ECONOMISING, STRATEGISING

AND

THE VERTICAL BOUNDARIES OF THE FIRM

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Abstract:

We bridge the organisational economics and industrial economics literatures on the vertical boundaries of the firm by contextualising the transaction cost approach to the make-or-buy decision within an oligopolistic market structure. Firms invest in the quality of the intermediate resulting in the endogenous determination of the price of the intermediate and marginal production cost of the final good. We highlight new strategic incentives to outsource/vertically integrate and show that firm asymmetries can emerge endogenously, with firms choosing different modes of operation, even when they are ex-ante identical. We apply our model to a number of different international trading setups.

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1. Introduction

This paper aims to shed light on the organisational and internationalisation strategies of firms in oligopolistic industries.

There has been a rapid expansion in outsourcing in recent years, with firms subcontracting activities as diverse as final assembly, R&D and after-sales services – both domestically and internationally. The growing importance of outsourcing, particularly across national borders, has resulted in a huge increase in interest in the factors determining the vertical boundaries of the firm and the 'fragmentation' of the production in both the applied[1] and theoretical academic literatures.

The vertical boundaries of the firm have been analysed by two fairly distinct traditions in economics.[2] The first, within Organisational Economics, dates back to Coase (1937) and Williamson (1975, 1985) and treats vertical integration as a response to contractual frictions. The second, emerged within Industrial Economics, focuses on market structure (with or without oligopoly). By endogenising a firm's make-or-buy trade-offs and showing how they are affected by its strategic interactions with competitors, this paper brings together the oligopolistic strategic strands of the Industrial Economics and the Organisational Economics literatures on the make-or-buy decision of the firm. In so doing, the paper contributes more broadly to the development of an "Organisational Industrial Organisation" (OIO) approach, as advocated by Legros and Newman (2014), capable of incorporating insights from incomplete contracting into industrial economics.[3]

The organisational economics strand of the theory has focussed on the incentives issues surrounding the emergence of the boundaries of the firm within bilateral (e.g. buyer-supplier) settings and studied the sources of transaction costs involved in market relations that can be overcome by vertical integration. Central to the bulk of this line of research is the concept of 'hold-up problem' that arises, in the presence of contract incompleteness, from the need by one party to undertake relationship-specific investments that are of little value

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[1]   For applied work see, for instance, Abraham and Taylor (1996), Audet (1996), Feenstra (1998), Campa and Goldberg (1997), Hummels *et al* (2001), and Bartel *et al* (2005).

[2]   See Bresnahan and Levin (2013) for a recent survey that points out this dichotomy.

[3]   As pointed out by Legros and Newman (2014), *imperfections within firms*, that are the focus of the industrial organisation literature, have hitherto played little role in the industrial economics literature – which has focussed on market power as a source of market imperfection and has continued to treat the firm as a *black-box*. In their paper, Legros and Newman consider an example of OIO within a price-taking environment.

outside the particular relationship. In the transaction cost theory of the firm, vertical integration thus emerges as a solution to the hold-up problem.

Until fairly recently, its firm-pair level focus had to a great extent set this tradition apart from strands of the industrial economics literature concerned with the role of market structure, as well as from areas that have developed from advances in microeconomic and industrial economic theory, e.g. 'modern' international trade and investment theories. The last decade has seen the emergence of a number of path-breaking contributions that have succeeded in contextualising the bilateral buyer-supplier relationships within broader market structures that also allow for the incorporation of international interactions.[4] One group of papers endogenises the mode-of-operation choice in the presence of a specialised input within the property-right approach: see Antràs (2003, 2005), Antràs and Helpman (2004), Grossman and Helpman (2004), and Feenstra and Hanson (2005).[5] Another set of papers is based on the transaction cost approach and highlights the importance of 'market thickness effects' (McLaren, 2000; Grossman and Helpman, 2002, 2005) for the emergence of bilateral buyer-supplier relationships. In both of these strands of the literature, the decision to outsource is endogenous, contracts are incomplete and the intermediate input is specialised and requires relationship-specific investment.[6] Their fundamental contribution is to embed the mode of operation decision of the firm within general equilibrium frameworks that can account for the role of the standard drivers of international trade specialisation (i.e., differences in factor endowments and/or product differentiation and love of variety).

Given their emphasis on general equilibrium effects, however, these models (that are developed mostly within monopolistically competitive market structures) rule out by assumption the existence of strategic interaction between firms.

We argue that additional insights into the determinants of firms' boundaries can be obtained by contextualising the transaction cost approach[7] to the make-or-buy decision of the firm within a broader market structure that is characterised by oligopolistic behaviour.

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[4] An excellent survey of this literature is offered by Spencer (2005).
[5] For a comprehensive and stimulating review of this literature see Antràs (2014).
[6] The choice between the use of specialised components and generic inputs is endogenised within partial equilibrium settings in a number of other papers (see Spencer and Qiu, 2001; Qiu and Spencer, 2002; Head et al, 2004; Feenstra and Spencer, 2005).
[7] The Transaction Costs (TC) and the Property-Right (PR) approaches are often considered to be very similar; however, it has been argued that they can instead be very different in their fundamental predictions (see for instance Whinston, 2003). In particular, evidence from supplier–manufacturer relationships tends

We develop a model in which final good production requires the use of a customised intermediate, and oligopolistic final good firms decide whether to source this input from a non-affiliated outside supplier or to produce it in-house. Downstream firms that outsource[8] enter a bilateral relationship with an upstream firm that must carry out a relationship-specific investment in the quality and customisation of the input. A major innovative feature of our model is that it fully endogenises the investment decision in the quality and customisation of the intermediate good. The endogeneity of the quality of the intermediate, in turn, translates into an endogenous marginal cost of production for the final good. As a result, our approach implies that the key trade-off at the core of the outsourcing decision does not, as in the bulk of the extant oligopolistic literature on the make-or-buy decision of the firm, exist *by assumption*, but emerges *endogenously*. A vertically integrated firm incurs additional governance costs that can be avoided by outsourcing. If the outside supplier is not significantly more efficient at providing the intermediate to the required specifications, however, outsourcing will raise the final good producer's marginal production costs since, due to the hold-up problem that results from contract incompleteness, the supplier will tend to under-invest in the quality of the intermediate. Outsourcing then involves accepting higher marginal costs in exchange for a saving on governance costs.[9] This result provides a theoretical rationale for the stylised facts emerging from case studies and econometric

to support the predictions of the TC approach, whilst that on manufacturer–retailer or franchisor–franchisee relationships tends to be more consistent with the PR approach. In their recent survey of empirical evidence on the boundaries of the firm, Lafontaine and Slade (2007), point out that in the context of buyer-supplier relationships "*there are almost no statistically significant results that contradict TC predictions*" (p. 658). In addition, the TC approach, as shown by a large body of empirical evidence, performs particularly well in explaining the backward integration decision of firms. It thus appears to be a natural choice for studying the determinants and implications of the process of disintegration (both within and across national borders) of the vertical production chain – which concerns mainly the *backward* integration decision of the firm.

8   By outsourcing we mean the acquisition of an input or service from an unaffiliated firm whether domestic or foreign. This is the standard terminology. Bhagwati *et al* (2005) use the term in a narrower sense to refer to the acquisition of services from unaffiliated foreign firms.

9   As Buehler and Haucap (2006) perceptively point out, the outsourcing literature has largely ignored the endogeneity of the price of the outsourced goods and their paper is a notable exception in this respect. A fundamental difference between their model and ours, however, is that they assume the intermediate good to be a *generic* input that does not require a relationship-specific investment. Thus, the endogeneity of its price in their model does not result from a hold-up problem (as is standard in the transaction cost literature) but from market demand forces – via changes in the demand for the input resulting from outsourcing.

analyses that outsourcing may not lead to increases in quality and/or reductions in production costs.[10]

However, while the traditional transaction cost approach places emphasis on the economising dimension of the make-or-buy decision of the firm, by embedding the endogenous emergence of the hold-up problem within a strategic setting, in our model strategic considerations interact with economising considerations in determining the mode-of-operation choice of firms. This interaction underpins the possibility that both strategic vertical integration and strategic outsourcing arise in equilibrium. Furthermore, unlike most other contributions in this literature[11], 'mixed outcomes' can arise in equilibrium in which, even when they are ex-ante symmetric, firms may choose different modes of operation – resulting in different production costs and profitability. The endogenous emergence of differences in mode-of-operation among firms thus contributes to explain observed inter-firm cost and performance heterogeneity (see, e.g. Syverson, 2011) as well as offer a rationale for the stylised facts that not all firms in the same industry adopt the same mode of operation strategy: we identify cases in which vertical integration is a best response to a rival's outsourcing, but outsourcing is a best response to a rival that is vertically integrated. The emergence of asymmetric equilibria ultimately rests on a negative interdependence between the firms' mode-of-operation decisions. Vertical integration, which entails exchanging high fixed costs for lower marginal costs, is a higher output strategy. Instead, outsourcing – which involves trading off lower fixed costs for higher marginal costs – is a lower output strategy. A firm that faces a vertically integrated rival therefore has a lower anticipated market share and hence a lower incentive to be vertically integrated itself than a firm that faces an outsourced rival. Since outsourcing by one firm reduces the investment of

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[10] There exists survey evidence that outsourcing is greatly motivated by cost reductions (e.g. http://www.manpower.co.uk/news/OutsourcingSurvey.pdf), but also that it can lead to lower quality of the outsourced inputs (e.g. see the survey by Software Development Magazine, 2004; and, more recently, Ferreira and Prokopets, 2009). Görzig and Stephan (2002), using German firm level panel data, find that outsourcing firms experienced a deterioration of return per employee. A negative relationship between outsourcing and firm level profitability in the electronic industry in Ireland is found for smaller firms by Görg and Hanley (2004). See also Tadelis (2007) for further evidence and discussion of how outsourcing ultimately has translated for many companies into higher total costs than they had originally anticipated.

[11] See for instance Grossman and Helpman (2002, 2003, and 2005), and Antràs and Helpman (2004). Buehler and Haucap (2006) also find that strategic interaction can give rise to asymmetric equilibria. However, in their model, firms' decisions are sequential rather than simultaneous – and the first-mover advantage enjoyed by one firms thus implies that competitors are not a-priori identical as is the case in our paper.

its rival, outsourcing can be characterised as a defensive business strategy – in contrast to vertical integration that can be viewed as an aggressive business strategy. Ours is the first paper to identify this particular strategic incentive to outsource. Typically, in the literature, optimal governance structures are those that minimise overall efficiency losses. We show that, even though contract incompleteness with ex-ante costly private investment can lead to efficiency losses, the optimal governance structure may not be the one that minimises these losses: by affecting a rival's behaviour, defensive outsourcing implies that it may be optimal to adopt an internal structure that is not in itself the most cost efficient if doing so softens the behaviour of rivals. We also demonstrate that the incentive to outsource is relatively greater for smaller/higher cost firms: given its effects on a rival's investment, the strategic incentive to outsource is most effective when used by a less efficient firm against a highly efficient low cost and high investing rival.

An important contribution of the paper is therefore to examine the "make-or-buy" decision in a context in which final good firms compete on the product market as oligopolists and in which issues related to relationship-specific investment and incomplete contracts are also taken into account: in earlier oligopoly papers, the role of these key features of the transaction costs approach in determining the nature of the trade-offs facing firms when making their mode-of-operation decisions is disregarded.[12] Within a Cournot setting, Nickerson and Vanden Bergh (1999) show that organisational choices are affected by strategic considerations in the firm-customer transactions, but disregard transaction costs and contract incompleteness. Shy and Stenbacka (2003) show that competition in the upstream industry affects production efficiency and the choice in the mode-of-operation of a downstream differentiated Bertrand duopoly when vertical integration involves higher fixed costs but lower marginal costs. In their paper, the trade-off between fixed and marginal cost is however exogenous.[13]

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[12]   A prominent strand of the literature on oligopoly and vertical integration was developed in the early 1990s on vertical foreclosure, see for instance: Ordover *et al* (1990) and Hart and Tirole (1990). Some contributions on the Japanese Keiretsu are more in line with the standard outsourcing literature. For instance, in Spencer and Qui (2001), downstream Cournot oligopolists buy from upstream keiretsu members in a context in which investment contracts cannot be written and upstream firms carry out relationship-specific investments. Their paper, however, does not endogenise the outsourcing versus vertical integration decision.

[13]   Chen *et al* (2004) present a special case of outsourcing where an oligopolistic domestic firm may buy an intermediate from a more efficient firm that is also its competitor on the final goods market. This type of outsourcing, which facilitates collusion, differs substantially from the one we consider in this paper and

An important reason for the revival of interest in the literature on the boundaries of the firm has been the perceived relationship between outsourcing and globalisation. We apply our model to examine the effect of trade liberalisation on the mode-of-operation decision of firms and show how increased competitive pressure can affect the vertical structure of firms – further highlighting how market interaction effects are entwined with organisation decisions.

In Section 2, we start with the analysis of a monopoly model that will offer a useful reference point for the analysis of the effects of strategic interaction between firms. In Section 3, we set up and discuss the oligopoly model. The mode-of-operation equilibria of the game focussing on the benchmark case of ex-ante firm symmetry are discussed in Section 4. In section 5, we explore strategic behaviour, show how it relates to inter-firm asymmetries, and discuss the idea that outsourcing can often be a defensive business strategy.   In Section 6, we examine the effects of trade liberalisation on equilibrium outcomes and on the welfare of consumers. [14] Section 7 draws some conclusions from the analysis.

2.   The Monopoly Model

In this section we consider the make-or-buy decision of a monopolist firm. This useful benchmark allows us to abstract from the strategic interaction between rival downstream firms. In the section that follows we will show what difference oligopolistic interaction makes to the mode-of-operation decision of the firms.

Consider a monopoly that produces a homogenous product. The inverse demand for the final good is given by:

$$p = a - by,$$
(1)

where p and y are the price and quantity of the good respectively, and a and b are positive constants.

highlights a different kind of strategic effect. Buehler and Haucap (2006) adopt the taxonomy of Fudenberg and Tirole (1984) to characterise equilibria in a duopoly in which firms choose sequentially between outsourcing a generic input or producing it in-house.

[14] Ornelas and Turner (2008, 2012) analyse the effects of trade policy on organisation choice in the presence of hold-up problems and relationship-specific investment. Their focus, however, is on the bilateral relationship between an upstream supplier and a downstream firm and they hence abstract from strategic considerations

We assume that the production of the final good requires a non-generic intermediate component or service. The firm can choose a vertical integration strategy in which it invests in the development of and produces this input itself, or an outsourcing strategy in which it sources it from an outside unaffiliated supplier. Due to the specialised nature of the input, if the firm chooses to outsource, it will not be able to purchase the intermediate from a spot market. Instead it must buy it from a supplier that has made a relationship-specific investment (RSI) in the development of the input.[15]

Thus, we allow the firm to decide whether to become vertically integrated or to follow an outsourcing strategy. Specifically, the firm can make the intermediate in-house at a marginal cost of r or buy it from an upstream supplier at a price q. We assume that the intermediate must be combined in fixed proportions with other factors of production; we model these factors as a composite input whose price is normalised at unity. Units are chosen so that one unit of the customised intermediate is required per unit of output. Let $e = \bar{e} - z > 0$ be the per-unit input requirement for the composite input, where $\bar{e}$ is a constant and z captures the 'usefulness' of the intermediate: a better intermediate, from the point of view of the downstream firm, is one that requires to be combined with fewer other inputs in order to produce a unit of output. Using the superscripts V and O to denote vertical integration and outsourcing respectively, the monopolist's marginal production cost will thus be:

$$c^V = r + \bar{e} - z \ , \tag{2a}$$

if the intermediate is produced in-house, and:

$$c^O = q + \bar{e} - z \ , \tag{2b}$$

if it is outsourced.

Let K be investment in quality and customisation of the intermediate, with $K = \gamma z^2 / 2$. Thus, the usefulness of the input ($z = \sqrt{2K/\gamma}$) increases in K but at a diminishing rate. The parameter γ determines the cost of investment in quality.

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[15] The relationship-specificity of investment, in the presence of incomplete investment contracts, gives rise to a hold-up problem.

In line with the literature on vertical integration, we assume that vertically integrated firms incur fixed governance costs – *à la* Williamson (1975, 1985) – that are higher than those of a firm that outsources; without loss of generality, we shall then set the fixed governance cost for the latter to zero.[16] If the firm is vertically integrated, its profit function is therefore given by:

$$\pi^V = (p - c^V)y - K - G, \tag{3a}$$

where *G* represents the fixed component of the governance costs of running a larger and more complex organisation.[17] If the firm chooses to outsource, its profit function will therefore be:

$$\pi^O = (p - c^O)y. \tag{3b}$$

Note that, by outsourcing, the firm avoids both the governance cost associated with vertical integration and the investment cost associated with the intermediate. The latter, is now borne by the upstream supplier. The supplier earns operating profit: $(q - r^u)m$, where r^u is the marginal cost it incurs in producing the intermediate and *m* is its output. Note that we assume that the marginal production cost of the intermediate can differ depending on whether it is produced in-house or by the upstream firm: thus, r^u is not necessarily equal to *r*. Differences between r^u and *r* can be due to a host of reasons – e.g. higher marginal costs associated with the governance of a vertically integrated firm, factor cost advantages that a supplier might enjoy, technological differences or differences in expertise between the firms. Making use of the fact that one unit of the intermediate is needed in the production of each unit of final output, we can write *m=y*. The upstream firm invests $K^u = \gamma^u z^2 / 2$, where the cost parameter γ^u may differ from that of the downstream firm. In addition, the firm must pay a fixed entry cost *F*. Its total profit is:

$$\mu = (q - r^u)y - K^u - F. \tag{4}$$

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[16] For a discussion and further references on fixed governance costs see McLaren (2000).

[17] Clearly, running a larger and more complex organisation can result in higher fixed and/or marginal costs. *G* captures the fixed aspect of these costs. As we will mention below, our model also allows for the possibility of higher marginal costs associated with the governance issues of vertical integration. For expositional simplicity, we shall refer to *G* as the governance costs.

The model is a four stage game. In stage one, the monopolist decides whether to outsource its intermediate or to produce it in-house. If it decides to outsource, the firm approaches a specialised supplier firm which will produce the input. In stage two, the downstream firm (if it is vertically integrated) or the supplier (if the downstream firm chooses to outsource) invest in the development of the intermediate. If outsourcing, in stage three the monopolist bargains with the intermediate supplier over the price of the input. We assume that the final good producer only has enough time to negotiate with a single supplier. As in Grossman and Helpman (2003), should bargaining breakdown, 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.[18] In stage four, the intermediate is supplied and the final output is produced.[19]

We are concerned with the subgame perfect equilibria, hence the game is solved by backward induction. In the final stage, the monopolist's outputs is determined by the following first-order conditions:

$$\frac{\partial \pi}{\partial y} = p - c^h - by = 0,$$ (5)

where c^h will vary depending on the mode-of-operation ($h=V,O$) chosen by the firm. The resulting equilibrium output will then be:

$$y = \frac{a - c^h}{2b},$$ (6)

where ($h=V,O$).

In stage three, recognising that all fixed and investment costs are now sunk, the final good firm (if outsourcing) bargains with an upstream supplier over the price of its

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[18] Given that the intermediate component in this model is a non-generic input which is highly specific to the particular downstream firm, we model the relationship between upstream and downstream firms as a bilateral one – between a specific firm and a specific supplier. The supplier cannot sell the intermediate to another firm and the buyer cannot buy it from a firm that has not carried out the relationship-specific investment. Only one firm will enter the intermediate market to make this investment; this is because if more than one supplier entered, they would play a Bertrand game with each other, driving the intermediate price to its marginal production cost. In this instance, suppliers would be unable to cover their development and entry costs. Anticipating this, only one supplier firm will enter in equilibrium.

[19] This set up corresponds to the *'informal arrangement'* described by McLaren (1999), who argues that trade liberalisation works towards less formality in contracting, making informal arrangements more likely.

intermediate. The price q of the intermediate good results from the maximisation of the following Nash bargain:

$$N = \left[(p - c^O)y\right]^{\beta}\left[(q - r^u)y\right]^{1-\beta},\qquad(7)$$

where β and $(1-\beta)$ represent the bargaining power of the downstream firm and its upstream partner respectively, with $0 \leq \beta \leq 1$. Note that we have used $m=y$ to eliminate m. Taking the first–order condition for the maximisation of N with respect to q and rearranging, we obtain:

$$q = r^u + 2\frac{(1-\beta)}{(1+\beta)}by.\qquad(8)$$

The equilibrium mark-up of the intermediate supplier, $q - r^u$, falls in the downstream firm's bargaining power, but increases in its output y.[20] The rent-extracting ability of the intermediate firm will be higher, ceteris paribus, the weaker is the bargaining position of the final good producer and the larger is the latter's output. Although q must be larger than r^u, it needs not be higher than r. Furthermore, even if q is lower than r, it may still be the case that the marginal production cost of a vertically integrated firm is lower than that of a downstream firm that chooses to outsource. This is because the final good marginal production cost also depends on the quality of the intermediate and thus on the level of investment in its development. As we shall see, in fact, the level of investment may be lower under outsourcing.

In stage 2, the firms (either the downstream monopolist when it vertically integrates, or the intermediate supplier when the former outsources) choose their investment levels. We can model this decision as firms choosing the level of z, since this is directly related to that of investment. A firm that produces the intermediate in-house, will choose z to maximise

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[20]   The purchase of intermediate components is sometimes assumed to involve the combination of a fixed lump-sum payment and a price set at marginal cost. As highlighted by Spencer (2005), however, the transfer of rents through lump-sum payments is at odds with stylised facts about domestic and international transactions. Our paper recognizes that outsourcing contracts typically involve strictly positive prices that exceed marginal costs, with the distribution of rents between intermediate supplier and final good producer – and hence the returns to relationship-specific investment – being determined through Nash bargaining over the price after investment is sunk. The resulting 'double marginalisation' is also an important feature of transaction costs economics – indeed, in the words of Williamson, a key distinction between the transaction costs and the Grossman-Hart-Moore property right framework is their assumption of costless bargaining (Williamson, 2000).

(3a). The corporate governance costs, G, have already been sunk before the firm invests so they play no part in the optimal choice of investment levels. Thus, the vertically integrated firm first-order condition is:

$$\frac{d\pi}{dz} = -y\frac{dc^V}{dz} - \gamma z = 0 \qquad (9)$$

which implies

$$z = \eta by , \qquad (10)$$

and where $\eta = 1/b\gamma$ is a measure of the effectiveness of investment.

If the intermediate is outsourced, then the investment is carried out by the upstream firm which only receives a share (determined by its bargaining power) of the rent generated by the investment; as a result, it does not fully appropriate the marginal benefit of its investment and this reduces its incentive to invest. We can use (8) in (4) to obtain:

$$\mu = 2\frac{(1-\beta)}{(1+\beta)}by^2 - K^u - F . \qquad (11)$$

The first order condition for the profit maximising choice of z_i is then:

$$\frac{d\mu}{dz} = 4\frac{(1-\beta)}{(1+\beta)}by\frac{dy}{dz} - \gamma^u z = 0 \qquad (12)$$

where $b(dy/dz) = -\frac{1}{2}(dc^O/dz)$ from (6) and $dc^O/dz = (dq/dz) - 1$ from (2b). Notice that investment affects the marginal cost both directly and through a change in the negotiated price of the input. We can make use of (8) in the above to obtain $b(dy/dz) = (1+\beta)/4$. We can then eliminate $b(dy/dz)$ in (12). Rearranging , this implies

$$z = (1-\beta)\eta^u by . \qquad (13)$$

where $\eta^u = 1/b\gamma^u$ is a measure of the supplier's effectiveness of investment.

Lemma 1: *For a given relative effectiveness of investment ($\eta_i^u = \eta_i$), the monopolist z/y ratio is higher when it is vertically integrated than when it outsources.*

Proof. It follows from inspection of expressions (10) and (13).

Thus, vertical integration results in a higher investment to output ratio than outsourcing.

In the first stage of the game, the monopolist chooses its mode-of-operation. To establish whether the firm will choose to outsource or to be vertically integrated, we must compare its profits under the two regimes. To facilitate this comparison, it proves helpful to derive an expression for the profits in terms of outputs and parameters only. By using the first-order conditions in (5) and (10), we can rewrite the profit functions in the two regimes respectively as:

$$\pi^V = \left(1 - \tfrac{\eta}{2}\right)b(y^V)^2 - G, \tag{14a}$$

and

$$\pi^O = b(y^O)^2, \tag{14b}$$

It is immediately obvious from equations (14a) and (14b), that a sufficient condition for outsourcing to yield higher profits is $y^O \geq y^V$. Another way to state this sufficient condition is to say that outsourcing must yield higher profits if $c^O \leq c^V$. Hence, if outsourcing results in an increase in output (perhaps because the marginal cost of producing the intermediate is so much lower if it is carried out by a specialised upstream producer), then it dominates vertical integration.

3. The Oligopoly Model

We now extend the model of the previous section and allow for two oligopolistic final good firms (labelled 1 and 2) serving the same market and producing a homogenous product.[21] To begin with, we shall not need to specify the international trade context. Thus, the two firms can be thought of as competing on a home market, a foreign market, or an integrated market such as would exist in a customs union. We will be more specific in Section 6, where we shall consider a number of alternative trading setups in order to analyse the effects of trade liberalisation.

Let y_1 and y_2 be the quantities produced by firm 1 and 2 respectively, with $y = y_1 + y_2$. The inverse demand for the final good is given by expression (1) above.

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[21] An extension to differentiated products is straightforward but would not yield many additional insights.

We allow both firms to decide whether to become vertically integrated or to follow an outsourcing strategy. Each firm $i=1,2$ can make the intermediate in-house at a marginal cost of r_i or buy it from an upstream supplier at the price q_i. We assume that if both outsourcing, the firms use different specialised producers. We allow for the possibility that firms have different efficiencies hence the marginal costs of downstream firms are firm specific. Thus, modifying (2a) and (2b), the marginal production cost for firm $i=1,2$ will be: $c_i^V = r_i + \overline{e}_i - z_i$ if the intermediate is produced in-house and: $c_i^O = q_i + \overline{e}_i - z_i$ if it is outsourced. The profit functions for firms under the different modes of operation are appropriately modified versions of those in the monopoly case (expressions (3) and (4)). Thus, profits of the downstream firms are: $\pi_i^V = (p - c_i^V)y_i - K_i - G_i$ and $\pi_i^O = (p - c_i^O)y_i$ ($i=1,2$) under vertical integration and outsourcing, respectively. The upstream firms' profits are: $\mu_i = (q_i - r_i^u)y_i - K_i^u - F_i$ ($i=1,2$).

As in the monopoly case the model is a four stage game. In stage one, the downstream firms simultaneously decide whether to outsource their intermediate or to produce it in-house. In stage two, the firms simultaneously invest in the development of intermediates. In stage three, the firms that outsource bargain with their intermediate suppliers over the price of the input. When both firms outsource, the two upstream and downstream pairs bargain simultaneously. In stage four, the intermediate is supplied and final outputs are chosen simultaneously.

In the final stage, the two firms engage in Cournot competition. The resulting equilibrium output of firm i will then be:

$$ y_i = \frac{a - 2c_i^h + c_j^k}{3b}, \tag{15} $$

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

In stage three, if outsourcing, the final good firms bargain with an upstream supplier over the price of their intermediate. Again, let β_i and $(1 - \beta_i)$ represent the bargaining power of the typical downstream firm and its upstream partner respectively, with $0 \leq \beta_i \leq 1$.

Then, maximisation of the Nash bargain $N_i = \left[(p - c_i^O)y_i\right]^{\beta_i} \left[(q_i - r_i^u)y_i\right]^{1-\beta_i}$ of bargaining pair i yields the following intermediate good price:

$$q_i = r_i^u + \frac{3}{2}\left(\frac{1-\beta_i}{1+\beta_i}\right)by_i. \tag{16}$$

In stage 2, the firms choose their investment levels. We first examine the investment decision of a downstream firm that produces the intermediate in-house. In making its investment decision the firm takes account of both the direct cost-reducing effect of its investment on its own profit and the strategic effect on its rival's output in the final stage. Thus, firm i's first-order condition is:

$$\frac{d\pi_i}{dz_i} = \frac{\partial \pi_i}{\partial z_i} + \frac{\partial \pi_i}{\partial y_j}\frac{dy_j}{dz_i} = 0, \tag{17}$$

where the first term on the right-hand side, $\partial \pi_i / \partial z_i = -\left(\partial c_i^V / \partial z_i\right)y_i - \gamma_i z_i = y_i - \gamma_i z_i$, is the direct effect of z_i on own profits. The second term captures the strategic effect on the investment decision of the firm. Specifically, in the second term, $\partial \pi_i / \partial y_j = y_i p' = -by_i$. The expression for the term dy_j / dz_i differs depending on the mode-of-operation of firm j. If the rival firm j is vertically integrated, then $dy_j / dz_i = (1/3b)(\partial c_i^V / \partial z_i) = -1/3b$. Thus, in this case, the strategic effect $\left(\partial \pi_i / \partial y_j\right)\left(dy_j / dz_i\right)$ is positive and hence encourages the firm to invest more in the development of the intermediate good. The first-order condition for a firm that is vertically integrated and faces a vertically integrated rival can then be rewritten as:

$$z_i^{VV} = \theta^{VV}\eta_i by_i^{VV}, \qquad \text{where } \theta^{VV} = 4/3, \tag{18a}$$

and where $\eta_i \equiv 1/b\gamma_i$ is a firm-specific measure of the effectiveness of investment; also note that we adopt the convention that, when there are two superscripts, the first refers to firm i and the second to firm j. If, instead, the rival firm j outsources, then even though firm i's first-order condition takes the same form as in (17), the derivative dy_j / dz_i is different, as z_i now also affects y_j through changes in q_j. Hence, the strategic incentive for firm i's investment is lessened as a result of the endogenous change in the price of the intermediate

because now $dy_j/dz_i = (1/3b)(\partial c_i^V/\partial z_i) - (2/3b)(\partial c_j^O/\partial z_i)$, with the derivative $dc_j^O/dz_i = dq_j/dz_i = (3/2)[(1-\beta_j)/(1+\beta_j)]bdy_j/dz_i$. Rearranging, we get: $dy_j/dz_i = -(1/6b)(1+\beta_j) < 0$, the absolute value of which is less than that in the vertical integration case (where $dy_j/dz_i = -1/3b$) except when $\beta_j = 1$, that is when firm j has maximum bargaining power in its negotiations with the supplier firm. Thus, the first-order condition for a vertically integrated firm facing a rival that outsources can be rewritten as:

$$z_i^{VO} = \theta_i^{VO}\eta_i by_i^{VO}, \qquad \text{where } \theta_i^{VO} = \frac{7+\beta_j}{6}. \qquad (18b)$$

Thus, outsourcing by one firm 'softens' the behaviour of its rival, i.e. it reduces its aggressiveness in investment. We will return to this issue later when we discuss the strategic motive for outsourcing.

If the intermediate is outsourced, then the investment is carried out by the upstream partner. We can use (16) in the expression for upstream profits to obtain:

$$\mu_i = \frac{3}{2}\frac{(1-\beta_i)}{(1+\beta_i)}by_i^2 - K_i^u - F_i. \qquad (19)$$

The first order condition for the profit maximising choice of z_i is then:

$$\frac{d\mu_i}{dz_i} = 3\frac{(1-\beta_i)}{(1+\beta_i)}by_i\frac{dy_i}{dz_i} - \gamma_i^u z_i = 0. \qquad (20)$$

The expression for dy_i/dz_i differs depending on whether the rival is vertically integrated or outsourcing. When the rival is vertically integrated it is straightforward to combine $c_i^O = q_i + \bar{e}_i - z_i$ and (15) and thus to show that $dy_i/dz_i = -(2/3b)\{(\partial c_i/\partial z_i) + (\partial c_i/\partial q_i)(dq_i/dz_i)\}$ which simplifies to: $dy_i/dz_i = (1+\beta_i)/3b > 0$. We can use this in (20) to obtain:

$$z_i^{OV} = \theta_i^{OV}\eta_i^u by_i^{OV} \qquad \text{where } \theta_i^{OV} = (1-\beta_i), \qquad (21a)$$

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and where $\eta_i^u \equiv 1/b\gamma_i^u$. However, when the rival firm is outsourcing, then straightforward (if lengthy) calculations show that the effect of z_i on y_i becomes $dy_i/dz_i = (2/3b)(7+\beta_j)(1+\beta_i)/(15+\beta_i+\beta_j-\beta_i\beta_j) > 0$. The use of this in (20) yields:

$$z_i^{OO} = \theta_i^{OO}\eta_i^u b y_i^{OO} \qquad \text{where} \quad \theta_i^{OO} = \frac{2(7+\beta_j)}{15+\beta_i+\beta_j-\beta_i\beta_j}(1-\beta_i). \qquad (21b)$$

Again, outsourcing by one firm 'softens' the investment behaviour of its rival in the sense that z_i/y_i is lower when its rival outsources its intermediate than when it chooses to vertically integrate.

Lemma 2. *The z_i/y_i ratio is lower when the rival firm j outsources its intermediate than it is when firm j is vertically integrated.*

Proof. It follows from inspection of expressions (18a), (18b) (21a) and (21b).

Furthermore, as in lemma 1 for the monopoly case, vertical integration implies a more aggressive investment strategy than outsourcing unless η_i^u is much larger than η_i.

Lemma 3: *For a given relative effectiveness of investment ($\eta_i^u = \eta_i$) and given the mode-of-operation choice of the rival, firm i's z_i/y_i ratio is higher when it is vertically integrated than when it outsources.*

Proof. It follows from inspection of expressions (18a), (18b) (21a) and (21b).

In the first stage of the game, the firms simultaneously choose their mode-of-operation. To establish whether a firm will choose to outsource or to be vertically integrated, we must compare its profits under the two regimes for a given mode-of-operation choice of its rival. To facilitate this comparison, it proves helpful to derive an expression for the profits in terms of outputs and parameters only. By using the first-order conditions for output and investment, we can rewrite the profit functions in the two regimes respectively as:

$$\pi_i^{Vk} = \Omega_i^{Vk} b(y_i^{Vk})^2 - G_i, \qquad (22a)$$

and

$$\pi_i^{Ok} = b(y_i^{Ok})^2, \qquad (22b)$$

where $k=(V,O)$, $\Omega_i^{VV} = (1-\frac{8}{9}\eta_i)$ and $\Omega_i^{VO} = \left(1-\frac{(7+\beta_i)^2}{72}\eta_i\right)$.

## 4.	The Mode-of-operation Equilibria

We turn now to a discussion of the mode-of-operation equilibria. There are four possible candidate equilibrium regimes: (VV), (VO), (OV), and (OO), where the first letter refers to the mode-of-operation selected by firm 1 and the second letter refers to that chosen by firm 2.

Our model is quite rich and there are many possible asymmetries between firms. These asymmetries will be explored in detail in the next section. However, to begin with, we shall focus on the case of ex-ante symmetry. The symmetry assumptions employed in this section serve to introduce the importance of adding strategy to the transaction cost approach. We show that even with full ex-ante symmetry strategic behaviour can generate asymmetric ex-post outcomes in terms of mode-of-operation, costs, outputs and investment levels.

In this section then we assume that the downstream firms are *ex ante* identical, in that neither firm has an underlying cost advantage. The upstream firms are also *ex ante* identical to each other. In addition, we assume the bargaining power parameters to be identical, so that $\beta_1 = \beta_2 = \beta$; we also assume that there is no underlying marginal 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 by the downstream or by the upstream supplier (i.e. $r_i = r_i^u$). Furthermore, we let $G_1 = G_2 = G$ – that is, take the fixed governance cost of vertical integration to be the same for both firms.

Given these symmetry assumptions, we obtain the following proposition:

Proposition 1: *Under symmetry, the pattern of equilibria depends on the level of governance costs, G:* (*i*) *at G=0, the subgame perfect equilibrium entails both firms choosing vertical integration* (VV)*;* (*ii*) *at sufficiently large levels of G, the subgame perfect equilibrium entails both firms choosing to outsource* (OO)*;* (*iii*) *at intermediate levels of G, multiple asymmetric equilibria* (VO) *and* (OV) *occur.*

Proof. See Appendix.

Thus, for a range of *G*, asymmetric outcomes emerge despite the fact that the firms are fully symmetric *ex ante*. The underlying reason for the emergence of asymmetric equilibria derives from a negative interdependence between the firms' mode-of-operation decisions. The intuition for this is that, given our *ex ante* symmetry assumptions, vertical integration always entails exchanging high fixed costs for lower marginal costs – and is therefore a

higher output strategy. On the other hand, outsourcing – which involves trading off lower fixed costs for higher marginal costs – is a lower output strategy. A firm that faces a rival which is vertically integrated has, ceteris paribus, a lower anticipated market share and hence a lower incentive to be vertically integrated itself than a firm that faces an outsourced rival. Hence, over a range of G, vertical integration is a best response to a rival's outsourcing but outsourcing is a best response to a rival that is vertically integrated. The profit levels in the different equilibrium regimes are plotted against the governance costs G in Figure 1 for the case of ex-ante symmetry. When governance costs are low enough, both firms choose vertical integration and have the same equilibrium profits. As G rises, asymmetric equilibria emerge: the best reply to a firm's vertical integration is outsourcing (and vice-versa). In this region of G, the vertically integrated firm's profits are higher than that of the outsourcing firm.[22] As shown in the figure, the profits of the vertically integrated firm increase when the other firm switches to outsourcing. This is because here outsourcing is less aggressive than vertical integration and results in lower investment and output. At high levels of G, the vertically integrated firm switches to outsourcing and this leads to an increase in the profits of the other firm (which is also outsourcing).

Figure 1 about here

Both strategising and economising considerations are at work in determining the equilibrium outcomes; in particular, oligopolistic strategic interaction means that – even when firms are ex-ante symmetric – asymmetric equilibria (in which firms choose different mode-of-operation strategies) can emerge. A better appreciation of how strategic behaviour can be used to soften the behaviour of rivals can be gained by considering underlying asymmetries between firms, to which we now turn.

5. A Closer Look at Strategic Behaviour: Aggressive and Defensive Business Strategies

As highlighted in Lemma 2, outsourcing by one firm softens the investment behaviour of its rival. This gives rise to a 'strategic motive' to outsource. This strategic feature arises from

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[22] Nevertheless, in this region of parameter space, the outsourcing firm does not have an incentive to vertically integrate given that its rival is vertically integrated – as then both it and its rival would have lower profits.

oligopolistic interaction and is of course absent in the monopoly model discussed in Section 2. In this section, we show how the choice of the mode-of-operation can be used strategically by firms to affect the oligopoly game between them. To this end, we ask how the make-or-buy decision affects the equilibrium market shares and profit levels. A natural approach to answering this question is to consider the effect of the mode-of-operation on the firms' output reaction functions and thus on outputs. The reaction function of firm i, that is obtained from the output first-order condition $\dfrac{\partial \pi_i}{\partial y_i} = p - c_i^h - by_i = 0$ can be written as $y_i = \psi_i(y_j; c_i)$. Note that the effect of outsourcing on c_i occurs via changes in z_i and q_i. It therefore proves useful, by making appropriate substitutions given the solutions of previous stages of the game, to eliminate z_i and q_i. The resulting functions, which we call *output response functions*,[23] take account of the indirect effect of outsourcing on outputs through changes in the level of investment and the price of the intermediate good. We will use these functions to illustrate what happens when one of the firms chooses to outsource rather than to vertically integrate. In the absence of outsourcing, these output response functions for firm 1 and firm 2 are, respectively:

$$y_1^{VV} = \frac{A - by_2^{VV}}{bM_1^{VV}}, \tag{23a}$$

and

$$y_2^{VV} = \frac{A - \Phi - by_1^{VV}}{bM_2^{VV}}, \tag{23b}$$

where $M_1^{VV} = (2 - \theta^{VV}\eta_1)$, $M_2^{VV} = (2 - \theta^{VV}\eta_2)$ and $A = (a - \bar{e}_1 - r_1)$. The parameter $\Phi = \bar{e}_2 + r_2 - \bar{e}_1 - r_1$ can be thought of as the underlying ('pre-investment') marginal cost disadvantage of firm 2 which can reflect relative productivity differences (of course Φ could be negative, giving firm 2 an *ex ante* cost advantage). When firm 2 chooses to outsource but firm 1 remains vertically integrated, the corresponding output response functions are:

$$y_1^{VO} = \frac{A - by_2^{VO}}{bM_1^{VO}} \tag{24a}$$

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[23] These are effectively reduced form reaction functions.

and

$$y_2^{vo} = \frac{A - \Phi + \rho_2 - b y_1^{vo}}{b M_2^{vo}}, \tag{24b}$$

where $M_1^{vo} = (2 - \theta_1^{vo} \eta_1)$ and $M_2^{vo} = \left\{7 + \beta_2 - 2\eta_2^u(1 - \beta_2^2)\right\}/\left\{2(1 + \beta_2)\right\}$. Note that here we are using the first superscript to refer to firm 1 and the second to firm 2. Thus, y_2^{vo} is the output of firm 2 when firm 1 is vertically integrated and firm 2 is outsourcing. The parameter $\rho_2 = r_2 - r_2^u$ captures the difference between the marginal costs of producing the intermediate incurred by the downstream firm 2 (when it is vertically integrated) and by its upstream intermediate supplier. Thus, when $\rho_2 > 0$, the upstream firm has a cost advantage over the downstream firm in producing the intermediate.

These functions are illustrated in Figure 2. In the figure, we assume *ex ante* symmetry between the firms, so that $\Phi = 0$ and $\eta_1 = \eta_2$. In the Figure, we allow for both $\rho_2 = 0$ and $\rho_2 > 0$. We begin by discussing the case in which $\rho_2 = 0$ and shall return to consider the case in which $\rho_2 > 0$ later in the section. The curves labelled R_1 and R_2 are the output response functions for firm 1 and 2 respectively when both firms are vertically integrated. The equilibrium is at point E. The curve labelled R_1' is the output response function of firm 1 when firm 2 outsources the intermediate; the curve labelled R_2' is the output response function of firm 2 when it outsources. In this case, the corresponding equilibrium is at point E'. Inspection of equations (23) and (24) reveals that, at $\rho_2 = 0$, a switch to outsourcing by firm 2 does not affect the zero-output intercept of these curves (which depend only on the terms in the numerators). It does however lead to a pivoting inwards of firm 2's output response function about the zero-output point – provided that $M_2^{vv} < M_2^{vo}$ (this will be true unless $\eta_2^u - \eta_2$ is sufficiently large), which is the case illustrated in the figure.[24] The reason why firm 2's output response function pivots inwards is twofold. First, the firm now faces a higher marginal cost of the intermediate, as the upstream firm captures some of the available rents. Second, the investment behaviour is now less aggressive as explained earlier. Firm 1's

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[24] Firm 1's output response function would remain unchanged at $\eta_2^u - \eta_2 = 0$ in the mathematically limiting case of $\beta_2 = 1$, when $q_2 = r_2^u$ and $z_2 = 0$. However, we rule out this degenerate case by assumption.

output response function always pivots inwards when its rival outsources, as $M_1^{VV} < M_1^{VO}$ given that $\theta^{VV} > \theta^{VO}$. At the new equilibrium E', total production is lower.

Figure 2 about here

The effect of outsourcing on firms' market shares will depend on Φ, the extent of the relative cost difference between the two firms. When Φ is small (as in Figure 2), so that the firms have ex-ante very similar efficiencies, outsourcing by firm 2 lowers its market share and raises the market share of firm 1. This does not imply, however, that outsourcing necessarily reduces firm 2's profits, since it must be remembered that it also saves on governance costs. When Φ is large enough, i.e. when firm 2 is sufficiently less efficient than its competitor, then the market share shifting effect of outsourcing is reversed. We show this in Figure 3 in which $\rho_2=0$ and Φ is large. Compared to Figure 2, firm 2's output response functions have moved inward. Inspection of (23) and (24) reveals that firm 1's output response curves are independent of Φ, whilst an increase in Φ shifts firm 2's output response functions inwards in a parallel manner. In Figure 3, outsourcing by firm 2 increases its own market share at the expense of firm 1. As we have seen, the change in regime between outsourcing and vertical integration causes the output response curves to pivot around the firms' zero output points. Thus, the effect of outsourcing on an output response curve is greater the further away we are from the firm's zero output point. When Φ is high, firm 2's relative market share is small and the negative impact of outsourcing on firm 2's output response curve is locally very small, while the negative effect on the corresponding curve for firm 1 is locally much larger. The net result is that firm 1's output falls and firm 2's output rises.

The results obtained so far in this section can be summarised by the following proposition:

Proposition 2. *Outsourcing by a firm can never result in an increase in the output of both firms. In addition, when $\rho_1=\rho_2=0$ and $\eta_i=\eta_i^u$ (i=1,2), then: (i) at $\Phi=0$, firm i's output always falls if it outsources; and (ii) there exist values of Φ large enough such that outsourcing by firm 2 increases its output at the expense of firm 1's.*

Proof. See Appendix.

Note that the seemingly paradoxical result that $y_2^{VO} > y_2^{VV}$ when Φ is very large, despite an inward shift of the output response curve, is due to the strategic interaction between firms under oligopoly and does not occur under monopoly. The firm's decision to outsource can raise its own market share when the effect on the strategic aggressiveness of its rival is very strong. This is more likely to be the case the larger is the rival's market share in the equilibrium with vertical integration; the reason for this is that the bigger and more powerful is one's competitor, the larger is the gain from reducing its aggressiveness.[25] In this sense, outsourcing can be thought of as a defensive business strategy helping a firm to hold on to its market share and, in some cases, to remain in business when it otherwise would not. Because of this strategic effect, under oligopoly outsourcing can sometimes be optimal even when it is unambiguously cost increasing.[26]

Figure 3 about here

As we saw in the previous section, $y_2^{VO} \geq y_2^{VV}$ is a sufficient condition for $\pi_2^{VO} > \pi_2^{VV}$. Thus, even when $\rho_2=0$ and $\eta_2^U - \eta_2 = 0$ (or even when ρ_2 and/or $\eta_2^U - \eta_2$ are slightly negative), outsourcing is preferred if, due to an underlying cost disadvantage, firm 2's market share is small enough. Thus we have the following corollary to Proposition 2(ii):

Corollary. *Even when $G_2=0$, $\rho_2=0$ and $\eta_2 = \eta_2^u$ (i=1,2), there exist values of Φ large enough for firm 2 to prefer outsourcing over vertical integration.*

These results are in stark contrast to the monopoly case, where firms have an incentive to outsource only if it involves some cost saving.

When vertical integration reduces the rival's output it can be seen as an aggressive business strategy. This is the case for firm 2 when Φ is not too large, as in Figure 2, when the firm has a strategic incentive to vertically integrate.

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[25] In this analysis we have, for simplicity, focused on the case of $\Phi>0$. If $\Phi<0$, firm 1 is small and the returns to firm 2 from reducing its aggressiveness by outsourcing is consequently reduced. Hence, at $\rho_2=0$ and with $\Phi<0$, outsourcing could never increase firm 2's output. Therefore, $\Phi<0$ is qualitatively a special case of Φ small.

[26] It is worth pointing out that the nature of the softening effect of outsourcing on the rival's behaviour is completely different in this model from that discussed in other contributions. Earlier work has focussed on cost increases in a Bertrand setting (whereby, by increasing prices, the higher marginal costs resulting from outsourcing act as a facilitating device). Instead, in our model, outsourcing by one firm reduces the aggressiveness of investment of its rival and occurs under Cournot. Under Bertrand competition, the two forms of strategic effect may combine to further increase the incentive to outsource.

Sometimes outsourcing can lead to much lower production costs than in-house production. This is the case when the upstream firm is much more efficient than its downstream partner in producing the intermediate. Thus, we can see in Figure 2 that if $\rho_2 > 0$, then firm 2's output response function, in addition to pivoting inward, also shifts outwards in a parallel manner. A comparison of (23) and (24) reveals that whilst firm 2 switching to outsourcing does not affect the numerator in the output response function for firm 1, it will affect that of firm 2 if $\rho_2 > 0$ – i.e. when the underlying marginal cost of producing the intermediate is lower under outsourcing than under vertical integration. Note that outsourcing can be an aggressive business strategy that raises foreign output at the expense of firm 1 (as illustrated in Figure 2) even when Φ is zero. For this to happen, however, ρ_2 needs to be positive and very large. In Figure 2, the dotted curve labelled R_2'' is the output response function of firm 2 when it outsources and ρ_2 is large enough to cause its equilibrium output to rise.

Proposition 3. *At $\Phi=0$ and $\eta_i - \eta_i^u = 0$ ($i=1,2$), there always exists a ρ_i large enough such that a switch to outsourcing by firm i raises its output at the expense of the output of firm j.*

Proof. See Appendix.

6. Outsourcing and International Trade

A major reason for the upsurge of interest in the literature on the mode-of-operation decision of firms has been the perception that there is a positive relationship between outsourcing and trade liberalisation. However, it is noteworthy that much outsourcing is actually domestic in character, being carried out within national boundaries. Also, firms can offshore production of intermediates while keeping them in house through foreign direct investment. Thus, how globalisation and trade policy affect the internalisation decision of a firm depends on whether the outsourcing or the vertical integration is domestic or international. In this section, we will apply our model to a number of different trading setups in order to examine how the internationalisation and internalisation strategies of firms interact. Specifically, we examine the effect of trade liberalisation, modelled as a fall in trade costs, on the incentives of firms to outsource – and thus on the mode-of-operation equilibria. We will show that

changes in trade costs can have an impact on these incentives by affecting the underlying cost differences between firms. Thus, for instance, if firms are located in different countries, then trade liberalisation can affect their costs of supplying a market asymmetrically. We discuss this case in Section 6.1. Trade liberalisation can also affect firms' costs by making it relatively cheaper to procure inputs from abroad; we discuss this in section Section 6.2. To focus on the impact of changes in trade cost on the game played by the firms we abstract from other asymmetries between firms that derive from underlying differences in the efficiencies of investment, or from differences between downstream firms in their governance costs or in their bargaining power vis à vis upstream firms. Thus, we shall assume throughout this section that $G_1 = G_2$, $\beta_1 = \beta_2$, $\eta_1 = \eta_2$, and $\eta_i = \eta_i^u$ ($i=1,2$). (Relaxing this simplifying assumption yields no real additional insights).

6.1. Trade liberalisation as an intensification of competitive pressure

In this subsection we consider how outsourcing can be a response to an increase in foreign competition resulting from trade liberalisation. To examine this, we consider the following setup: downstream firm 1 is located in the home country while firm 2 produces its final good in a foreign location. The firms compete on the home market. To focus on the effect of trade liberalisation on the relative incentive to outsource via the intensification of competitive pressure route, we will assume that firms outsource from domestic suppliers, i.e. we rule out international outsourcing. The effect of trade liberalisation on the relative cost of foreign outsourcing will be discussed in the next subsection. Clearly, one could consider a setup with foreign outsourcing that combines the two effects, but this would yield less transparent results.

The trade costs faced by firm 2 will be parameterized by a per-unit tariff τ. This can be neatly incorporated into the firm's marginal cost by including it in $\bar{e}_2$. As a result, the cost difference parameter Φ is now increasing in the tariff. Trade liberalisation will reduce Φ and this will have implications for output, prices and investment under a given regime and, under certain circumstances, it will also lead to a regime shift.   We shall begin by examining the effects of trade liberalization within a given regime and then consider its effects on regime outcomes.

Under a given regime, a fall in τ improves the relative competitive position of firm 2 at the expense of firm 1 and this will yield a market share reallocation in favour of the former. Under outsourcing, this market share reallocation results in a fall in the negotiated price of the intermediate good in the home country. This is because trade liberalisation decreases the available rents to be bargained over by the domestic downstream and upstream firms.

A fall in trade costs can also lead to regime shifts as it can affect firms' decisions about their mode-of-operation. A fall in τ (and hence in Φ) will increase the incentive of firm 2 and decrease the incentive of firm 1 to choose vertical integration.[27]

In Figure 4, at free-trade, firm 2 has an underlying cost advantage. In notational terms: $\Phi<0$ at $\tau=0$. Giving firm 2 a cost advantage at free-trade allows us to present cases in which Φ is positive and cases in which it is negative on the same diagram. At high values of t ($\Phi>0$), firm 1 has a cost advantage, while at low values of t ($\Phi<0$), firm 2 has a cost advantage.[28]

Figure 4 about here

As can be seen from the figure,[29] at sufficiently low levels of governance costs, and with $\Phi>0$, a fall in τ will eventually lead to a switch from the (V,O) to the (V,V) regime (as firm 1 stays vertically integrated and firm 2 is induced to change regime). At negative values of Φ, further trade liberalisation can result in a switch from (V,V) to (O,V). At sufficiently high levels of governance costs, and with $\Phi>0$, trade liberalisation leads to a move from (V,O) to (O,O), as firm 1 is induced to outsource whilst firm 2 remains outsourced. When $\Phi<0$, further reductions in trade costs can result in a shift to the (O,V) equilibrium region.

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[27]   Under outsourcing, trade liberalisation increases the profit of the intermediate supplier in the foreign country and reduces the profit of the intermediate supplier in the home country. Clearly, excessive competitive pressure may prevent outsourcing from being supplied.

[28]   Other constellations of parameters values can be considered but this one is chosen because it captures all the interesting cases.

[29]   The curves dividing up the parameter space in Figure 4 are the relevant sections of the two firms' *indifference profit loci* in Φ and G space – which give the combinations of Φ and G at which firms are indifferent between outsourcing and vertical integration, *given the mode of operation chosen by their rival*. In the figure, the first superscript in the profit indifference conditions refers to the mode of operation of firm 1 and the second to that of firm 2. So, for instance, $\pi_1^{VV} = \pi_1^{OV}$ refers to the indifference locus of firm 1, given that firm 2 is vertically integrated. Similarly, $\pi_2^{OV} = \pi_2^{OO}$ refers to the indifference locus of firm 2, given that firm 1 is outsourcing.

In Figure 4, we see that (V,O) is the typical outcome when τ is high and hence firm 2 has a strong competitive disadvantage; however, for low trade costs, (O,V) can emerge as the competitive advantage swings towards firm 2. Also note that the range of G over which multiple equilibria occurs is at its largest when Φ is zero.

Finally, it is interesting to briefly explore the implications of the analysis for the effects of trade liberalisation on the consumer in the home country. With this particular trading set up, trade liberalisation at a given regime raises output and thus works to increase consumer surplus. This increase in consumer surplus is further enhanced when the fall in trade cost reaches a threshold level of τ that causes firm 2 to switch to vertical integration. This is because when firm 2 switches to vertical integration, both its own output and that of the industry experience a discrete upward jump. However, a tariff reduction will lead to a discrete downward jump in consumer surplus when it results in the crossing of a threshold τ that brings about a switch to outsourcing by firm 1. This implies that, somewhat counter-intuitively, consumer surplus is not always maximised at free-trade.

6.2. *Trade liberalisation and the costs of international outsourcing*

Trade liberalisation may also change the relative cost of outsourcing. This is particularly plausible if the firms have the possibility to outsource abroad. To disentangle the effect of trade costs on the costs of outsourcing from the effect of trade costs on the competitive pressure faced by firms, we shall assume that the two downstream firms are located in the same country or in a customs union so that further trade liberalisation does not affect the ex-ante relative cost differences between them. To begin with, we shall focus on the case in which the firm chooses between *domestic* vertical integration and foreign outsourcing – i.e. we shall rule out the possibility of vertical foreign direct investment. We again parameterize trade cost by a per-unit tariff τ. To deliver the input to the home country when a firm outsources from abroad, the firm must pay τ per unit of output.[30] This can be neatly incorporated into the firm's profits by adding it to its marginal costs when the firm outsources abroad, but not when it produces the intermediate in-house domestically. When

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[30] Note that the results would not be materially changed were we to assume instead, that it is the upstream firm that pays the tariff. Note too that effectively we are assuming an asymmetry between the trade cost associated with selling the final good and importing the intermediate. This implies that the supplier is located, for instance, in an LDC that is geographically farther away.

we adopt this specification, the parameter ρ_i – which captures the difference between the marginal costs of producing the intermediate incurred by the downstream firm and its upstream outsourcing partner – is decreasing in the tariff.

Figure 5 illustrates the effect of trade liberalisation on the mode-of-operation when the two firms are ex-ante symmetric but the upstream firms have lower marginal production costs than the downstream firms. Unsurprisingly, a fall in tariff leads to an increase in the range of parameter values at which firms outsource. Interestingly, once again, trade liberalisation does not necessarily have a monotonic effect on consumer surplus if it leads to more outsourcing – since a switch to outsourcing will lead to an upward jump in the price of the good.

Figure 5 about here

We have now seen two routes by which trade liberalisation may encourage outsourcing. However, we will now consider a setup in which, by contrast, trade liberalisation leads to more vertical integration. Suppose that the costs of setting up a fully owned subsidiary in which the intermediate can be developed and produced are not prohibitively high, as we had implicitly assumed above by ruling out this mode-of-operation option. Instead, assume now that foreign vertical integration dominates domestic vertical integration – perhaps because production or investment costs are lower abroad than in the home country. Hence, the relevant trade-off is now between international outsourcing and international vertical integration. We will refer to the latter as FDI. Assume that under both outsourcing and vertical integration the downstream firm must pay a trade cost of τ per unit of output to deliver this input to the home country where it is combined with the composite input. In the interests of clarity, we continue to assume that the firms are ex-ante symmetric. In order to focus on the trade-off between the different modes of operation, we restrict attention to parameter values that imply a lower ex-post marginal production cost for the final producer under FDI than under outsourcing. Outsourcing however involves a lower fixed cost. This is due to lower investment and governance costs.

We find that in this case 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 output scale than those that outsource. This is because they have lower marginal costs under vertical integration. This means that any fall

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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 the available rents – but this increases the opportunity for rent extraction by the upstream firm under outsourcing. A fall in trade costs thus leads to an increase in the bargained intermediate price and this reduces some of the benefit of trade liberalisation to the downstream firm.

The effect of trade liberalisation on the mode-of-operation outcomes when the trade-off is between FDI and international outsourcing is illustrated in Figure 6.

Figure 6 about here

7.   Concluding Remarks

In this paper we have developed a model of endogenous outsourcing in an oligopoly setting. In showing that the choices of firms' organisational boundaries affect and are affected by a firm's strategic interaction with its competitors, the paper takes a major step towards a more realistic analysis of the make-or-buy decision and obtains a number of new results that contribute to our understanding of the vertical boundaries of the firm.

In line with some other recent theoretical contributions, the outsourcing arrangement is modelled as one where a final good producer enters a bilateral relationship with an upstream supplier which undertakes a relationship-specific investment. Previous authors who have adopted this approach have done so within non-strategic environments (either a single buyer-supplier pair, or a monopolistically competitive market structure). In addition, we are the first within the oligopoly literature on outsourcing to fully endogenise the investment decision in the quality and customisation of the intermediate good. This enables us to endogenise the trade-off between lower governance costs and higher marginal production costs that lies at the core of the make-or-buy decision, and that exists *by assumption* in the extant oligopoly strand of the literature. Thus, in our model, the choice of the mode-of-operation by firms is shown to be more complex than that implied by standard transaction cost theory and to depend on the combined influence of cost considerations (the incentive to economise) and strategic considerations.

We have demonstrated that the interaction between the oligopolistic setup and contract incompleteness implies that additional strategic considerations play a role in explaining the choice of mode-of-operation of firms, and that these considerations underpin the possible emergence of both strategic vertical integration and strategic outsourcing. In particular, we have shown how the interaction between strategic behaviour and the endogeneity of marginal costs can produce our novel result that outsourcing – even when it leads to lower overall cost efficiency – can be used as a defensive business strategy. This is because when a firm chooses outsourcing, the rival firm's incentive to invest strategically is reduced. This implies that, when it has a sufficiently small market share under vertical integration, a firm has an incentive to strategically switch to outsourcing so as to increase its own and reduce its rival's investment and output (which also implies that smaller, less productive, firms have a greater incentive to outsource). In a Cournot oligopoly setting, we also show that there exists an additional strategic incentive to vertically integrate – as the lower marginal costs reduce the rival's output and thus indirectly raise the integrated firm's profits.

Thus, our framework enables us to provide a theoretical rationale for the important stylised fact (emerging from case studies and econometric analyses) that outsourcing may not lead to the hoped-for increases in quality or reductions in production costs: even if a supplier has an underlying cost advantage, vertical integration may be preferable if contractual incompleteness results in underinvestment and a lower quality of the intermediate.

Furthermore, unlike most contributions in the outsourcing literature (e.g. Grossman and Helpman, 2002), this model gives rise to the possibility of 'mixed outcomes' in which, even when firms are ex-ante symmetric, they may choose different modes of operation in equilibrium; this is consistent with existing stylised facts whereby not all firms in the same industry adopt the same mode-of-operation.

In the paper, we have assumed Cournot competition. It is fairly straightforward to extend our framework to Bertrand competition with heterogeneous goods. In that case, to the extent that outsourcing increases the marginal cost of production, the novel strategic incentive to outsource that we find as a result of the endogeneity of investment would be reinforced by a standard Bertrand strategic incentive to raise the rival's price.

Finally, we examined the effects of trade liberalisation on the relative incentive to outsource. Trade liberalisation can mean that domestic firms face tougher competition and a firm under greater competitive pressure is shown to have a greater incentive to outsource. Furthermore, trade liberalisation can also reduce the cost of international outsourcing. If the relevant trade-off is between domestic vertical integration and international outsourcing, then trade liberalisation increases the incentive to outsource. However, if international vertical integration in the form of FDI is the viable alternative to outsourcing, then our model suggests that trade liberalisation actually reduces the incentive to outsource.

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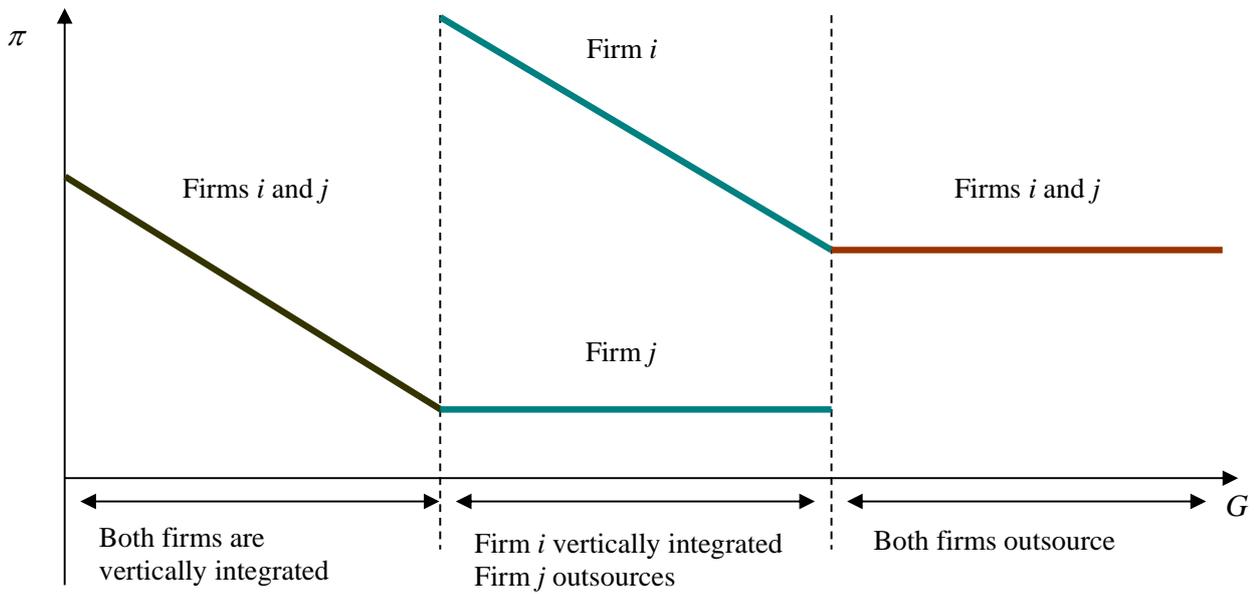
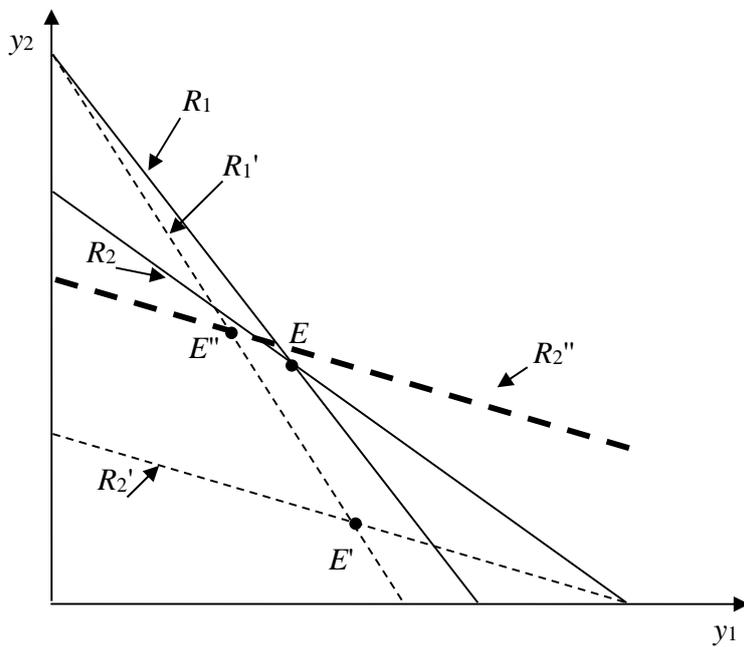**Figure 1. Profit levels of firms as a function of G under ex-ante symmetry**
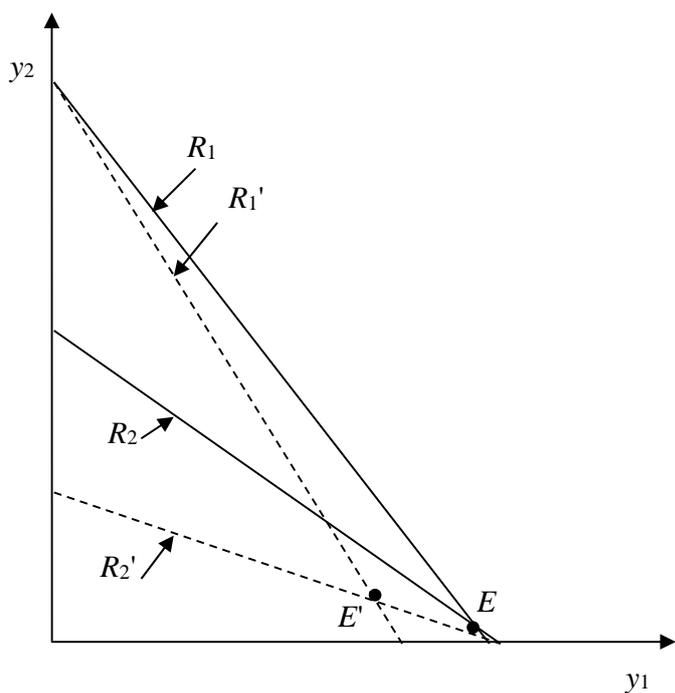

Figure 2. Output response functions ($\Phi=0$)

Figure 3. Output response functions (Φ is large and $\rho_2 = 0$)

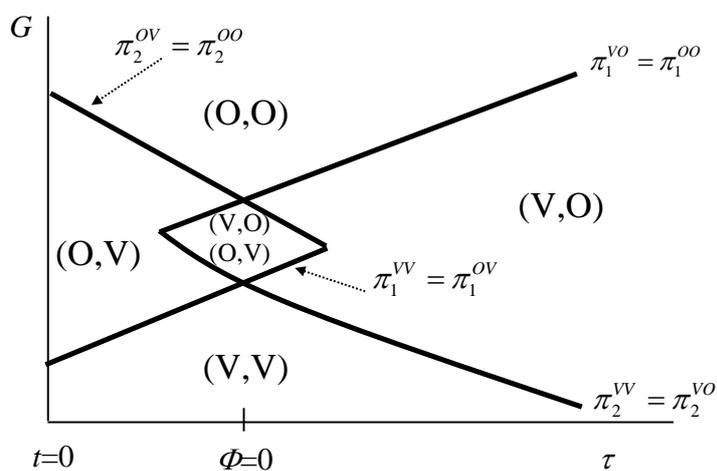**Figure 4**. **The effects of trade liberalisation when the foreign firm has an underlying cost advantage in the absence of a tariff**
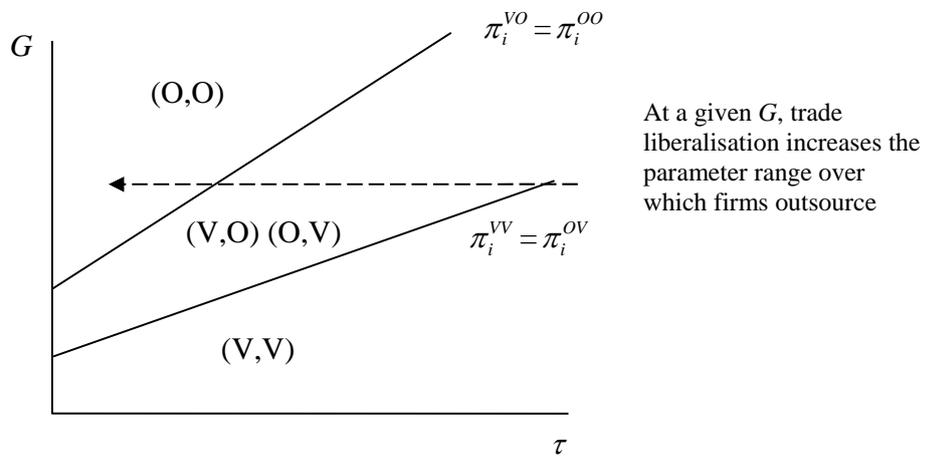
36

G

(O,O)

$\pi_i^{VO} = \pi_i^{OO}$

At a given G, trade liberalisation increases the parameter range over which firms outsource

(V,O) (O,V)

$\pi_i^{VV} = \pi_i^{OV}$

(V,V)

τ

Figure 5. **Domestic vertical integration versus international outsourcing: trade liberalisation favours outsourcing**

G

(O,O)

At a given G, trade liberalisation reduces the parameter range over which firms outsource

(V,O) (O,V)

$\pi_i^{VO} = \pi_i^{OO}$

(V,V)

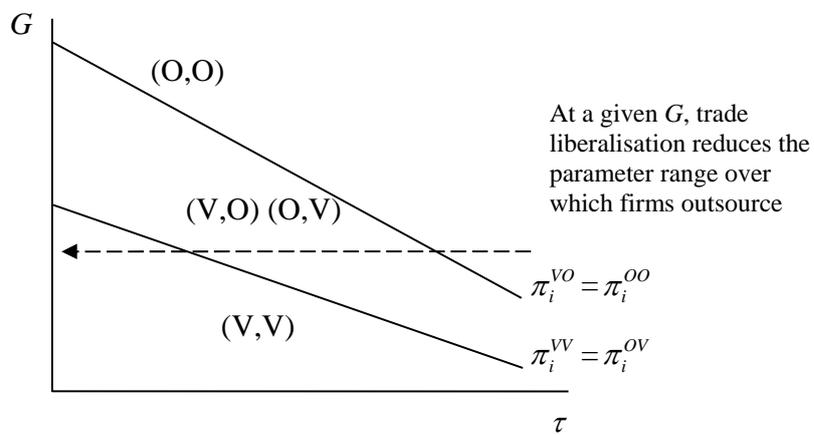$\pi_i^{VV} = \pi_i^{OV}$

τ

Figure 6. **International vertical integration (FDI) versus international outsourcing: trade liberalisation favours FDI**

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Appendix

Proof of Proposition 1

As a preliminary step to proving this proposition, it is helpful to look at the outputs in the fully symmetric base case. When both firms are vertically integrated, their equilibrium outputs are both:

$$y^{VV} = \frac{A}{b(M^{VV}+1)}, \text{ where with ex-ante symmetry: } M^{VV} = (2 - \theta^{VV}\eta). \quad (A1)$$

On the other hand, when both downstream firms are outsourcing their intermediate production, their outputs are:

$$y^{OO} = \frac{A}{b(M^{OO}+1)}, \text{ where } M^{OO} = (2 - \theta^{OO}\eta) + \upsilon \quad \text{and } \upsilon = \tfrac{3}{2}\tfrac{1-\beta}{1+\beta}. \quad (A2)$$

When one downstream firm is vertically integrated and the other outsources, then the output of the vertically integrated one is:

$$y^{VO} = \frac{A(M^{OV}-1)}{b(M^{VO}M^{OV}-1)}, \text{ where } M^{OV} = (2 - \theta^{OV}\eta) + \upsilon \text{ and } M^{VO} = (2 - \theta^{VO}\eta). \quad (A3)$$

The output of the firm that outsources when its rival is vertically integrated is:

$$y^{OV} = \frac{A(M^{VO}-1)}{b(M^{VO}M^{OV}-1)}. \quad (A4)$$

Let $\underline{G}$ be the critical level of G above which a firm will choose to outsource given that its rival is vertically integrated. Thus:

$$\underline{G} \equiv b\big(\Omega^{VV}(y^{VV})^2 - (y^{OV})^2\big) = \frac{A^2}{b}\left(\frac{(1-\tfrac{8}{9}\eta)}{(3-\tfrac{4}{3}\eta)^2} - \frac{(1-\tfrac{7+\beta}{6}\eta)^2}{\{(2-\tfrac{7+\beta}{6}\eta)(2+\upsilon-(1-\beta)\eta)-1\}^2} \right), \text{(A5a)}$$

where we have made use of expressions (22a), (22b), the definitions of M^{VV}, M^{VO} and M^{OV} above and Ω^{VV}, θ^{VV}, θ^{VO}, and θ^{OV}, in the text.

Similarly, making use of expressions (22a), (22b), the definitions of M^{OO}, M^{VO} and M^{OV} above and Ω^{VO}, θ^{OO}, θ^{VO}, and θ^{OV}, in the text, we obtain:

$$\overline{G} \equiv b\left(\Omega^{VO}(y^{VO})^2 - (y^{OO})^2\right) =$$

$$\frac{A^2}{b}\left(\frac{(1 - \frac{(7+\beta)^2}{72}\eta)(1 + \upsilon - (1-\beta)\eta)^2}{\{(2 - \frac{7+\beta}{6}\eta)(2 + \upsilon - (1-\beta)\eta) - 1\}^2} - \frac{1}{\left[3 + \upsilon - \frac{2(7+\beta)(1-\beta)}{15+2\beta-\beta^2}\eta\right]^2} \right) \tag{A5b}$$

as the level of G above which a firm will outsource when its rival is also outsourcing. Straightforward, if tedious, calculations show that:

$$\overline{G} > \underline{G} > 0. \tag{A6}$$

Below $\underline{G}$, vertical integration is a dominant strategy for both firms and hence VV is the unique equilibrium. Above $\overline{G}$, outsourcing is the dominant strategy for both firms and hence OO is the unique equilibrium. For values of G that lie between $\underline{G}$ and $\overline{G}$, vertical integration is the best reply to outsourcing but outsourcing is the best reply to vertical integration. Hence when G lies between $\underline{G}$ and $\overline{G}$, there are two asymmetric equilibria VO and OV.

Proof of Proposition 2

As a preliminary step, we will find it useful to rewrite the output response functions for the different mode-of-operation regimes in compact form:

$$y_1^{hk} = \frac{A + \delta_1\rho_1 - by_2^{hk}}{bM_1^{hk}} \quad \text{and} \quad y_2^{hk} = \frac{A + \delta_2\rho_2 - \Phi - by_1^{hk}}{bM_2^{hk}}, \tag{A7}$$

where $h=O,V$ is the mode-of-operation of firm 1 and $k=O,V$ is the mode-of-operation of firm 2. The parameter δ_j ($j=1,2$) is an indicator variable that is unity if firm j outsources and zero if it is vertically integrated.

Using (A7), we can now show that outsourcing by a firm never results in an increase in the output of both firms. To see this, note that the output of firm i when firm j is vertically integrated is $y_i^{hV} = \frac{\hat{A}_i - by_j^{hV}}{bM_i^{hV}}$, where ($h=V,O$) and $\hat{A}_i = A + \delta_i\rho_i$ if $i=1$, and $\hat{A}_i = A - \Phi + \delta_i\rho_i$ if $i=2$. A comparison of this with the output of firm i when firm j chooses

outsourcing, $y_i^{hO} = \dfrac{\hat{A}_i - by_j^{hO}}{bM_i^{hO}}$, gives: $M_i^{hO} y_i^{hO} - M_i^{hV} y_i^{hV} = y_j^{hV} - y_j^{hO}$. Now, since

$M_i^{hO} \geq M_i^{hV}$, we have that if $y_i^{hO} \geq y_i^{hV}$ then $y_j^{hV} \geq y_j^{hO}$, and if $y_j^{hV} \leq y_j^{hO}$ then $y_i^{hO} \leq y_i^{hV}$.

Thus, the firms' outputs cannot both increase when one of the firms switches to outsourcing.

Proof of Proposition 2(i).

We need to show that: (a) $y_i^{VV} > y_i^{OV}$ and (b) $y_i^{VO} > y_i^{OO}$. Here, the first superscript refers to

the mode-of-operation of firm i and the second to that of its rival. Since $\rho_1 = \rho_2 = 0$, $\eta_i = \eta_i^u$

($i=1,2$) and $\Phi = 0$, we have full ex ante symmetry between firms here, and so we are able to

use the M^{hk} values that were given in (A1)-(A3) above for the base case. These can be

ranked as follows: $M^{OO} > M^{OV} > M^{VO} > M^{VV}$. For the case of inequality (a) above, using

(A1) and (A4), and the ranking of the M^{hk} values, we can see that:

$$y_i^{OV} = \frac{A(M^{VO} - 1)}{b(M^{VO} M^{OV} - 1)} < \frac{A}{b(M^{VO} + 1)} < \frac{A}{b(M^{VV} + 1)} = y_i^{VV}. \tag{A8}$$

In the case of inequality (b):

$$y_i^{OO} = \frac{A}{b(M^{OO} + 1)} < \frac{A}{b(M^{OV} + 1)} < \frac{A(M^{OV} - 1)}{b(M^{VO} M^{OV} - 1)} = y_i^{VO}. \tag{A9}$$

Hence, at $\Phi = \rho_1 = \rho_2 = 0$ and $\eta_i = \eta_i^u$ ($i=1,2$), firm i's output always falls if it outsources.

Proof of Proposition 2 (ii).

Here we assume that $\rho_2 = 0$ and $\eta_2^u - \eta_2 = 0$, so that there is no underlying cost advantage of

outsourcing for firm 2. Given that firm 1 chooses mode-of-operation h (where h can be V or

O), then the output of firm 2 when it is vertically integrated is:

$$y_2^{hV} = \frac{A(M_1^{hV} - 1) - M_1^{hV} \Phi}{M_1^{hV} M_2^{hV} - 1} \tag{A10}$$

This falls in Φ and reaches zero at, $\Phi = \tilde{\Phi}^{hV}$, where: $\tilde{\Phi}^{hV} = A\dfrac{M_1^{hV} - 1}{M_1^{hV}}$. If firm 2 is

outsourcing, then its output is:

$$y_2^{hO} = \frac{A(M_1^{hO} - 1) - M_1^{hO}\Phi}{M_1^{hO}M_2^{hO} - 1},\tag{A11}$$

which is also monotonically falling in Φ. We next need to check if the output of firm 2 is positive at $\Phi = \tilde{\Phi}^{hV}$. To do this, we must substitute $\Phi = \tilde{\Phi}^{hV}$ into (A11). It is then clear that: at $\Phi = \tilde{\Phi}^{hV}$, $y_2^{hO} > 0$ if and only if $M_1^{hO} > M_1^{hV}$. It is straightforward to show that this is the case. By continuity, we can see that for y_2^{hV} close to zero a switch to outsourcing raises the output of firm 2.

Proof of Proposition 3.

The larger is ρ_i, the more firm i's output response curve shifts outwards. It is clear that if this shift is large enough, then the output of firm i rises. From Proposition 2, this will lead to a fall in the output of firm j.