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## OUTSOURCING VERSUS FDI IN OLIGOPOLY EQUILIBRIUM

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# OUTSOURCING VERSUS FDI IN OLIGOPOLY EQUILIBRIUM

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## **Abstract:**

We consider the make-or-buy decision of oligopolistic firms in an industry in which final good production requires specialised inputs. Factor price considerations dictate that firms acquire the intermediate abroad, by either producing it in a wholly owned subsidiary or outsourcing it to a supplier who must make a relationship specific investment. Firms' internationalisation mode depends on cost and strategic considerations. Crucially, asymmetric equilibria emerge, with firms choosing different modes of internationalisation, even when they are ex-ante identical. With ex-ante asymmetries, lower cost producers have a stronger incentive to vertically integrate (FDI), while higher cost firms are more likely to outsource.

(100 words)

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## 1. Introduction

A deepening of specialisation and of vertical fragmentation of production has led in recent decades to increasing volumes of intra-firm trade and to a growing reliance on outsourcing both within and across national boundaries (with firms subcontracting activities as diverse as final assembly, R&D and after-sales services).<sup>1</sup> These trends reflect a growing complexity in the mode of operation decision of firms, in which the ‘traditional’ make-or-buy choice analysed in early theories of the firm (whether to produce intermediates in-house or to outsource them to an upstream supplier) is now entwined to an internationalisation dimension (whether to internalise or outsource domestically or internationally).

In this paper we focus on one particular dimension of the internalisation/internationalisation decision and study the trade-off between international outsourcing<sup>2</sup> and FDI.<sup>3</sup>

The phenomenon of outsourcing has received significant attention in both public discourse and academic literature, giving rise to a large body of empirical<sup>4</sup> and theoretical work. Despite this, we maintain that there still remain important dimensions of this phenomenon that have not been explored. In particular, we contend that in concentrated industries (where firms have significant degrees of market power) strategic considerations may be crucial in determining the mode of operation decision of firms. Hence, we adopt an oligopolistic setup in which strategic behaviour takes centre stage – with the immediate implication that the mode of operation choice of one firm affects that of its rivals. We argue that a model that recognises the existence of strategic considerations in determining the choice of firms’ organisational form can help to shed further light on the features that distinguish outsourcing and vertical FDI – given that, as

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<sup>1</sup> There is ample evidence of an increase in input trade – e.g. Feenstra and Hanson (1996), Campa and Goldberg (1997), Hummels *et al* (2001), Yeats (2001). The extent to which this is accounted for by intra-firm trade is more difficult to establish, given the paucity of sufficiently detailed firm-level data, but existing studies (e.g. Hanson *et al*, 2003) suggest that within MNEs intra-firm trade is of significant importance.

<sup>2</sup> Following standard terminology, by outsourcing we mean the acquisition of an input or service from another firm. Bhagwati *et al* (2005) use the term in a much more restricted way to mean the acquisition of services from unaffiliated foreign firms.

<sup>3</sup> Leahy and Montagna (2007) focus on the effects of competitive pressure on the choice between vertical integration and domestic outsourcing. In general, a firm can source its intermediate from another firm or make the input itself. In either case, the firm can choose whether to get the intermediate at home or abroad. The simultaneous trade-off between all the different possibilities facing the firm can prove rather complex. So, as is common in the literature, we prefer to examine a trade off between two modes of operation at a time.

<sup>4</sup> See for instance Abraham and Taylor (1996), Audet (1996), Feenstra (1998), Campa and Goldberg (1997), Hummels *et al* (2001), and Bartel *et al* (2005).

pointed out by Spencer (2004) – both organisational forms are driven by similar factors, such as cost of production and transport costs.

There already exists a small literature on outsourcing in oligopoly – see for instance, Nickerson and Vanden Bergh (1999) Shy, and Stenbacka (2003) and Chen *et al* (2004). While these papers are important in that they study outsourcing in a strategic environment, they ignore an important feature of outsourcing, because they model it as a situation in which downstream firms buy generic inputs from upstream firms. However, outsourcing is not restricted to the purchase of standardised inputs and raw materials but typically involves asset specificity, investment in customisation and contract incompleteness. These features of outsourcing, in a tradition that dates back to Coase (1937), Williamson (1975, 1985) and Grossman and Hart (1986), are instead at the core of the dominant framework proposed in recent years by Grossman, Helpman and Antràs (henceforth GHA) who, in a number of influential papers, have produced a series of monopolistically competitive general equilibrium models in which outsourcing involves forming a bilateral relationship with a partner firm that makes relationship specific investments so that it can produce a high quality customised input.<sup>5</sup> Following Leahy and Montagna (2007), in this paper we apply this approach in an oligopoly setting in which firms choose their mode of operation strategically.<sup>6</sup>

At the cost of abstracting from the general equilibrium feature of the GHA framework, our approach allows for a richer characterisation of the complex interdependence between the internal organisation of the firm and the strategic environment within which it operates.

A key result of the paper is the emergence of asymmetric equilibria, with firms choosing different modes of internationalisation even when they are ex-ante identical. This result is consistent with existing stylised facts whereby firms within the same industry adopt different mode of operation strategies, and differs fundamentally from that obtaining in the monopolistic competition literature *à la* GHA (where different behaviours can only emerge from ex-ante asymmetries between firms). Consistent with existing empirical work, we then find that when firms are ex-ante asymmetric lower cost producers have a stronger incentive to vertically integrate via FDI than higher cost competitors, which are more likely to outsource.

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<sup>5</sup> See for instance Grossman and Helpman (2002, 2003 and 2005) and Antràs, and Helpman (2004).

<sup>6</sup> Until Leahy and Montagna (2007), the GHA approach had not been applied to oligopoly.

The rest of the paper is organised as follows. Section 2 sets out the model. The game is solved in Section 3 and the equilibrium regimes are discussed in Section 4. Section 5 considers the implications of relaxing some of the basic model's assumptions and Section 6 concludes the paper.

## 2. The Model

We consider a market in which there are two ex ante identical final goods firms that are located in the North and sell a homogenous good to an integrated market. We assume that this final goods market is also located in the North and thus that sales do not involve a transport cost.<sup>7</sup> The inverse demand is given by:

$$p = a - (y_1 + y_2), \quad (1)$$

where  $p$  is the price of the good,  $a$  is a constant parameter, and  $y_1$  and  $y_2$  are the quantities produced by firms 1 and 2 respectively.

We assume that the production of the final good requires a specialised component, which is combined in fixed proportions with other inputs. One unit of this intermediate is required per unit of output. The firms must also use some other inputs to produce the good. We model these as a composite input and normalise its price at unity. Let  $e_i = \bar{e} - z_i > 0$  be firm  $i$ 's per-unit input requirement for the composite input, where  $z_i$  captures the 'usefulness' of the intermediate and  $\bar{e}$  is a constant. A more *useful* intermediate is one that requires to be combined with fewer other inputs in order to produce a unit of output.

We assume that due to factor price considerations it is too costly to produce or procure the intermediate in the North. Instead, the intermediate must be produced in the South. Hence we abstract from the location dimension of the sourcing decision of the firm and assume that, as in Grossman and Helpman (2003), the firm can either produce the intermediate in a subsidiary (FDI option) or purchase it from a specialised southern supplier (outsourcing option).

If the firm does FDI and so sets up a fully owned subsidiary in the South, then the input can be produced there at a marginal cost of  $r$ . On the other hand, if the firm's

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<sup>7</sup> This assumption may reflect the fact that the destination market is in the home country of the firms, and/or that it is highly integrated – perhaps in a customs union – with the market where the firms are located. Alternatively, we could assume that transport costs of serving the market are identical for the two firms and could thus be ignored. It is easy to show that allowing for a symmetric transport cost would not change the results qualitatively.

specialized component is outsourced then its price is  $q_i$ . In either event, to deliver this input to the home country where it is combined with the composite input, the firm must pay a transport cost of  $t$  per unit of intermediate.<sup>8</sup> If the firm chooses to carry out FDI, then it must pay a fixed cost  $F$  upfront. This includes both the standard fixed costs of setting up and operating a plant at arms length in the foreign country and the corporate governance cost of running an internationally vertically integrated firm. Since it is plausible to assume that the fixed costs of operating abroad are lower under outsourcing – there are no plant costs, for instance – and the governance costs under outsourcing are lower than those under vertical integrated FDI, we can normalise final goods firms fixed costs under outsourcing at zero.

The ‘usefulness’ of the intermediate to the final producer depends on the level of the investment in its quality and in customisation. We will assume that  $z = \sqrt{K}$ , where  $K$  is investment in quality and customisation. Thus, there are diminishing returns to investment. This is a plausible assumption and one that is needed to ensure an interior solution. Using the superscripts  $I$  and  $O$  to denote FDI and outsourcing respectively, marginal production cost for firm  $i$  will thus be:

$$c_i^O = q_i + \bar{e} - z_i + t, \quad (2a)$$

if the firm outsources its intermediate, and

$$c_i^I = r + \bar{e} - z_i + t, \quad (2b)$$

if it produces it in a wholly owned subsidiary.

If firm  $i$  does FDI, its profit function is given by:

$$\pi_i^I = (p - c_i^I)y_i - K_i - F, \quad (3)$$

where  $F$  represents the fixed cost of setting up a plant in the South plus the fixed governance cost that an internationally vertically integrated firm is assumed to incur. On the other hand, if the firm chooses to outsource, its profit function will instead be:

$$\pi_i^O = (p - c_i^O)y_i. \quad (4)$$

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<sup>8</sup> In the event of outsourcing we assume that it is the downstream firm that pays the transport cost. Note that the results would not be materially changed were we to assume, instead, that it is the upstream firm that pays the transport cost.

When a firm chooses to outsource, it avoids both the investment costs and the other fixed costs of FDI. The investment costs are now borne by an intermediate goods producer who has profits:

$$\mu_i = (q_i - r^m)m_i - K_i - E, \quad (5)$$

where  $E$  is a fixed entry cost and  $r^m$  represents the upstream producer's marginal production cost. We assume that the marginal production cost of the intermediate can differ depending on whether it is produced in-house under FDI ( $r$ ), or by an upstream firm under outsourcing ( $r^m$ ). Since one unit of the intermediate is needed in the production of each unit of final output, we can write  $m_i = y_i$ . Note that we will also use  $i$  to represent the southern upstream firm that has a bilateral outsourcing relationship with the northern downstream firm  $i$ .

### 3. The Game

The model is a four-stage game. In stage one, firms decide whether to outsource their intermediate or to do FDI. If they decide to outsource, they approach a specialised supplier firm, located in the South, which will produce the intermediate. International vertical integration entails instead the set-up of a wholly owned subsidiary in the South to manufacture the intermediate. In stage two, the firms invest in the development of the intermediate. If a downstream firm opts for outsourcing, then the specialised supplier firm undertakes the investment. In stage three, the firms (if they outsource) bargain with their intermediate supplier over the price of the intermediate.<sup>9</sup> As in Grossman and Helpman (2003), we assume that the final good producer only has enough time to negotiate with a single supplier and furthermore, should bargaining break down, the producer will not have sufficient time to produce the intermediate itself, and so will exit the market – while the supplier will have wasted its investment. In stage four, at a

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<sup>9</sup> We assume that the relationship between upstream and downstream firms is a bilateral one. We ignore the possibility that a large upstream supplier could force the two downstream firms to compete for its output. There are a number of ways in which this possibility can be ruled out. Perhaps, the simplest way is to assume that the firms choose to outsource the specialized component in different geographical locations in the South. Another possibility is that, as a result of customization, the intermediates used by downstream firms are sufficiently different from each other. We also rule out the possibility that more than one upstream firm compete to supply the downstream firm. One could think of there being ex-ante many identical potential intermediate suppliers. However, given that there is only one downstream firm in a particular location, *only* one firm will enter to supply it in equilibrium since with more than one upstream firms, as a result of Bertrand competition between firms, the intermediate price would be driven to the marginal production cost and the firms will be unable to cover their investment and fixed entry cost. Anticipating this, only one firm will enter to supply a downstream firm.



transport cost of  $t$ , the intermediate is shipped to the North where the downstream firm combines it with the other inputs to produce the final output.

We are interested in Subgame Perfect Nash equilibria and so, as usual, we begin by solving the final stage and then working backwards.

### 3.1 Stage 4

In the final stage of the game, firms choose their output level. The first-order conditions are given by:

$$\frac{\partial \pi_i}{\partial y_i} = p - c_i^h - y_i = 0, \quad (6)$$

where  $(h=O,I)$  and  $(i=1,2)$ .

We now combine equation (1) with these first order conditions and then solve to obtain the (final-stage) Nash equilibrium in quantities:

$$y_i = \frac{a - 2c_i^h + c_j^k}{3}, \quad (7)$$

where  $(h,k=O,I)$  and  $(i,j=1,2)$  with  $(i \neq j)$ .

### 3.2 Stage 3

Stage three of the game is the bargaining stage in which each of the final goods firms bargains with an upstream supplier over the price of its intermediate.<sup>10</sup> This stage will only exist if at least one firm chooses to outsource production of its intermediate input. When both firms outsource, the upstream and downstream pairs bargain simultaneously. Recall that all fixed and investment costs are sunk at this stage. Then, the price  $q_i$  of the intermediate good results from the maximisation of the following Nash bargain:<sup>11</sup>

$$N_i = [(p - c_i^o)y_i][(q_i - r^m)y_i], \quad (8)$$

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<sup>10</sup> In some models, the purchase of intermediate components is assumed to involve the combination of a fixed lump-sum payment and a price set at marginal cost. However, Spencer (2005) argues that it is important to recognize that outsourcing contracts typically involve a strictly positive price that exceeds marginal cost, whereas internal transactions within vertically integrated firms do not. She goes on to conjecture that the use of a price mark-up to compensate for relationship-specific investment would have implications for the level of investment and final-good output. Our paper recognizes this difference between outsourcing and FDI and we show that this has implications for the level of investment under the competing modes of operation.

<sup>11</sup> We assume that firms have equal bargaining power. Hence the profits of the upstream and downstream firm receive the same weights in the bargaining function. Allowing for different weights is straightforward but complicates the algebra without giving much additional insight. Leahy and Montagna (2007) allow for different bargaining powers.

where we have used  $m_i = y_i$  to eliminate  $m_i$ . Make use of (6), the final stage first-order condition, to write:  $N_i = (q_i - r^m)y_i^3$ . Maximising this with respect to  $q_i$  yields:

$$\frac{\partial N_i}{\partial q_i} = y_i^2 \left( y_i + 3(q_i - r^m) \frac{\partial y_i}{\partial q_i} \right) = 0. \quad (9)$$

From (7) and (2a) we obtain:  $\partial y_i / \partial q_i = -2/3$ . Combining this with (9), yields the price of the intermediate:

$$q_i = r^m + y_i / 2. \quad (10)$$

The equilibrium intermediate mark-up,  $q_i - r^m$ , is thus proportional to the final output of the downstream firm. Since  $r$  is not necessarily equal to  $r^m$ , although  $q_i$  must be larger than  $r^m$ , it need not be higher than  $r$ .

### 3.3 Stage 2

The firms choose their investment levels simultaneously in stage 2. If the intermediate is produced in a subsidiary abroad then  $K_i$  is chosen to maximise  $\pi_i^I = y_i^2 - K_i - F$ , where  $(p - c_i^I)$  has been eliminated using (6). As the FDI and corporate governance costs,  $F$ , have already been sunk before the firms invest in the intermediate, they play no part in the optimal choice of investment levels. The fact that  $z_i = \sqrt{K_i}$  enables us to model the firm as choosing the level of cost reduction:  $z_i$ , which proves to be analytically convenient. The resulting first-order condition is:

$$2 \left( y_i \frac{dy_i}{dz_i} - z_i \right) = 0, \quad (11)$$

which implies:  $z_i^I = \sqrt{K_i^I} = y_i \frac{dy_i}{dz_i}$ . As it will become clearer, it is useful to write this

as:

$$z_i^I = \sqrt{K_i^I} = \theta^{k} y_i \quad \text{where } k=(I,O). \quad (12)$$

Note that we adopt the convention that, when there are two superscripts, the first refers to firm  $i$  and the second to firm  $j$ . The parameter  $\theta^{k}$  is equal to  $dy_i / dz_i$  given that firm  $i$  does FDI and given the mode of operation ( $k=I,O$ ) of the other firm. It takes on a different value depending on the mode of operation of the rival firm. When the rival is

vertically integrated via FDI, a firm's choice of investment only affects its own equilibrium output,  $y_i$ , through changes in its own costs,  $c_i$ . However, if the rival chooses outsourcing, then own investment also affects the bargained price of the rival's intermediate good,  $q_j$ . Higher investment, by reducing the rival firm's output, tends to reduce the mark-up enjoyed by the upstream firm – making the downstream firm more competitive. This works to reduce the size of  $\theta^{ik} = dy_i / dz_i$  from  $2/3$ , in the case in which the rival does FDI, to  $15/24$  when the rival outsources (see the appendix for an explanation of how this happens). Thus:

$$z_i^{II} = \theta^{II} y_i^{II} \quad \text{with} \quad \theta^{II} = \frac{2}{3}, \quad (13a)$$

and

$$z_i^{IO} = \theta^{IO} y_i^{IO} \quad \text{with} \quad \theta^{IO} = \frac{15}{24}, \quad (13b)$$

where the first superscript refers to firm  $i$  and the second to firm  $j$ . A comparison of the investment-to-output ratios in (13a) and (13b) reveals that:  $\theta^{II} > \theta^{IO}$  and so firm  $i$ 's investment-to-output ratio is lower when its rival outsources its intermediate than when it chooses to produce it in a foreign subsidiary. Thus, outsourcing by one firm 'softens' the behaviour of its rival, i.e. it reduces its aggressiveness in investment. This results in a 'strategic motive' to outsource which is discussed in more detail in Leahy and Montagna (2007).

If the intermediate is outsourced, then  $z_i$  is chosen by the upstream firm to maximise  $y_i^2 / 2 - K_i$ , where we have made use of the fact that, from (10),

$$(q_i - r^m) = y_i / 2. \quad \text{This yields the expression for investment} \quad z_i^O = \sqrt{K_i^O} = y_i \frac{1}{2} \frac{dy_i}{dz_i},$$

which is obviously similar to that in which firm  $i$  is vertically integrated via FDI: it differs only in that the right-hand side is now multiplied by  $1/2$ . This difference reflects the fact that, although it incurs its cost, the upstream firm only appropriates a share of the marginal benefits from investment – and this reduces its incentive to invest in quality and customisation. Converting the expression into the same notational form as in (12) we get:

$$z_i^O = \sqrt{K_i^O} = \theta^{Ok} y_i, \quad \text{where } k=(I,O). \quad (14)$$

Once again, the  $\theta$  parameter takes on a different value depending on the mode of operation of the rival firm. Again, the reason for the difference lies in the fact that an increase in firm's investment only exerts a downward effect on its rival's intermediate price when the rival is outsourcing. This reduces the incentive for a firm to invest when the rival outsources its intermediate.

The expression for the investment level under outsourcing when the rival does FDI is:

$$z_i^{OI} = \theta^{OI} y_i^{OI} \quad \text{with} \quad \theta^{OI} = \frac{1}{4}. \quad (15a)$$

The corresponding expression for investment under outsourcing when the rival pair are also in an outsourcing relationship is:

$$z_i^{OO} = \theta^{OO} y_i^{OO} \quad \text{with} \quad \theta^{OO} = \frac{5}{21}. \quad (15b)$$

Again, outsourcing by one firm 'softens' the behaviour of its rival since  $\theta^{OI} > \theta^{OO}$  – a firm's investment-to-output ratio is lower when its rival outsources its intermediate than when it chooses to do FDI.

### 3.4 Stage 1

In the first stage of the game, firms choose their mode of operation. To establish whether a firm will outsource or choose to be vertically integrated internationally (FDI), we must compare its profits under the two regimes for a given behaviour of its rival. To this end, it proves useful to obtain an expression for the profits in terms of outputs and parameters only. By using the first-order conditions in (7), we can rewrite the profit functions as:

$$\pi_i^{Ik} = (y_i^{Ik})^2 [1 - (\theta^{Ik})^2] - F, \quad (16)$$

and

$$\pi_i^{Ok} = (y_i^{Ok})^2, \quad (17)$$

where  $k=(I,O)$ . It is immediately obvious from (16) and (17) that a sufficient condition for  $\pi_i^{Ok} > \pi_i^{Ik}$  is that  $y_i^{Ok} \geq y_i^{Ik}$ . The term in square bracket is less than unity and so, if outsourcing results in an increase in output (perhaps because the marginal cost of producing the intermediate is so much cheaper if it is carried out by a specialised

upstream producer), then it trivially dominates FDI. However, as we show in the Appendix, if firms are ex-ante symmetric and if the upstream supplier has no production cost advantage in the intermediate, then a firm's output is always higher under FDI than under outsourcing regardless of the mode of operation choice of the rival. There are two reasons for this. First, the level of investment in quality and customisation is lower under outsourcing due to the reduced incentive to invest experienced by the upstream firm. This implies that the Northern firm takes delivery of a poorer intermediate input and, as a consequence, must use more of the other inputs in the production of the final good. The second reason is that the upstream supplier must receive a positive mark-up over marginal production costs in order to enter and make any investment in the quality of the intermediate. Hence, choosing to outsource saves a Northern firm fixed plant and governance costs, but leads it to facing higher marginal production costs and consequently having a smaller market share.

#### 4. The Mode of Operation Equilibria

We turn now to a discussion of the mode of operation equilibria. Clearly, there are four possible candidate equilibrium regimes: **(II)**, **(IO)**, **(OI)**, and **(OO)**, where the first letter refers to the mode of operation selected by firm 1 and the second letter refers to the mode chosen by the second firm.

The downstream firms are ex-ante identical, which means that neither firm has an underlying cost advantage. The upstream firms are also ex-ante identical to each other.<sup>12</sup> However, as we will show below, ex-ante identical firms do not always choose the same mode of operation; in this instance, as we have argued, they will not invest the same amount and will therefore end up with different costs in equilibrium.

To begin with, we assume that there is no underlying cost advantage or disadvantage from outsourcing – by which we mean that the marginal production cost of the input is the same regardless of whether it is made in the wholly owned subsidiary or by the upstream foreign supplier. In this instance, the pattern of equilibria depends on the level of FDI/governance cost,  $F$ . If  $F$  is sufficiently large, then both firms will choose to outsource. It can be shown (see Appendix) that at  $F=0$  both firms choosing FDI **(II)** is the unique subgame perfect equilibrium. As shown in the Appendix there is

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<sup>12</sup> Leahy and Montagna (2007) consider the implications of ex-ante firm asymmetry for the mode of operation decision of firms. In that paper, firms from different countries choose between vertical intergration and outsourcing locally. They show that the most efficient firms will tend to choose vertical integration.

multiple asymmetric equilibria **(IO)** and **(OI)** for intermediate levels of  $F$ . Hence, for a range of  $F$  there are asymmetric outcomes despite the fact that the firms are fully symmetric *ex ante*.

The underlying reason for the emergence of asymmetric equilibria is that there is a negative interdependence between the firm's mode of operation decisions. The relative incentive to choose FDI is larger the larger is one's expected output. Given ex-ante symmetry between downstream firms, FDI is a lower marginal cost (in exchange for higher fixed cost) and hence a higher output strategy. A firm that faces a rival which is doing FDI has, *ceteris paribus*, a lower anticipated market share and hence a lower incentive to do FDI itself than a firm that faces an outsourced rival. Hence, over a range of  $F$ , FDI is a best response to a rival's outsourcing but outsourcing is a best response to a rival's FDI.

#### 4.1 Trade liberalisation

Trade liberalisation increases the profitability of using the foreign location to produce the intermediate irrespective of whether the firm uses the insourcing (FDI) or the outsourcing option. How does trade liberalisation affect the pattern of mode of operation equilibria? The first thing to note is that it has no effect on the qualitative ranking of equilibria with respect to the FDI costs,  $F$ . It remains the case that at low  $F$  we have **(II)**, at higher  $F$  we have **(IO)** and **(OI)**, and at higher still values of  $F$  we have **(OO)**. However, trade liberalisation reduces the amount of outsourcing relative to FDI. There are two main reasons for this. First, in exchange for facing higher fixed costs, the firms that choose FDI have a higher scale of output than those that outsource. This means that any fall in per unit trade costs applies to a larger output level under FDI and hence is more beneficial to firms choosing the FDI option. Second, trade liberalisation raises a firm's rents but this increases the possibility for rent extraction by the upstream firm under outsourcing. A fall in  $t$  leads to an increase in the bargained intermediate price and this reduces some of the benefit of trade liberalisation for the downstream firm.

The effect of trade liberalisation on the mode of operation outcomes is illustrated in Figure 1.

## 5. Robustness to asymmetries

So far we have assumed that there are no differences in the underlying cost of producing the intermediate via FDI or via outsourcing, and that Northern firms are *ex ante* symmetric. Despite the *ex-ante* symmetry, we found that outcomes are often highly asymmetric in terms of mode of operation, investments and outputs. It is interesting, however, to examine the effects of underlying differences in firms for the propensity to outsource. Thus, we shall now consider the robustness of the results when allowing for the possibility of: (i) asymmetries between upstream and downstream firms (in the underlying costs of producing the intermediate), and (ii) between downstream firms (first, in the timing of the mode of operation choice and then in their underlying production costs).

### 5.1 Upstream-downstream differences in the cost of producing the intermediate

It is plausible to assume that, for instance due to technological reasons, the cost of producing the intermediate in a foreign subsidiary may differ from that incurred by a foreign supplier. We capture cost differences between outsourcing and FDI with the parameter:  $\rho = r - r^m$ , which is the discrepancy between the marginal production cost of the intermediate within the firm under FDI and that incurred by the upstream firm. One plausible possibility is that  $\rho$  is negative. This would be the case if the Northern firm were to enjoy a technological advantage over the Southern firm. On the other hand, if the Southern firm had developed some additional expertise in producing this sort of intermediate, perhaps as a result of accumulated learning, then  $\rho = r - r^m$  would be likely to be positive. The effects of changes in  $\rho$  are illustrated in Figure 2 in which we show the different outcomes in  $F$  and  $\rho$  space. We see that the ranking of regimes<sup>13</sup> – (II) at low  $F$ , followed by the multiple equilibria region (IO) and (OI) for intermediate levels of  $F$ , and (OO) for high enough  $F$  – is unchanged. However, unsurprisingly, the regions in which FDI occurs as part of a subgame-perfect equilibrium get smaller in  $\rho$  and eventually disappear with the (II) region disappearing first (as  $\rho$  increases), followed by the multiple asymmetric equilibrium region with (IO) and (OI).

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<sup>13</sup> Clearly, the ranking of regimes in the figure is the same on either side of the vertical axis.

## 5.2 *Ex-ante asymmetry between northern firms*

So far we have assumed that the Northern firms are *ex ante* symmetric and shown that, despite this, the outcomes are not always symmetric, with equilibria emerging in which firms choose different modes of internationalisation.

We shall now examine the implications of two different types of ex-ante asymmetry. First, we study the effects of an underlying cost asymmetry between Northern firms. For ease of exposition, in this subsection we will restrict attention to the situation in which the parameter:  $\rho = r - r^m$ , the gap between the marginal production cost of producing the intermediate under FDI and that incurred by the upstream firm under outsourcing, is zero throughout. Then, we consider a situation in which the firms choose their mode of operation sequentially rather than simultaneously.

### 5.2.1 *Cost asymmetry – Outsourcing as the “poor man’s” foreign investment.*

Suppose firm 1 has an underlying cost advantage in producing the final good. An easy way to capture this is to assume that there is a difference in the pre-investment input requirements of the firms.<sup>14</sup> We will allow  $\bar{e}$  to take firm specific values,  $\bar{e}_1$  and  $\bar{e}_2$ , with  $\bar{e}_1 < \bar{e}_2$ , and define  $\phi \equiv \bar{e}_2 - \bar{e}_1 > 0$  as the underlying efficiency advantage of firm 1. We find that the higher cost firms are more likely to choose to outsource. This is illustrated in Figure 3 where we allow  $\phi$  to increase. As  $\phi$  increases, the cost advantage of firm 1 over firm 2 gets larger. What we see is that the region of (IO) in which the first firm is vertically integrated while the, now higher cost, second firm outsources gets larger in  $\phi$ . These results are consistent with those obtained by Antrás and Helpman (2004) and support existing empirical evidence that suggests that foreign outsources tend to be less productive than firms that invest abroad (e.g. Tomiura, 2007).

### 5.2.1 *The mode of operation is chosen sequentially.*

Firms might not always choose their mode of operation at exactly the same time. If they do not, then a firm that decides early will often be able to exploit this advantage to ensure it has higher profits than its rival. Without loss of generality, we assume that firm 1 chooses its mode of operation before firm 2. The remaining stages of the game are as before and there is no other ex-ante asymmetry between the firms. We find that at

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<sup>14</sup> This is not the only possible source of cost asymmetry. Others would be differences in production costs of the intermediate or in investment costs. These alternative sources of asymmetry would have very similar qualitative implications.



low levels of  $F$ , both the leader and the follower do FDI. At intermediate levels of  $F$ , the best reply to FDI is outsourcing. In this region of  $F$ , there is a first-mover advantage and the leader commits to do FDI before the follower chooses its mode of operation. As a result, the leader enjoys higher profits than the follower. As shown in Figure 4, the profits of the leader firm jump upwards in  $F$  when the follower switches to outsourcing. This is because outsourcing is a less aggressive mode of operation choice that results in lower investment and output. At high levels of  $F$ , the leader also switches to outsourcing and this leads to an upward jump in the profits of the follower in  $F$ . Hence, allowing for the possibility that firms choose their mode of operation sequentially does not alter the basic result of the paper.

## 6. Conclusions

We have studied the internalisation/internationalisation decision of firms, within a framework that allows for strategic considerations to play a role in determining the organisational mode of firms. We focussed on one particular dimension, namely the trade-off between international outsourcing and FDI. Both FDI and international outsourcing are affected in a similar manner by factors such as trade liberalisation and international differences in input costs, and changes in these tend to affect the profits of all firms within an industry in the same direction. Nevertheless, similar firms within an industry often choose very different modes of operation.

With a model in which outsourcing involves relationship specific investment in customisation and contract incompleteness, we showed that strategic considerations can give rise to asymmetric equilibria, in which firms choose different modes of internationalisation, even when they are ex-ante identical. We found that a shock experienced in common by all firms within an industry can have a qualitatively different effect on the returns from different organisational modes. In particular, we showed that trade liberalisation reduces the incentive to outsource relative to doing FDI. The emergence of asymmetric equilibria helps to shed light on existing stylised facts whereby firms within the same industry adopt different organisational modes. This stylised fact is not explainable from within the standard monopolistic competition literature that of necessity abstracts from strategic considerations.

Although the main results of the paper were derived in a model in which firms are symmetric, we have also shown that they are robust to the introduction of various types

of asymmetry across firms, such as allowing for different underlying costs of producing the intermediate under FDI and outsourcing, or allowing for a sequential choice in the mode of operation by firms. Interestingly, when allowing for ex-ante asymmetries between firms, the asymmetric equilibria are characterised by FDI being the likely mode of operation strategy chosen by relatively low cost producers, with outsourcing (*'the poor man's FDI'*) being chosen by relatively high cost firms.

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## Appendix

*The parameter  $\theta$  in the different regimes*

The parameter  $\theta$  takes on a different value depending on the mode of operation of the firm and its rival. When firm  $i$  does FDI, then  $\theta = dy_i / dz_i$  (see equation (12)) – but when the firm outsources then  $\theta = (\frac{1}{2})dy_i / dz_i$  (see equation (14)). To obtain an expression for  $dy_i / dz_i$  differentiate (7) to get:

$$\frac{dy_i}{dz_i} = \frac{1}{3} \left( -2 \frac{dc_i^h}{dz_i} + \frac{dc_j^k}{dz_i} \right) \quad \text{where } h, k = I, O,$$

$$\frac{dc_i^I}{dz_i} = -1, \quad \frac{dc_i^O}{dz_i} = -1 + \frac{dq_i}{dz_i} = -1 + \frac{1}{2} \frac{dy_i}{dz_i},$$

and

$$\frac{dc_j^I}{dz_i} = 0, \quad \frac{dc_j^O}{dz_i} = \frac{dq_j}{dz_i} = \frac{1}{2} \frac{dy_j}{dz_i}, \quad \text{where } \frac{dy_j}{dz_i} = \frac{1}{3} \left( -2 \frac{dc_j^h}{dz_i} + \frac{dc_i^k}{dz_i} \right).$$

So, it is easy to see that  $\theta^{II} = 2/3$ .

To find  $\theta^{IO}$  one can first write:  $\theta^{IO} = \frac{2}{3} + \frac{1}{6} \frac{dy_j}{dz_i}$ . Then note that:  $\frac{dy_j}{dz_i} = -\frac{1}{3} \left( \frac{dy_j}{dz_i} + 1 \right)$

from which can obtain:  $\frac{dy_j}{dz_i} = -\frac{1}{4}$ . Substitution into the expression for  $\theta^{IO}$  finally

yields:  $\theta^{IO} = 15/24$ .

To find  $\theta^{OI}$ , one can first note that:  $\theta^{OI} = \frac{1}{2} \frac{dy_i}{dz_i}$  and find that  $\frac{dy_i}{dz_i} = \frac{2}{3} \left( 1 - \frac{1}{2} \frac{dy_i}{dz_i} \right)$

which, when simplified, gives:  $\frac{dy_i}{dz_i} = \frac{1}{2}$  and therefore:  $\theta^{OI} = 1/4$ .

Finally, the most complicated case is that of  $\theta^{OO}$  which can be written as  $\theta^{OO} = \frac{1}{2} \frac{dy_i}{dz_i}$ ,

where  $\frac{dy_i}{dz_i} = \frac{2}{3} - \frac{1}{3} \frac{dy_i}{dz_i} + \frac{1}{6} \frac{dy_j}{dz_i}$  and  $\frac{dy_j}{dz_i} = -\frac{1}{3} \frac{dy_j}{dz_i} - \frac{1}{3} \left( 1 - \frac{1}{2} \frac{dy_i}{dz_i} \right)$ . Combining these

two equations, it is straightforward to obtain:  $\frac{dy_i}{dz_i} = \frac{10}{21}$  and hence  $\theta^{OO} = \frac{5}{21}$ .

*Reduced form outputs and profits in the different regimes*

The first order condition for investment in equation (12) and (14) can be written in compact form as:

$$z_i^{hk} = \theta^{hk} y_i^{hk}, \quad (\text{A1})$$

where the first superscript refers to the mode of operation of firm  $i$  and the second refers to the mode of operation of its rival.

The first order condition for output in (6) can be combined with (2a) or (2b) as appropriate, (A1), and (when the firm outsources) the expression for the price of the intermediate in (10) to obtain the following expression for firm  $i$ :

$$A^h - 2y_i - y_j + \eta^{hk} y_i = 0 \text{ where } h=(I,O), \quad (\text{A2})$$

where  $A^I = a - \bar{e} - r - t$  and  $A^O = a - \bar{e} - r^m - t$  only depend on the firm's own mode of operation, and  $\eta^{ok} = \theta^{ok} - \frac{1}{2}$  and  $\eta^{lk} = \theta^{lk}$  (where the first superscript refers to the mode of operation  $h=(I,O)$  of firm  $i$  and the second superscript  $k=(I,O)$  refers to that of the rival firm). Using  $\rho = A^O - A^I = r - r^m$  to represent the pre-investment cost saving from outsourcing, we can write:  $A^O = A^I + \rho$ .

Directly from the two equations in (A2), we can obtain reduced form equilibrium output expressions for the two firms. When firm  $i$  chooses mode of operation  $h$  ( $h=I,O$ ) and its rival chooses mode of operation  $k$  ( $k=I,O$ ),

$$y_i^{hk} = \frac{(2 - \eta^{kh})A^h - A^k}{3 - 2(\eta^{hk} + \eta^{kh}) + \eta^{hk}\eta^{kh}}. \quad (\text{A3})$$

Finally, to obtain reduced form expressions for profits in the different regimes we simply substitute from (A3) into (16) when firm  $i$  is choosing FDI and into (17) when it is outsourcing.

*Equilibria in the fully symmetric case*

Assuming that the firms are ex-ante symmetric and there is no underlying cost advantage from outsourcing, then at  $F=0$  both firms doing FDI (**II**) is the unique subgame perfect equilibrium. At  $F=0$  this requires that:

$$(y^{Ik})^2 [1 - (\theta^{Ik})^2] > (y^{Ok})^2 \quad \text{for } k=(I,O). \quad (\text{A4})$$

Taking the square root of both sides and making use of the reduced form expressions for output, this condition becomes:

$$\frac{\sqrt{1 - (\theta^{Ik})^2} (1 - \eta^{kI}) A}{3 - 2(\eta^{Ik} + \eta^{kI}) + \eta^{Ik} \eta^{kI}} - \frac{(1 - \eta^{kO}) A}{3 - 2(\eta^{Ok} + \eta^{kO}) + \eta^{Ok} \eta^{kO}} > 0, \quad \text{for } k=(I,O), \quad (\text{A5})$$

where  $A^I = A^O = A$  as  $\rho = 0$ . Tedious but straightforward calculations show that the condition in (A5) holds.

At intermediate levels of  $F$  there are multiple asymmetric equilibria **(IO)** and **(OI)**. To see this, first note that straightforward calculations show that in the base case the difference in (A5) is strictly larger when the rival firm outsources. At any given  $F$ , the gain in profit from FDI relative to outsourcing is larger when the rival is outsourcing.

Hence, there exists a non empty set of  $F$  such that:

$$(y^{IO})^2 [1 - (\theta^{IO})^2] - (y^{OO})^2 > F > (y^{II})^2 [1 - (\theta^{II})^2] - (y^{OI})^2 \geq 0.$$

For levels of  $F$  within this range, a firm will find it more profitable to do FDI if its rival is outsourcing, but more profitable to be outsourcing if its rival does FDI. Hence, there are multiple asymmetric equilibria **(IO)** and **(OI)**.

Clearly, for  $F > (y^{IO})^2 [1 - (\theta^{IO})^2] - (y^{OO})^2$ , firms will always wish to outsource; hence **(OO)** is the unique equilibrium.

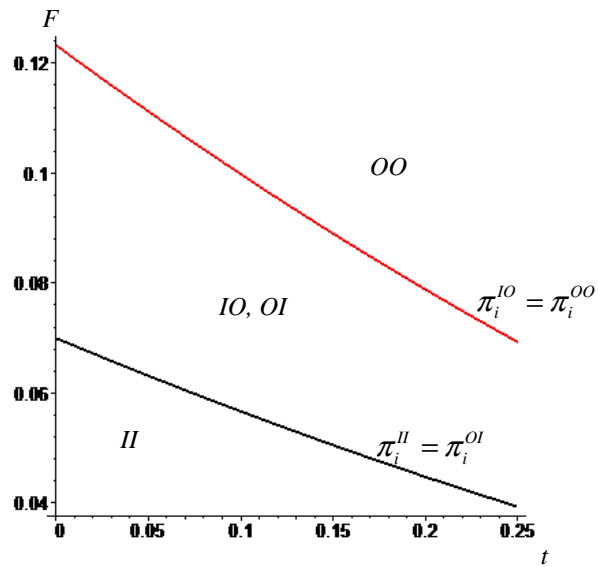


Figure 1. *Effects of trade liberalisation*

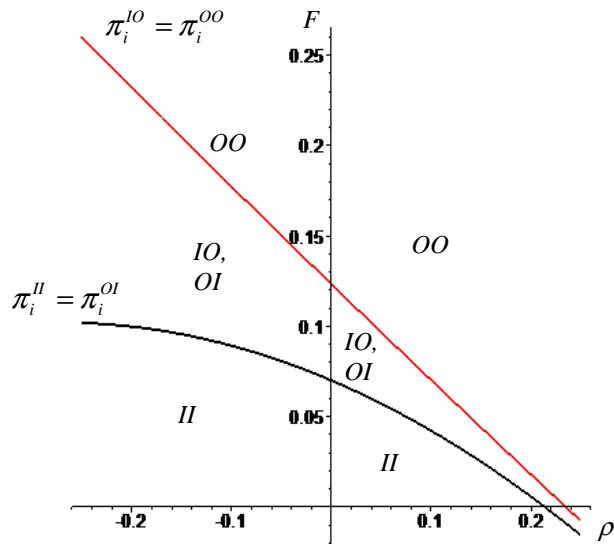


Figure 2. *Upstream-downstream differences in the cost of producing the intermediate component (at  $\phi=0$ )*

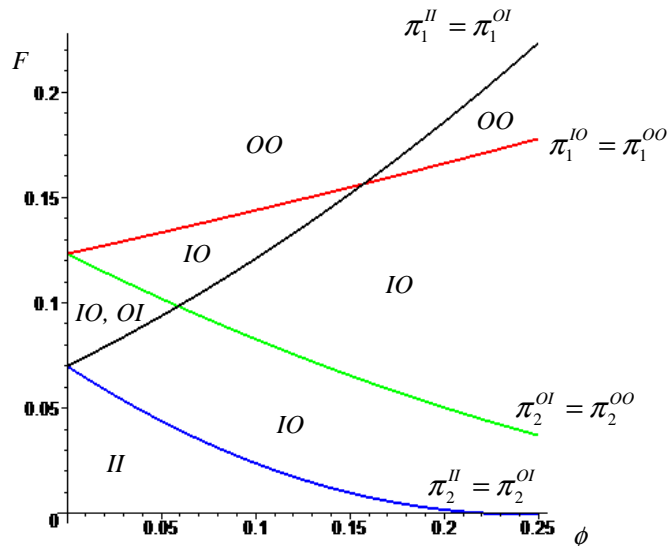


Figure 3. *Ex-ante asymmetry between northern firms (at  $\rho_1=\rho_2=0$ )*

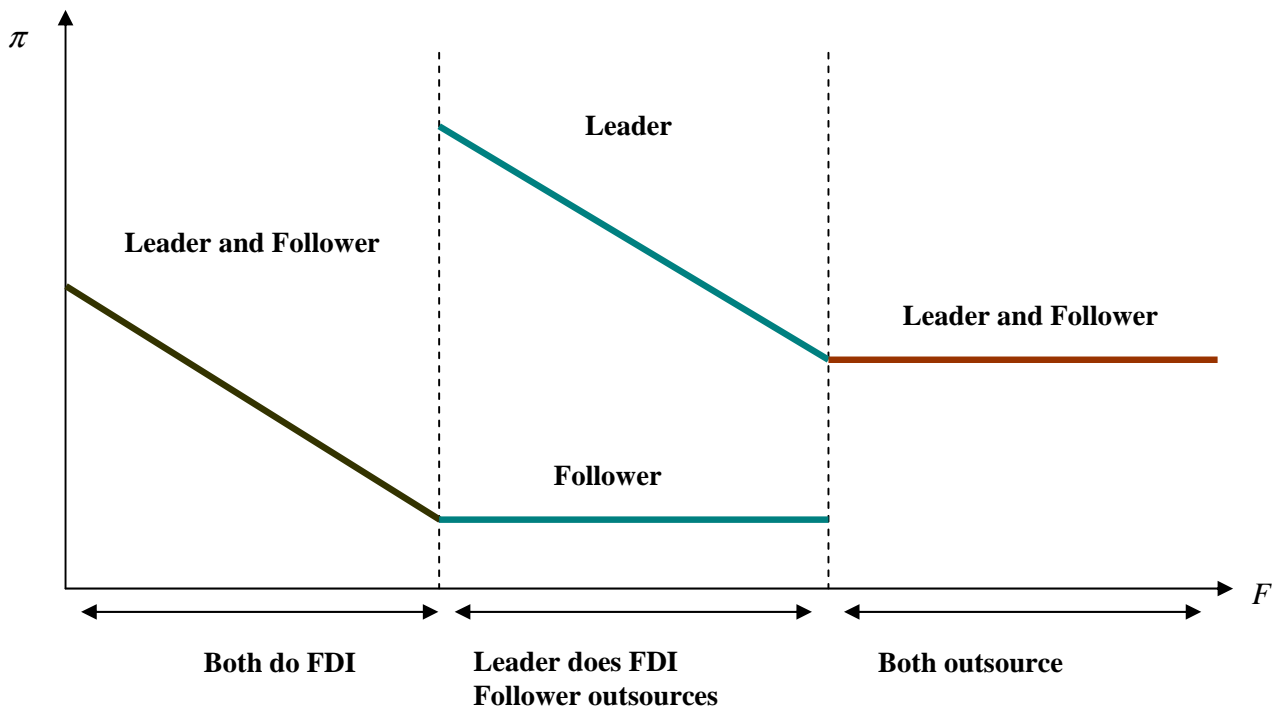


Figure 4. *The mode of operation is chosen sequentially*