2003).

Insofar as subcontracting has been used with increasing frequency in the last two decades and because the existing literature has emphasised the case of FDI, our work focuses on the choice of the country in which to subcontract. In line with Grossman and Helpman (2002), our definition of subcontracting means more than just purchasing raw materials and standardised intermediate products. It entails finding a "partner" with which the MNF can establish a bilateral relationship governed by a contract (an effective agreement between the MNF and a foreign firm to produce a certain good or component, to a customised specification provided by the MNF, in exchange for some form of payment).¹

¹Usually, the terms subcontracting, outsourcing, contracting-out, and contract manufacturer are used

Concerning the increasing use of subcontracting, as has been pointed out in some studies, we live in the age of subcontracting [Feenstra (1998), Vining and Globerman (1999), UNCTAD (2002) and Grossman and Helpman (2002)]. Firms, particularly MNFs, have used subcontracting extensively, not only in the secondary activities of their value chain, but also in their core activities, which reflects the MNFs' efforts in concentrating on their main capabilities (UNCTAD, 2002). However, it must be noted that it has been difficult to measure its growth since contractual agreements are difficult to isolate in the international trade statistics. Nevertheless, stories about international subcontracting abound in the business press (Grossman and Helpman, 2003). We can also report some articles, such as, Donaghu and Barff (1990) and Grazianni (2001), which emphasise the subcontracting experience of some multinationals, as is the case of Nike, and Benetton and Levi, respectively.

Despite the growing importance of subcontracting, the literature has neglected the question of knowing which factors influence the firms' choice of the country in which to subcontract. In fact, the existing literature has essentially been based on the neoclassical theory of the firm, focusing on the choice between subcontracting or investing directly, and centring on the factors that favour the subcontracting.² The multinational firm will subcontract the production of a certain good if the respective production costs are lower than those that would result from direct investment. We cannot, however, apply the neoclassical theory of the firm to the choice of location, since the MNF does not have perfect knowledge of the foreign firms' production costs. In fact, it is reasonable that foreign firms

indistinctly, as is the case of our paper. However, some authors use the term outsourcing in a broader sense, to include all the foreign production resulting from other modes of entry into foreign markets.

²With respect to that, most of the literature considers that the cost of inputs (especially labour costs) are of fundamental importance [Walker and Weber (1984); Abraham and Taylor (1996); Park et. al. (2000)].

(subcontractors) possess private information of their type (firms have private information concerning their costs of production), that is, there is information asymmetry (an adverse selection problem), which may give the foreign agents the edge in their relationship with the multinational.

Literature is scarce, however, about the role of asymmetric information on the MNF decision concerning the country in which to subcontract. The Grossman and Helpman' (2002) study is one of the few exceptions. Grossman and Helpman (2002) developed a general equilibrium model that they used to study the firms' decisions concerning the subcontracting location of an intermediate input (in the domestic country - North - or in a foreign country - South), admitting that the subcontracting activities require the accomplishment of specific investments on the part of the subcontractor firm. These investments are unverifiable or are verifiable only partially, that is, they consider that the subcontracting relationship is characterised by a moral hazard situation.

Similarly to Grossman and Helpman (2002), our work aims to analyse whether the firm's decision is influenced by the presence of asymmetric information. However, it is distinct from the Grossman and Helpman' (2002) work in two basic aspects. First, it has a different emphasis insofar as it focuses on the firm's individual decision. Second, it focuses on a different type of asymmetric information. In fact, while Grossman and Helpman (2002) lead with a moral hazard situation, our work considers a situation of adverse selection. Since the subcontracting relationship is normally established through the accomplishment of a contract between the two firms (MNF and foreign firm, subcontractor), the choice of the place in which to subcontract is intimately related with the definition of the best contract to offer to the foreign firm.

The remainder of this paper is organised as follows: in the next section we introduce the

basic hypotheses of the model; in section 3 we analyse the decision of the firm in a context absent of adverse selection; in section 4 we develop a model of adverse selection applied to the choice of the country in which to subcontract, and determine the MNF's optimal strategy under these circumstances; finally, in section 5 we present our main conclusions.

2 Basic hypotheses for the location choice model

In this section, assuming that the MNF has decided to subcontract the production of a good to a foreign firm, a crucial decision the MNF faces is to select the country in which to subcontract. To this end, we assume that there are n possible places (countries). These n locations are constituted by n_G type G firms and n_B type B .³ The two types of firms present different production costs: for a particular quantity, the costs are higher for a type B firm ("bad" firm) than for a type G firm ("good" firm). This means that, for the same output level, the multinational has to pay more to the type B firm, that is, to the less efficient firm.

The MNF sells in the worldwide market, a quantity q at the price P . The output q is a function of the effort (ε) by the foreign firm that produces the good (agent or subcontractor). Similar to Das (1999), we assume the following production function: $q(\varepsilon) = \varepsilon$. Furthermore, we assume that the agent's effort is observable and that the multinational (principal) is risk neutral. Ignoring the effect of the state of nature, we analyse the MNF's decision as if it were a situation of certainty (there is only uncertainty concerning the type of agent). The MNF's behaviour depends on the following profit

³In both cases we assume that firms are homogeneous.

function:⁴

$$\pi_{MNF} [q(\varepsilon), w] = Pq(\varepsilon) - w \quad (1)$$

where w represents the wage the MNF has to pay to the subcontractor firm.

The function $\pi_{MNF}(\cdot)$ is ascending and concave (not strict) in ε considering that $\pi'_\varepsilon > 0$ and $\pi''_\varepsilon = 0$, and descending and concave in w ($\pi'_w < 0$ and $\pi''_w = 0$), indicating that the MNF is risk neutral.

As to the subcontractor firm, we assume the following profit function:

$$\Pi_i^{SUB}(w, \varepsilon) = u(w) - d_i(\varepsilon), \quad i = G, B. \quad (2)$$

As the previous function indicates the two types of firms differ only in respect to the disutility of the effort, $d_i(\varepsilon)$, which, in our case, reflects the production costs. Concerning this disutility, we assume that a greater effort means a higher disutility ($d'_i(\varepsilon) > 0$) and that the marginal disutility of effort is not decreasing ($d''_i(\varepsilon) \geq 0$). We consider the following functions for the type G firm and type B firm, respectively:

$$d_G(\varepsilon) = \frac{\varepsilon^2}{2} \quad (3)$$

$$d_B(\varepsilon) = k \frac{\varepsilon^2}{2}, \quad k > 1. \quad (4)$$

The previous expressions reveal that the production of a given quantity is more costly for the type B firm than for the type G firm (the former presents a larger disutility of effort).

Relative to the function $u(w)$, we assume that $u(w) = w$ and, therefore, $u' > 0$ (i.e., $u(\cdot)$ is an increasing function in w) and $u'' = 0$. This means that, similarly to the MNF, the foreign firm is also risk neutral. We still consider that, in the absence of contracting, the firm gets a null profit, that is, the profit that the firm would obtain in its better alternative (the reservation utility level).

⁴Wherever the place the MNF subcontracts the production, its destination is the worldwide market.

We thus assume that the transport costs are the same wherever the location, and normalise them to zero.

We start by analysing the MNF's location decision, admitting that no problem of adverse selection exist. Later, we analyse the situation of asymmetric information characterised by the fact that the subcontractor firm knows its type but the multinational does not.

3 Absence of adverse selection in the location choice

3.1 Optimal contracts

In the absence of asymmetric information, particularly of adverse selection, we assume that the MNF knows the location of type G firms and type B firms. In this situation, and admitting absence of uncertainty concerning the state of nature, the MNF faces the following maximisation problem:

$$\underset{(\varepsilon, w)}{\text{Max}} [\pi_{MNF}(\varepsilon, w)] = P\varepsilon - w$$

s.t.

$$\Pi_i^{SUB}(w, \varepsilon) = u(w) - d_i(\varepsilon) \geq 0, i = G, B. \quad (5)$$

Condition (5) represents the agent's participation constraint, indicating that the subcontractor firm will accept the contract if it allows the firm to obtain a profit at least equal to that the firm would get in its better alternative. So, there is an optimal contract for type G firms and another optimal contract for type B firms. However, given that the MNF knows the location of firms with smaller costs, the MNF will offer only the contract designed for this type of firm since it will allow the MNF to get a higher profit, as we will prove in the following points.

If the MNF decides to contract the type B firm, the Lagrangean relative to the

maximisation problem is:

$$L = P\varepsilon_B^* - w_B^* + \lambda \left(w_B^* - k \frac{(\varepsilon_B^*)^2}{2} \right).$$

Through calculating the respective first-order conditions, we obtain the following optimal contract for the type B firm:

$$\left(\varepsilon_B^* = \frac{P}{k}, w_B^* = \frac{P^2}{2k} \right). \quad (6)$$

If the firm is type G , $k = 1$, therefore, appealing to the contract defined for the type B firm, given by (6), we have the following optimal contract for the most efficient location:

$$\left(\varepsilon_G^* = P, w_G^* = \frac{P^2}{2} \right). \quad (7)$$

Comparing the two contracts, and since $k > 1$, we verify that $\varepsilon_G^* > \varepsilon_B^*$, that is, it is optimal for the MNF to demand higher quantity (effort) from the firm in which the production is less costly (type G firm). In our case, we also confirm that it is optimal to offer higher payment to the type G firm ($w_G^* = \frac{P^2}{2} > w_B^* = \frac{P^2}{2k}$, taking into account that $k > 1$).⁵

3.2 Optimal strategy in the absence of adverse selection

Taking into account the MNF's profit function given by (1) and on the basis of the contract defined in (6), the MNF would get the following profit if it subcontracted a type B firm:

$$\pi_{MNF}(w_B^*, \varepsilon_B^*) = P\varepsilon_B^* - w_B^* = \frac{1}{2} \frac{P^2}{k}. \quad (8)$$

⁵This situation is not always verified in more general cases, because the relation between wages depends on two aspects. On one hand, any effort level is more costly to a type B firm than to a type G firm and, therefore, for a particular effort level, a type B firm demands a higher wage than a type G firm. On the other hand, the MNF requests a smaller effort of the type B firm than of the type G firm, so the latter should receive a higher wage for equal effort disutility.

Bearing in mind the contract defined in (7), the resulting MNF's profit from subcontracting type G firms would be:

$$\pi_{MNF}(w_G^*, \varepsilon_G^*) = P\varepsilon_G^* - w_G^* = \frac{P^2}{2}. \quad (9)$$

Since the MNF knows the type G firms and the type B firms' locations, it will obviously offer the contract designed for the former, that is, (w_G^*, ε_G^*) , insofar as it is the contract that grants higher profit to the MNF. In fact, comparing (9) and (8) we obtain:

$$\Delta\pi_{MNF} = \pi_{MNF}(w_G^*, \varepsilon_G^*) - \pi_{MNF}(w_B^*, \varepsilon_B^*) = \frac{P^2(k-1)}{2k}. \quad (10)$$

Since $k > 1$, expression (10) assumes a positive value. Hence, the contract (w_G^*, ε_G^*) is always preferable and $\Delta\pi_{MNF}$ increases with the increase in k .⁶

It is worth noting that type B firms are not interested in the contract (w_G^*, ε_G^*) because $\Pi_B^{SUB}(w_G^*, \varepsilon_G^*) < 0$.⁷ Without any contract, this type of firms would get a null profit (reservation utility level), the same as it would get with (w_B^*, ε_B^*) , because the participation constraint is active, that is, is satisfied in equality. Thus, type B firms would only accept the contract (w_B^*, ε_B^*) and never (w_G^*, ε_G^*) . However, the same does not occur with type G firms. In effect, if the MNF offered two contracts, (w_B^*, ε_B^*) and (w_G^*, ε_G^*) , type G firms would opt for (w_B^*, ε_B^*) and they would not be interested in (w_G^*, ε_G^*) , since they would get a higher profit with the former.⁸ This fact makes this contract menu unfeasible under asymmetric information.

⁶The MNF would be indifferent to both contracts in the case of $P = 0$ (which does not make economic sense).

⁷In fact, taking into account the profit function given by (2) and the contract (w_G^*, ε_G^*) given by (7) we get $\Pi_B^{SUB}(w_G^*, \varepsilon_G^*) = (1-k)\frac{P^2}{2}$, which is negative since $k > 1$.

⁸Actually, $\Pi_G^{SUB}(w_G^*, \varepsilon_G^*) = 0$ and $\Pi_G^{SUB}(w_B^*, \varepsilon_B^*) = \frac{1}{2}P^2\frac{(k-1)}{k^2} > 0$. Insofar as $k > 1$, $\Pi_G^{SUB}(w_B^*, \varepsilon_B^*) > 0$.

4 The adverse selection case

4.1 Introduction

In the previous section we showed that in symmetric information, since the MNF knows where type G firms (more efficient firms) and type B firms are located, its optimal strategy consists of offering the contract defined for the former type of firms. However, as pointed out previously, the choice of the place in which to subcontract can involve asymmetric information, in particular, an adverse selection situation.

In a situation of adverse selection, the subcontractor firm has knowledge that is pertinent to the transaction but is unknown to the MNF. That is, before signing the contract (before the relationship begins), the MNF (the party establishing the contract's terms), has less information than the foreign firm, subcontractor; the latter has pre-contractual information concerning its own characteristics, that are relevant to the contractual relationship, which can give it an advantage in its relationship with the MNF. In our study, we assume that the firm has private information concerning its technology and, therefore, concerning its production costs. The MNF has, thus, to choose between two types of firms (located in different countries).

The timing of this game is the following:

(1) nature chooses the firm's type t_i ($i = G, B$), admitting that the probability of the firm being of type G is p , with $0 < p < 1$ (obviously, the probability of the firm being of type B is $(1-p)$). That is, as we have mentioned above, the MNF has n possible locations, and the probability of being type G is p while the probability of being type B is $(1-p)$.⁹

(2) the MNF defines the contract;

⁹It is worth noting that we admit that there is only uncertainty concerning the type of the subcontractor firm (agent).

- (3) the subcontractor accepts or rejects;
- (4) the subcontractor and the MNF get a payoff.

How does the MNF decide in this situation, that is, knowing that it has less information than foreign firms? The MNF has three possibilities:

- 1) To offer the contracts (w_B^*, ε_B^*) and (w_G^*, ε_G^*) , determined in symmetric information;
- 2) To offer only the contract (w_G^*, ε_G^*) , defined in symmetric information. However, the contract only takes place with probability p ;
- 3) To use an adverse selection model, taking into account the probability of the firm being type G or type B (that is, the MNF defines a menu of contracts aimed at supplying incentives and/or inducing the revelation of private information, that is, a menu of contracts that induces the type G firm to accept the contract designed for its own type).

We will analyse these three possibilities in the following sections in order to determine the MNF's optimal strategy (the strategy that provides the MNF with a higher expected profit).

4.2 The MNF offers the contracts defined in symmetric information

As we have indicated above, if the multinational offers the contracts, (w_B^*, ε_B^*) and (w_G^*, ε_G^*) , both types of firms will have an interest in choosing the contract (w_B^*, ε_B^*) , which means that the contract (w_G^*, ε_G^*) does not satisfy the self-selection constraint. Thus, since both types of firms would choose (w_B^*, ε_B^*) the MNF would not differentiate the locations and its profit would be equal to the profit given by expression (8). Looking at

this expression we realise that the higher the production costs (higher effort disutility) of the type B firm, the smaller the MNF's expected profit. That is, the multinational's expected profit will be much higher the more similar both types of firms are (lower k).

4.3 The MNF offers the contract designed for the type G firm

In this situation, the MNF's aim will be to offer a contract menu that induces only the type G firm to accept. That is, the underlying idea is that the MNF only intends to subcontract production if the location has low costs. This case is equivalent to a situation of symmetric information with only one type of firm. However, the contract will only take place with probability p . Thus, taking into account expression (9), the MNF's expected profit with the contract (w_G^*, ε_G^*) is the following:

$$E[\pi_{MNF}(w_G^*, \varepsilon_G^*)] = p\pi_{MNF}(w_G^*, \varepsilon_G^*) = p\frac{1}{2}P^2. \quad (11)$$

The previous expression shows that the higher the probability of the firm being type G , the higher MNF's expected profit will be, and it will tend to approximate the MNF's profit in symmetric information, given by equation (9), if p tends to 1.

4.4 The MNF offers a self-selective contract menu

As shown above, the contracts designed when there is complete or symmetric information do not satisfy the self-selection constraints. A type G firm prefers the contract designed for a type B firm, since with this contract it will obtain a profit higher than zero (the reservation utility level). The solution comprises altering the contracts so as to make the type G firm indifferent both to its contract and to the one offered the type B firm. In this type of situation, it is optimal for the MNF to prepare a contract for each type of firm, which establishes a level of payment and a level of effort that will induce each

firm to choose the contract established for its type, that is, the payment scheme should be self-selective. Thus, the MNF offers two contracts, (w_G, ε_G) and (w_B, ε_B) , obtaining a separating equilibrium and allowing the MNF to identify the type of firm by the type of contract.

In this way the multinational's problem consists of maximising its expected profit subject to the constraints that, after considering the contracts offered, the subcontractor firm decides to accept the contract, choosing that defined for its particular type:¹⁰

$$\underset{[(\varepsilon_G, w_G), (\varepsilon_B, w_B)]}{Max} E[\pi_{MNF}] = p[P\varepsilon_G - w_G] + (1-p)[P\varepsilon_B - w_B]$$

s.t.

$$w_G - \frac{\varepsilon_G^2}{2} \geq 0 \quad (12)$$

$$w_B - k\frac{\varepsilon_B^2}{2} \geq 0 \quad (13)$$

$$w_G - \frac{\varepsilon_G^2}{2} \geq w_B - \frac{\varepsilon_B^2}{2} \quad (14)$$

$$w_B - k\frac{\varepsilon_B^2}{2} \geq w_G - k\frac{\varepsilon_G^2}{2}. \quad (15)$$

Constraints (12) and (13) ensure that the two types of firms will accept their respective contract (participation constraints). Constraints (14) and (15), known as self-selection or incentive compatibility constraints, ensure that each type of firm will prefer the contract designed for its own type to the contract defined for the other type of firm. In other words, constraint (14) prevents a type G firm from choosing the contract intended for a type B firm whereas constraint (15) prevents a type B firm from choosing the contract devised for a type G firm.

¹⁰In this section we follow closely the general model proposed by Macho-Stadler and Pérez Castrillo (1997), proceeding to its adaptation to the particular case in analysis: the choice of the country in which to subcontract.

It should be noted that constraint (12) is redundant, therefore it can be excluded.¹¹

In fact, and considering that $k > 1$, constraint (12) is verified due to (13) and (14). With effect:

$$w_G - \frac{\varepsilon_G^2}{2} \geq w_B - \frac{\varepsilon_B^2}{2} \geq w_B - k \frac{\varepsilon_B^2}{2} \geq 0.$$

In order to solve the maximisation problem displayed above, we consider λ , μ , and δ , the Lagrange multipliers associated with constraints (13), (14) and (15), respectively. The Lagrangean for this problem is then:

$$\begin{aligned} L = & p(P\varepsilon_G - w_G) + (1-p)(P\varepsilon_B - w_B) + \lambda \left(w_B - k \frac{\varepsilon_B^2}{2} \right) + \\ & \mu \left(w_G - \frac{\varepsilon_G^2}{2} - w_B + \frac{\varepsilon_B^2}{2} \right) + \delta \left(w_B - k \frac{\varepsilon_B^2}{2} - w_G + k \frac{\varepsilon_G^2}{2} \right). \end{aligned}$$

The respective first-order conditions are:

$$-p + \mu - \delta = 0 \Leftrightarrow \mu - \delta = p \tag{16}$$

$$-1 + p + \lambda - \mu + \delta = 0 \Leftrightarrow \lambda - \mu + \delta = 1 - p \tag{17}$$

$$pP - \mu\varepsilon_G + \delta k\varepsilon_G = 0 \Leftrightarrow \mu - k\delta = \frac{pP}{\varepsilon_G} \tag{18}$$

$$P - pP - \lambda k\varepsilon_B + \mu\varepsilon_B - \delta k\varepsilon_B = 0 \Leftrightarrow k\lambda - \mu + k\delta = \frac{(1-p)P}{\varepsilon_B}. \tag{19}$$

Equations (16) and (17) imply that $\lambda = 1$, which means that the type B firm's participation constraint is satisfied in equality. Moreover, $\mu > 0$ because $\mu = 0$ would imply, by equation

¹¹As mentioned by Macho Stadler and Pérez Castrillo (1997), this is a characteristic of adverse selection problems. The only participation constraint with which the principal should be concerned is the participation constraint of the least efficient agent in the measure where the incentive compatibility constraint of a type G agent tells us that it does not want to come across as the other type. A type B agent has guaranteed its reservation utility level even with a higher disutility associated with the contracted effort. Thus, a type G agent has also guaranteed the reservation utility level.

(16), $\delta < 0$, which is impossible.¹² On the other hand, (18) and (19) imply:

$$k\lambda = \frac{pP}{\varepsilon_G} + \frac{(1-p)P}{\varepsilon_B}. \quad (20)$$

It must be noted that, in order to satisfy the constraints, the optimal contract must demand a higher effort of the most efficient firm ($\varepsilon_G > \varepsilon_B$). In fact, (14) and (15) imply:

$$\frac{\varepsilon_G^2}{2} - \frac{\varepsilon_B^2}{2} \leq w_G - w_B \leq k \left(\frac{\varepsilon_G^2}{2} - \frac{\varepsilon_B^2}{2} \right), \quad (21)$$

which implies $\frac{\varepsilon_G^2}{2} \geq \frac{\varepsilon_B^2}{2}$ since $k > 1$. If $\varepsilon_G = \varepsilon_B$, then $w_G = w_B$ since (21) implies $w_G - w_B = 0$. In this case, that is, for the values of ε and w common to both types of firms, since $\lambda = 1$ expression (20) implies $k = \frac{P}{\varepsilon}$. Finally, (16) and (18) imply:

$$\mu = p + \delta \quad (22)$$

$$\mu = \frac{pP}{\varepsilon} + k\delta = kp + k\delta = k(p + \delta), \quad (23)$$

which is impossible since $k\mu$ cannot be equal to μ , with $k > 1$ and $\mu > 0$. Thus, the optimal menu includes two different contracts, with $\varepsilon_G > \varepsilon_B$.

Taking into account that $\mu > 0$, equation (14) is satisfied in equality. Equation (15), for its side, is not satisfied in equality, which means that $\delta = 0$. Insofar as $\varepsilon_G > \varepsilon_B$, it is not possible that the two self-selection constraints are, simultaneously, satisfied in equality given that $k > 1$ implies that one of expression (21)'s inequalities be strict.

Taking into consideration that $\delta = 0$, (16) and (18) imply:

$$\varepsilon_G = P. \quad (24)$$

This represents the efficiency condition of the contract (ε_G^*, w_G^*) . Finally, given that (17) is equivalent to $-\mu = 1 - p - \lambda$ and that $\lambda = 1$, equation (19) can be rewritten as:

$$k - p = \frac{(1-p)P}{\varepsilon_B} \Leftrightarrow \varepsilon_B = P \frac{1-p}{k-p}. \quad (25)$$

¹²Note that the Kuhn - Tucker conditions require that the Lagrange multipliers are not negative.

To sum up, the four equations that define the optimal contracts menu are the ones that indicate that (13) and (14) are satisfied in equality, together with (24) and (25). Solving this system of four equations we get the following contract menu:

$$\left(\varepsilon_G = P, w_G = \frac{1}{2}P^2 \frac{k^2 - 4kp + k + kp^2 - 1 + 2p}{(-k + p)^2} \right) \quad (26)$$

and

$$\left(\varepsilon_B = P \frac{-1 + p}{-k + p}, w_B = \frac{1}{2}kP^2 \frac{(-1 + p)^2}{(-k + p)^2} \right). \quad (27)$$

This optimal contract menu has the following characteristics:

- Only the type B firm's participation constraint is satisfied in equality, which means that the least efficient firm presents a profit level that is exactly the same as the reservation utility level, similarly to the situation involving symmetric information. As with the symmetric information situation, in this case the incentive compatibility constraint (15) guarantees that a type B firm does not have an interest in choosing the contract designed for a type G firm since this contract would give it a negative profit.¹³
- The type G firm gets a profit level that is higher than the reservation level (which we assume to be zero), that is, it obtains an informational rent (R). In fact, equation (14) is satisfied in equality, that is:

$$w_G - \frac{\varepsilon_G^2}{2} = w_B - \frac{\varepsilon_B^2}{2}.$$

The previous equation can be rewritten as:

$$w_G - \frac{\varepsilon_G^2}{2} = w_B - k \frac{\varepsilon_B^2}{2} + (k - 1) \frac{\varepsilon_B^2}{2}.$$

¹³ Actually $\Pi_B^{SUB}(w_G, \varepsilon_G) = w_G - k \frac{\varepsilon_G^2}{2} = -\frac{1}{2}P^2 \frac{(k-1)^2(k-2p+1)}{(k-p)^2}$, which assumes a negative value in the measure that $k - 2p + 1 > 0$ since $k > 1$ and $0 < p < 1$.

Since $w_B - k\frac{\varepsilon_B^2}{2} = 0$ (as we have indicated in the previous point), then:

$$w_G - \frac{\varepsilon_G^2}{2} = (k-1)\frac{\varepsilon_B^2}{2} > 0 = R.$$

Insofar as $\varepsilon_B = P\frac{-1+p}{-k+p}$, after simplification we get:

$$R = (k-1)\frac{\varepsilon_B^2}{2} = \frac{1}{2}P^2\frac{(p-1)^2(k-1)}{(k-p)^2}. \quad (28)$$

Since $k > 1$, expression (28) takes a positive value.¹⁴ Analysing the previous expression, we conclude that the informational rent depends on the probability of the firm being type G (represented by p), as well as the difference between the two firms' disutilities of effort (represented by k). The higher p is, the lower will be the informational rent the multinational has to pay to the subcontractor firm, as $\frac{dR}{dp} < 0$. In terms of k , we verify that $\frac{dR}{dk} \gtrless 0$, depending on $k+p \lesseqgtr 2$.¹⁵ This means that, in the case of $p = 0$, the informational rent increases with an increase in k if this is lower than 2, while it diminishes with an increase in k if this is higher than two. At the other extreme, that is, if $p = 1$, then the informational rent diminishes with an increase in k ($k > 1$); in this situation, in order for the informational rent to increase, k would have to be lower than one, which is impossible given the model's hypothesis. For intermediate values of p , the relation between R and k depends on the values of k and p ; thus, if $k+p < 2$ (that is, if the two types of firms do not differ too much in terms of production costs - k is not very large - and if the probability of the firm presenting lower production costs is not very high), an increase in k leads to an increase in R ; if $k+p > 2$, an increase of k leads to a reduction in the informational rent.

¹⁴Note that the informational rent given by (28) exactly equals the firm's profit since the reservation profit is zero.

¹⁵In fact, $\frac{dR}{dk} = -\frac{1}{2}P^2(p-1)^2\frac{k+p-2}{(k-p)^3} \gtrless 0$.

- The self-selecting constraint is active (is satisfied in equality) for the efficient firm, whereas for type B , the opposite occurs. In fact, contrary to that which would occur in symmetric information, in which a type G firm has interest in coming across as a type B and in accepting the contract (w_B^*, ε_B^*) , under adverse selection this does not happen, because the profit obtained with (w_B, ε_B) equals the profit obtained with (w_G, ε_G) . In effect:

$$\Pi_G^{SUB}(w_B, \varepsilon_B) = w_B - \frac{\varepsilon_B^2}{2} = \frac{1}{2}P^2(-1+p)^2 \frac{k-1}{(k-p)^2}. \quad (29)$$

This expression equals $\Pi_G^{SUB}(w_G, \varepsilon_G)$ given by equation (28).

- The efficiency condition is satisfied in equality for the type G firm. This means that, given the adverse selection problem, the only efficient contract is the one devised for the type G firm, that is, for the firm which the others have no interest in coming across as. It is worth noting that, since the foreign firm is risk neutral, $\varepsilon_G = \varepsilon_G^*$, that is, the level of effort required is equal to that which would occur in a situation of symmetric information. In terms of wages, comparing (26) with (7) we have:

$$w_G - w_G^* = \frac{1}{2}P^2 \frac{(k-1)(p-1)^2}{(k-p)^2} > 0. \quad (30)$$

Therefore, the MNF now offers a higher wage, contributing to the firm's informational rent and discouraging it from accepting the contract (ε_B, w_B) .

- A distortion is introduced in the type B firm's efficiency condition, in the sense that the contract (ε_B, w_B) becomes less attractive to type G firms. With this distortion, the multinational loses efficiency in terms of type B firms, but wins in terms of the informational rent it has to pay to the type G firm. Thus, if we compare this contract, given by (27), with the corresponding one in symmetric information, given

by (6), we conclude that:

$$\varepsilon_B - \varepsilon_B^* = -Pp \frac{k-1}{(k-p)k} < 0 \quad (31)$$

and

$$w_B - w_B^* = \frac{1}{2} P^2 p \frac{(k-1)[p(k+1) - 2k]}{(k-p)^2 k} < 0. \quad (32)$$

Taking into account that $0 < p < 1$ and $k > 1$, then $[p(k+1) - 2k]$ assumes a negative value. Hence $w_B - w_B^*$ also assumes a negative value, that is, the wage offered to a type B firm under adverse selection is lower than that of symmetric information, thus leading to a reduction in the demanded effort. Since the demanded effort is lower, only a reduction in the wage allows the type B firm's participation constraint to be satisfied in equality, as we have indicated above.

In the presence of the contract menu established by equations (26) and (27), the multinational's expected profit under adverse selection will be:

$$E[\pi_{MNF}]_{AS} = p(P\varepsilon_G - w_G) + (1-p)(P\varepsilon_B - w_B) = \frac{1}{2} P^2 \frac{kp + 1 - 2p}{k-p}. \quad (33)$$

Analysing the previous expression, we find that its derivative in order to p is positive. That is, the higher the probability of the firm being type G , the higher the MNF's expected profit, since, as we have already seen, the informational rent that has to be paid to this firm is lower. We also find that its derivative in order to k is negative. This means that when a type B firm's disutility of effort is higher, the multinational's expected profit is lower.

4.5 Optimal strategy under adverse selection

In order to determine which of the three alternatives presented in the previous sections is the MNF's optimal option, we will have to compare the expected profit resulting from

each one of the options.

Comparing (11) and (8) we can inquire whether it is preferable to offer the contract (w_B^*, ε_B^*) defined under symmetric information or to offer only the contract designed for the type G firm. Thus, we have:

$$E[\pi_{MNF}(w_G^*, \varepsilon_G^*)] - \pi_{MNF}(w_B^*, \varepsilon_B^*) = \frac{P^2}{2} \left(p - \frac{1}{k} \right). \quad (34)$$

In this way, we verify that the preference for one or another option depends on the value of the probability of the firm being type G and on the value of k (which reflects the difference of production costs between both types of firms). The higher k is, the lower p must be in order to be preferable to offer (w_B^*, ε_B^*) . Summarising, a clear preference for one or the other strategy does not exist, since the difference of the expected profits depends on the values of p and k .

We now proceed to check whether it is preferable to offer the self-selective contract menu or to offer the contract (w_B^*, ε_B^*) , which would result from a situation of symmetric information. Thus, comparing the MNF's expected profit under adverse selection, given by equation (33), with the profit that would result from symmetric information contracts, supplied in equation (8), we find that:

$$\pi_{MNF}(w_B^*, \varepsilon_B^*) - E[\pi_{MNF}]_{AS} = -\frac{1}{2} P^2 p \frac{(k-1)^2}{k(k-p)} < 0, \text{ since } k > p. \quad (35)$$

That is, if the MNF took the situation of adverse selection into account, defining two types of contracts, it would identify the type G firm and would get a higher expected profit than the profit it would get in the case of ignoring the information asymmetry by offering the contract (w_B^*, ε_B^*) .

Summarising, the optimal contract menu when the MNF is interested in subcontracting the production, regardless of the type of firm, is the self-selective menu of contracts

$[(w_B, \varepsilon_B); (w_G, \varepsilon_G)]$. However, the multinational has the option to offer the contract that will be accepted only by a type G firm. In this case, in order to determine which is the best strategy, we have to compare the expected profit in the case of the MNF that intends to subcontract only the type G firm, given by equation (11), with the expected profit in the case where the MNF offers a self-selective contract menu, given by equation (33). The MNF will offer the self-selective contract menu if:

$$\Delta E [\pi_{MNF}] = E [\pi_{MNF}]_{AS} - E [\pi_{MNF} (w_G^*, \varepsilon_G^*)] > 0. \quad (36)$$

Thus, after simplification, we have:

$$\Delta E [\pi_{MNF}] = \frac{1}{2} P^2 \frac{(p-1)^2}{k-p}. \quad (37)$$

Since $0 < p < 1$ and $k > 1$ then the previous expression is always positive. Therefore the MNF's optimal strategy will be to offer a self-selecting contract menu. The self-selective contract menu is always preferable, except in the case where the probability of the firm being type G equals 1. In this situation this menu would be indifferent to the contract defined for the type G firm.

Now we analyse how the previous difference of profits reacts to changes in p and k . Thus, as for p , we can conclude that the higher the probability of the firm presenting lower production costs, the smaller the difference of expected profits between the contracts defined in adverse selection and the contract designed only for the type G firm. Relative to k we conclude that, the higher the production costs of a type B firm relative to the type G firm, the larger the interest of the MNF in offering only the contract aimed at this latter type of firm.

To sum up, we conclude that under asymmetric information characterised by the fact that the subcontractor firm knows its own type but the multinational does not, the symmetric information contracts are not optimal from the multinational firm's point of view.

In fact, it is possible to define a menu of contracts that provides a higher expected profit for the MNF. However, this does not mean that the MNF does not have to subcontract since the MNF's expected profit is positive even with the contract (w_B^*, ε_B^*) . It just means that there is a better contract from the MNF's point of view, that is, a pooling equilibrium does not exist since if the multinational separates the contracts it obtains, in general, higher profit. Under adverse selection, the optimal strategy consists, thus, in offering the self-selective contract menu insofar as this option is better than the other two.

Comparing the MNF's expected profit in the absence of adverse selection (symmetric information), given by expression (9) with the expected profit under adverse selection, given by expression (33), we get:

$$\Delta E[\pi_{MNF}]_{AS} = \pi_{MNF}(w_G^*, \varepsilon_G^*) - E[\pi_{MNF}]_{AS} = \frac{P^2(k-1)(1-p)}{2(k-p)} > 0. \quad (38)$$

In terms of expected profits we verify that adverse selection involves a cost to the MNF since its expected profit is lower than the profit it would get in the case of knowing the location of the type G firm. This difference in profits is much higher, the higher k is and the lower p is. That is, the higher the production costs of a type B firm relative to the type G firm, the higher the MNF's losses with the information asymmetry. The higher the probability of the firm being type G is, the lower are the effects that asymmetric information has on the MNF's expected profit.

5 Concluding remarks

In this paper we have studied the effects that the presence of adverse selection on the subcontracting relationship has on the choice of the country in which to subcontract. Since the subcontracting relationship normally comes about by means of a contract between the MNF and the foreign firm, the subcontractor, our analysis stressed the determination of

the optimal contract in each one of the two situations (symmetric information and adverse selection).

Our analysis indicates that, in the absence of adverse selection, the MNF's best strategy consists of offering only the contract defined for the most efficient firm (type G), since the multinational knows where it is located. Thus, this contract allows the MNF to choose the best location.

However, taking into account that foreign firms have, before signing the contract, more information concerning its type than the multinational firm (adverse selection situation), the symmetric information contracts are not adequate. As we have indicated, the optimal strategy consists of differentiating the two types of firms by offering a self-selective contract menu. This is the adequate option either when the MNF is interested in subcontracting regardless of the foreign firm's type, or when the MNF only wishes to subcontract the most efficient firm. That is, the fact that the foreign firms have pre-contractual information gives them an advantage in their relationship with the MNF, since the MNF will subcontract to both types of firms. The existence of adverse selection involves a cost for the MNF, since its expected profit is lower than the profit it would get in the case of knowing the location of a type G firm.

The presence of asymmetric information can justify the empirical evidence that reveals the diversity of countries in which MNFs subcontract, that is, when firms subcontract the production of a good or component they are not usually restricted to only one country. The presence of asymmetric information also justifies other empirical evidence that shows a fast production relocation between countries, insofar as, once the MNF has established the subcontracting relation, it identifies the location with lower cost and, consequently, the MNF will take this into consideration when it decides to establish future contractual

relations. For example, we can report Nike's case. According to Donaghu and Barff (1990) the growth of Nike "(...) *was also associated with the switching of places of assembly.* (...) *The relatively rapid relocation of production between countries illustrates how Nike's subcontracting system has allowed the company to quickly disassociate itself with factories that failed to meet standards of performance set by Nike or where price changes rendered an uncompetitive product*" (Donaghu and Barff, 1990, p.541).

References

- [1] Abraham, Katharine and Taylor, Susan, 1996. Firms' use of outside contractors: theory and evidence. *Journal of Labor Economics* 14 (3), 394-424.
- [2] Das, Satya, 1999. Direct foreign investment versus licensing. *Review of Development Economics* 3 (1), 86-97.
- [3] Donaghu, Michael and Barff, Richard, 1990. Nike just did it: international subcontracting and flexibility in athletic footwear production. *Regional Studies* 24 (6), 537-552.
- [4] Feenstra, Robert, 1998. Integration of trade and disintegration of production in the global economy. *Journal of Economic Perspectives* 12 (4), 31-50.
- [5] Graziani, Giovanni, 2001. International subcontracting in the textile and clothing industry. In: Sven A. and Henryk K. (Eds), *Fragmentation - New Production Patterns in the World Economy*, Oxford University Press, New York.
- [6] Grossman, Gene and Helpman, Elhanan, 2004. Managerial incentives and the international organization of production. *Journal of International Economics* 63 (2), 237-262.

- [7] Grossman, Gene and Helpman, Elhanan, 2005. Outsourcing in a global economy. *Review of Economic Studies* 72 (1), 135-159.
- [8] Macho-Stadler, Inês and Pérez-Castrillo, David, 1997. *An Introduction to the Economics of Information*, Oxford: Oxford University Press.
- [9] Park, Hong; Reddy, Surender and Sarkar, Sam, 2000. Make or buy strategy of firms in the U.S.. *Multinational Business Review FALL*, 89-97.
- [10] Porter, Michael E., 1985, *Competitive Advantage – creating and sustaining superior performance*, New York: The Free Press.
- [11] UNCTAD - United Nations Conference on Trade and Development, 2002. *World Investment report: Transnational corporations and export competitiveness*, New York and Geneva: United Nations.
- [12] UNCTAD - United Nations Conference on Trade and Development, 2003. *World Investment report: FDI Policies for Development: National and International Perspectives*, New York and Geneva: United Nations.
- [13] Vining, Aidan and Globerman, Steven, 1999. A conceptual framework for understanding the outsource decision. *European Management Journal* 17 (6), 645-654.
- [14] Walker and Weber, 1984. A Transaction cost approach to make-or-buy decisions. *Administrative Science Quarterly* 29, 373-391.
- [15] WTO - World Trade Organization, 1998. *Annual Report 1998*, Geneva: World Trade Organization.
- [16] WTO - World Trade Organization, 2003. *Annual Report 2003*, Geneva: World Trade Organization.