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MERGE AND COMPETE: STRATEGIC INCENTIVES FOR VERTICAL INTEGRATION

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Abstract

Vertical integration followed by quantity competition is studied. In the first stage of the game downstream firms simultaneously decide whether to integrate with one of the upstream suppliers. If firms are not able to observe whether their vertically integrated competitor enters the intermediate-good market then they are indifferent about vertical integration. If the entry choice of the integrated firm is observable then the unique equilibrium involves vertical integration and in-house production of the intermediate good. The importance of entry observability sheds light on the strategic importance of information exchange institutions such as the internet and business fairs.

Keywords: Vertical integration, Cournot competition, Market entry.

JEL Classification: L13, L22.

Contents

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1. Introduction[1]

Mergers often prove not to be as profitable as announced in the pre-merger declarations (Cabral, 2002 and Scherer and Ross, 1990). If in the real world mergers do not increase the profits of the merging parties then explanations given by economic theory are not suitable to describe the phenomenon fully. This paper focuses on vertical mergers which occur when an intermediate-good producer and a final-good producer merge into a single firm. Vertical integration is usually explained in terms of technological synergies (e.g. scale or scope economies, input customisation and production coordination externalities) or in terms of market structure and interaction (e.g. double marginalisation, transaction costs, incomplete contracts and market foreclosure).

Our aim is to analyse the purely strategic incentives for vertical mergers. We therefore present a simple model abstracting from all the traditional motives, in which vertical integration is neither profitable nor harmful *per se*. Yet the fact that it is the unique equilibrium of the model adds purely strategic incentives to the list of explanations of mergers.

In our model symmetric vertical integration is the unique equilibrium if entry in the intermediate-good market by vertically integrated firms is observable by competitors. This is not a remote hypothesis as many real-world institutions allow for observable market entry. If, for example, a firm operates in an internet-based market and does not supply certain products on its website, then everyone can observe that the firm's main objective is not to maximise the sale of these goods. Alternatively, the agglomeration of production activities in given locations may allow for direct observation of the nature of the output of a firm's plants. Finally, many firms regularly meet at least once a year – but generally more often – in business fairs where each of the participants can observe the range of products sold by its competitors.[2]

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[1] This paper is a revised version of Vergara Caffarelli (2004) and it is based on the second chapter of my PhD dissertation. I thank Karl Schlag, Paolo Guerrieri, Stefen Huck, Antonella Ianni, Massimo Motta and Jacques-François Thisse for fruitful discussions and comments. I wish to thank senior staff at Marazzi Group S.p.A. for useful information. I am also indebted to two anonymous referees for their helpful remarks. The views in this paper are those of the author and do not necessarily reflect those of the Bank of Italy. The usual disclaimer applies. E-mail: filippo.vergara@eui.eu.

[2] Note that the last two conditions are frequently met by small and medium-sized enterprises as they are often localised in certain geographic locations (the so-called *industrial districts*) and they are also involved in business fairs.

This paper analyses a merge-and-compete game with four players: two upstream firms and two downstream firms. Each vertical pair can either be integrated or not. Integration occurs if a downstream firm takes over one of the upstream suppliers. The game-form is as follows. Downstream firms first decide whether or not to buy out one of the upstream firms, anticipating the effect of such a decision on competition in the final-good market. Then, if vertically integrated, a firm chooses whether to sell on the market both the intermediate and the final good or the final product only. Finally, production and competition take place both upstream and downstream. Downstream firms compete in quantities while upstream firms are price setters. While vertical integration is always observed, both cases of observable and of unobservable entry in the intermediate-good market are studied separately.

We analyse the merge-and-compete game by backward induction. The subgames, called *configurations*, are determined by plant property structure. These are the dispersed configuration (each plant is an independent firm), the vertically integrated duopoly, and the two asymmetric configurations each consisting of one vertically integrated entity and of two independent firms. Note that the two asymmetric configurations can be reduced to one by symmetry, so that one only needs to analyse three subgames.

In all configurations all four plants produce a positive quantity in equilibrium (and all the goods are produced in all configurations). In the dispersed and in the asymmetric configurations there exists a market for the intermediate good. In the duopoly, however, the intermediate good is only produced within each firm and transferred from the upstream to the downstream division.

Upstream technology exhibits constant returns to scale and only requires labour input. Moreover, upstream firms are price-setters and hence compete in prices (à la Bertrand). The final good is horizontally differentiated between the downstream producers which compete à la Cournot (Singh and Vives, 1984). Downstream plants employ a convex, constant-returns-to-scale technology that does not allow for total substitution of one production factor with the other. Finally, the labour market is perfectly competitive and firms compete to employ (a given supply of) homogenous workers. The appendix discusses the case of a labour market characterised by the presence of a monopolist trade union.

The results of the paper are the characterisation of the equilibria of the merge-and-compete game. The assumptions on production technologies and on the structure of market competition imply that firms are indifferent about symmetric vertical (dis)integration. Thus the crucial part of the analysis is the case in which only one of the downstream firms vertically integrates while the other does not. In this asymmetric configuration subgame there are only three firms in the market. The intermediate-market entry decision of the vertically integrated entity depends on observability of this choice.

In the observable-entry scenario the vertical firm abstains from selling the intermediate good because the independent upstream firm can observe such a choice and so behaves as a monopolist on the intermediate market. This is profitable for the integrated firm which then competes in the final market with a firm that has higher costs than itself. Needless to say, this is also profitable for the independent intermediate-good producer. Therefore in the observability scenario the unique equilibrium of the game is symmetric vertical integration. Such a Nash equilibrium is also strict. In the asymmetric case the vertically integrated entity is strictly better off than the independent downstream firm and the payoffs players receive in both symmetric configurations are equal and lie between those of the asymmetric configuration. This establishes the strategic incentives for vertical integration as it is dominant to integrate with a supplier when entry is observable.

Indeed, vertical mergers are profitable because they harm the opponent in the downstream market who will face higher input prices after the exit of one firm in the upstream market. An example of this has already been given by Adams and Dirlam (1964) in a study of the US steel industry. The logic of the current analysis is close to foreclosure models. However, these models focus on situations in which independent downstream firms' access to the intermediate-good producer (or at least to the efficient one) is blocked by vertical integration of a competitor. The current approach stresses the effects of market power in the intermediate-good market when firms are all equally efficient.

The equilibrium of the asymmetric configuration changes if entry in the intermediate-good market is not observable: in this case both upstream plants sell the intermediate good at the competitive price in equilibrium. This is because the vertical firm cannot resist the temptation of stealing the market from the independent upstream firm, if the independent intermediate-good producer prices above marginal cost. Consequently, in this scenario downstream firms are indifferent as to whether they should vertically integrate or not.

Some interesting implications for competition policy and merger control can be drawn from the results. The EU Commission would either prohibit the merger or impose remedies eliminating the strategic incentives for vertical integration found in the model. In the US, however, the Department of Justice would not intervene and the incentives would remain.

The model is built in order to avoid the occurrence of the standard justifying motives for vertical integration.[3] Indeed, there are no increasing returns of scale and no economies of scope. Double marginalisation (Spengler, 1950) is not a relevant issue since upstream firms compete in prices. Moreover, contracts are complete and vertical integration does not lead to any profit-increasing effect such as quality enhancements through input customisation or cost-saving effects due to a reduction in transaction costs or to better coordination in the production process (the so-called *just-in-time* production). Finally, the presence of two intermediate-good producers prevents incentives to foreclose the input market from determining the choice of vertical integration. Yet vertical integration is the unique equilibrium in the case of observable entry.

In the industrial organisation literature most of the research efforts have been devoted to the analysis of the anti-competitive reasons and effects of vertical integration such as market foreclosure. This stream of research has been excellently reviewed by Motta (2003) and Rey and Tirole (2003). A recent paper by Nocke and White (2005) suggests that vertical merges facilitate collusion in the upstream market. Even if anti-competitive behaviour is a major concern in industrial organisation, Grossman and Helpman's (2002) analysis abstracts from this issue in order to focus on integration synergies due to input customisation. In general, in a world with incomplete contracts vertical integration is a solution to the hold-up problem (Williamson, 1975 and 1985) and may lead to efficient investment (Grossman and Hart, 1986 and Maness, 1996).[4]

Acemoglu *et al.* (2004) study both theoretically and empirically the effect of technology and technical change on vertical integration. Their findings include that incentives to vertically integrate depend on the relative technology intensity of the downstream sector with respect to the upstream one and are consistent with incomplete-contract theories.

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[3] Lieberman (1991) empirically investigates the determinants of vertical intergration.

[4] See also the surveys by Joskow (2005) and by Whinston (2001).

Horn and Wolinsky (1988) focus on a similar model to the one analysed here. A duopoly supplies an intermediate good to a duopoly which then sells to final consumers. However, their analysis concerns horizontal mergers and is centred on the assumption that input-suppliers and downstream firms are locked in a bilateral monopoly and hence bargain on input-prices.

Salinger (1988) analyses an industry with two stages of production and Cournot oligopoly both upstream and downstream. In the equilibrium vertical mergers can either cause an increase or a decrease in both the intermediate- and the final-good price depending on parameter values. Salinger's (1988) insightful paper does not, however, address the incentives for vertical integration in a strategic manner although it provides a comparative static analysis on the number of vertically integrated firms that operate in the industry.

Economides (2005) analyses vertical integration in a two-stage Bertrand duopoly, in which intermediate goods are complement and final products substitute. Incentives for vertical integration depend on the level of complementarity and substitutability of the goods.

The current paper also relates to the "raising rivals' costs" literature such as Sibley and Weisman (1998). This field of research studies the strategies that one firm may implement in order to induce its competitors to face higher costs, thus gaining a competitive advantage over them. Here, though, the cost asymmetry is not due to any direct action of any of the competing firms.

Industrial districts[5] are a field in which the hypotheses of this paper might be easily satisfied. Interestingly, a phase of both vertical and horizontal mergers has been predicted (Brusco *et al.*, 1996 and Nuti and Cainelli, 1996) and is now being observed in Italy (Becattini, 1998; Brioschi *et al.*, 2002; Dei Ottati, 1996; Withford, 2001). Models of industrial districts are proposed by Souberayn, Thisse and Weber (1999 and 2002). New economic geography[6] singles out the reasons for the aggregation of similar firms in the same location (Krugman, 1991).

The remainder of the paper is organised as follows: Section 2 introduces the model and discusses the assumptions. Sections 3, 4 and 5 respectively analyse the equilibrium

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[5] See Banca d'Italia (2005), Becattini (1990) and Signorini (2000). The large world-wide diffusion of industrial districts is documented by Bagella and Becchetti (1999), Pyke *et al.* (1990) and Vergara Caffarelli (2003).

[6] See Baldwin *et. al.* (2002), part I, and the survey by Ottaviano (2000).

in the dispersed configuration, in the vertically integrated duopoly and in the asymmetric configuration. The complete merge-and-compete game is solved in Section 6. Section 7 presents some policy implications of the model and Section 8 concludes. An appendix analyses the case of a monopolist trade union.

2. The Model

As said in the introduction there are four plants, two upstream and two downstream. Downstream plants produce the final good q_i combining labour l_i and the intermediate good y_i according to a concave, constant-returns-to-scale production function $f(l_i, y_i)$ that does not allow for total factor substitution. Labour employed downstream is paid a wage w and the price of the intermediate good is ρ. Let $C(w, \rho, q_i)$ be the cost function associated with the production function $f(l_i, y_i)$. By the constant-returns-to-scale assumptions on the production technology the cost function is homogenous of degree one in the output, as well as homogenous of degree one in the factor prices. So it can be written as $C(w, \rho, q_i) = q_i C(w, \rho, 1) = q_i c(w, \rho)$. The function $c(\cdot, \cdot)$ is homogenous of degree one in its two arguments. Thus there exists a function $\alpha(\cdot) : \mathbb{R}_+ \longrightarrow \mathbb{R}_+$, such that

$$c(w, \rho) = \rho \alpha \left(\frac{w}{\rho} \right) \tag{1}$$

Final goods are horizontally differentiated and the demand function for each good is $p_i = a - bq_i - vq_j$, where $i = 1, 2$, $j \neq i$ and $b > v > 0$ (Singh and Vives, 1984). So the profit function of downstream plant i is:

$$\pi_i(q_i, q_j, w, \rho) = aq_i - bq_i^2 - vq_iq_j - q_i c(w, \rho) \tag{2}$$

Upstream plants produce their output indicated by t_n for $n = 1, 2$ with a constant-returns-to-scale technology. The only market for upstream firms' output is the intermediate-good market generated by the conditional factor demands of the downstream plants. Upstream firms' only input is labour and hence they use a linear production function: $t_n = h\lambda_n$ where $h > 0$ is the marginal and average productivity of labour and λ_n represents the labour employed in upstream plant $n = 1, 2$. Indicating the wage in the upstream sector with ω the cost function of each upstream plant is $c_n(\omega, t_n) = (\omega/h)\, t_n$.

To close the model it is necessary to analyse the labour market. Let us assume that insider workers are endowed with industry-specific skills so that the total labour supply L is fixed. Workers from outside cannot compete (in the short run) with insiders because they lack the necessary training. However, insiders supply homogenous labour to the four plants and are perfectly mobile. The labour market is characterised by perfect competition.

In the examples used below to illustrate the results downstream plants employ a Cobb-Douglas technology $q_i = l_i^{\gamma} y_i^{1-\gamma}$ for $i = 1, 2$ and $\gamma \in [0, 1]$ which satisfies all the assumptions above. It is well known that Cobb-Douglas production functions have a linear cost function: $c(w, \rho, q_i) = \left[\left({}^{\gamma}/_{1-\gamma} \right)^{1-\gamma} + \left({}^{1-\gamma}/_{\gamma} \right)^{\gamma} \right] w^{\gamma} \rho^{1-\gamma} q_i$. For the sake of simplicity γ is set equal to $\frac{1}{2}$, hence $c(w, \rho, q_i) = 2 q_i \sqrt{w\rho}$.

Let us now turn to the structure of the strategic interaction of the players. The order of the moves of the merge-and-compete game is as follows: I) downstream firms simultaneously choose whether to integrate or not with their own supplier; the vertical integration decision is observed; II) if vertically integrated then each firm decides whether to enter the intermediate-good market in addition to in-house production; III) upstream production takes place and upstream firms simultaneously set the price for the intermediate good; IV) finally, downstream production and quantity-competition take place. The main point of the current analysis is the effect on the equilibrium of different assumptions concerning the observability (by the competitors) of intermediate-good market entry by a vertically integrated firm.

In the dispersed configuration each plant is an independent firm. Downstream firms compete à la Cournot while upstream firms are price-setters and compete à la Bertrand. Downstream firms are price-takers in the intermediate-good market. Whenever a pair of firms vertically integrates the upstream division transfers the intermediate good to the downstream plant at marginal cost. If the upstream division of an integrated entity enters the market for the intermediate input then it behaves as a price-setter.

In the model vertical integration is necessary because neither side of the intermediate-good market can exercise any market power on the other. For instance, it is impossible for upstream firms to use non-linear pricing schemes such as a franchise fee[7] and downstream buyer(s) cannot open a bargaining phase with the seller(s) in bilateral monopoly fashion.

Examples of vertical relations similar to the current model may be found in the automotive industry between part-suppliers and car-producers, in the apparel (or fashion) industry between textile- and clothing-producers, in the ceramic industry between intermediate- and final-good producers and in electricity generation. In these cases, while producing a necessary input for downstream firms, upstream suppliers are in tough competition with each other as intermediate goods are highly homogenous. Indeed, in these sectors vertical integration has occurred. Some fashion houses like Missoni and Dolce & Gabbana produce both clothing and (at least partially) fabrics. In the automotive sector FIAT owns Magneti Marelli (a component producer) and in the ceramic sector the Marazzi Group – originating from the ceramic district of Sassuolo – developed through a process of vertical integration. Finally, Joskow (1985) reports that mine-mouth electricity generation plants are six-times more likely to own the coal mine located next to them than non-mine-mouth competitors.[8]

It might seem that our model is based on too many specific assumptions on production technologies and competition structure. However, these assumptions are necessary in order to correctly focus on the desired effects.

Bertrand competition upstream is necessary to abstract from double marginalisation which would otherwise be sufficient to set strong incentives for vertical integration.[9] Cournot competition downstream can be argued along the lines of Kreps and Scheinkman (1983) as the reduced form of a game of price-competition with previous choice of capacities. Final-product differentiation is motivated by the fact that in the real world goods are differentiated and homogeneity is a limit case.

The assumption on the type of competition in the intermediate-good market deserves further attention. Indeed, alternative market structures would induce double marginalisation thus reinforcing the incentives for vertical integration.[10] Actually, in a setup where upstream

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7 See Motta (2003), p. 411 ff. and Tirole (1988), p. 170 ff..

8 See also Pint and Baldwin (1997), ch. 3, pg. 15.

9 See Spengler (1950), Motta (2003), p. 419 ff. and Tirole (1988), p. 174 ff..

10 As noted, Salinger (1988) discusses the case of vertical mergers in a two-stage Cournot oligopoly, finding

producers make positive profits one could explicitly model the market for corporate control. In particular, downstream firms would be required to pay a positive price to merge. The price would then account both for the strategic effects found in the paper and for the benefits of eliminating double marginalisation.

Let us now move on to the discussion of the hypotheses about production technologies. The stronger assumption is clearly that the downstream technology is convex and does not allow for the total substitution of one production factor with another. These technologies have the important property that the solution of the firm's maximisation problem is internal because a strictly positive output can only be produced with strictly positive quantities of all (in the specific case both) inputs. This condition implies that the system of four plants is viable, i.e. it is a genuine multistage production process in which it is not possible to totally substitute one factor with another. Total input substitution would be neither realistic nor sound: a corner solution means that downstream firms either use only the intermediate good (which is not realistic) or only labour (which implies that in equilibrium upstream firms do not operate). The further assumption of constant returns to scale is introduced to abstract from the scale factor so that the results can only be attributed to the different assumptions on market entry observability.

The existence of two plants that supply the intermediate good prevents anti-competitive incentives (for example foreclosure) from determining the vertical integration decision. Finally, the labour market is introduced so that the model describes a closed production system whose end market is the rest of the world. It also adds neatness to the model as the equilibrium of the dispersed configuration, of the duopoly, and of the observable-entry scenario of the asymmetric configuration is easily determined parametrically in the wage.

Lastly, it is necessary to address the issue of entry of new firms into the industry. It is assumed that entry cannot take place. This final assumption can be justified by setting the time horizon of the model to the short run. The very definition of short-term analysis prescribes that the number of firms in the market is given. Moreover, barriers to entry may remain in the

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that no unambiguous prediction may be drawn as to the effect of integration on the price of the final good. Likewise, Economides (2005) shows that in a two-stage Bertrand olygopoly, in which final goods are substitute and intermediate products complement, integration incentives are non-monotonic in goods' complementarity and substitutability.

long run if there exist high sunk costs for the establishment of new firms in the industry. This frequently happens in the case of highly specialised industries.

To complete this discussion it is necessary to sketch the long-run equilibrium. As pointed out in the introduction, if entry in the intermediate-good market is observable then both firms vertically integrate in the short-run equilibrium and there is no market for an independent producer of the intermediate good. Likewise, none of the two vertically integrated entities has any incentive to sell the intermediate good to an entrant in the production of the final good, thus foreclosing the market to any such entrant. Hence, if the number of active firms in the intermediate-good market is observable no entry of a single firm occurs in the long run. Nevertheless, if two firms simultaneously enter one upstream and the other downstream, they will integrate and remain in the market, adding a new vertically integrated entity in the long-run equilibrium. In the unobservable-entry case firms are indifferent between integrating or not in the short run. However, the intermediate good is exchanged at its marginal cost. Thus, in the long run there are no incentives to enter the intermediate-good market as it either does not exist (in the case of vertical integration) or no profits are obtainable there (otherwise). If a firm enters downstream, however, the incumbents will accommodate entry unless they are vertically integrated.

For the sake of clarity the following three sections analyse each of the subgames separately: first, the dispersed configuration which is the case when no pair of firms vertically integrate, then the duopoly that occurs when both pairs integrate simultaneously, and finally the asymmetric configuration in which one vertically integrated entity competes with a chain of independent firms. Both cases of observable and of unobservable entry in the intermediate-good market are analysed. Section 6 presents the equilibrium analysis of the whole game.

3. The Dispersed Configuration

The four plants correspond to four independent firms (see Figure 1 below).

Consider first the (differentiated) final-good market. To calculate the Cournot equilibrium it is necessary to find a fixed point of the best-response correspondence. Thus, solving

$$\begin{cases} R_1(q_2) = \frac{a - vq_2 - c(w,\rho)}{2b} \\ R_2(q_1) = \frac{a - vq_1 - c(w,\rho)}{2b} \end{cases}$$

we obtain

$$q_d^* = q_1^* = q_2^* = \frac{(a - c(w,\rho))(2b - v)}{4b^2 - v^2} = \frac{a - c(w,\rho)}{2b + v}$$

which are the equilibrium quantities. The profits of both Cournot competitors are identical:

$$\pi^*(w,\rho) = b\left(q_d^*(w,\rho)\right)^2 = b\left(\frac{a - c(w,\rho)}{2b + v}\right)^2$$

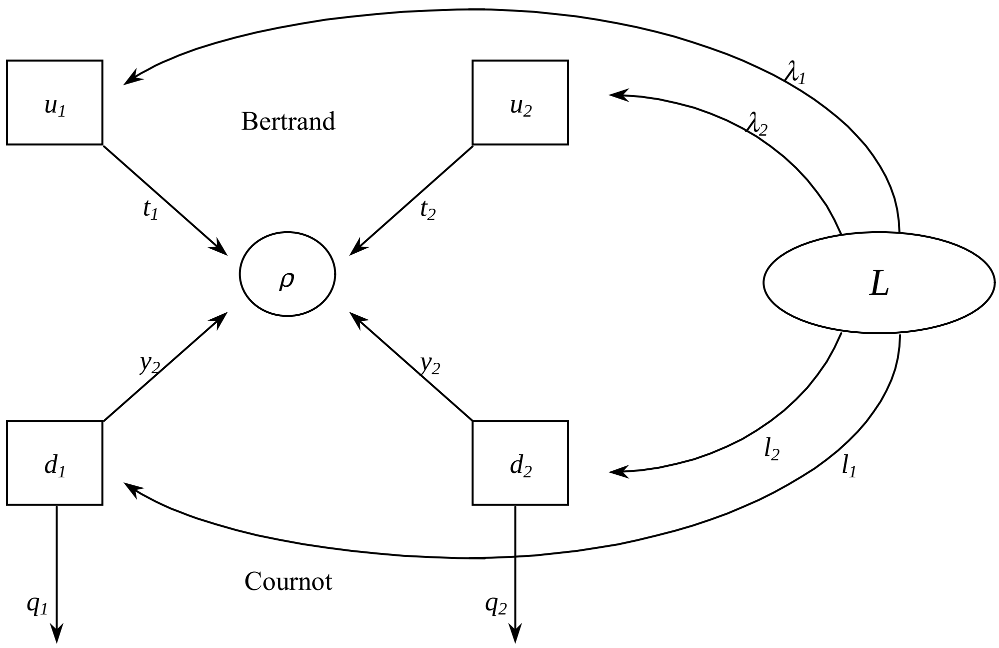

Figure 1: Dispersed configuration

By Shepard's Lemma (Mas-Colell *et al.*, 1995, p. 141) conditional factor demands are $l_i(w,\rho,q_d^*) = q_d^* \frac{\partial}{\partial w} c(w,\rho)$ and $y_i(w,\rho,q_d^*) = q_d^* \frac{\partial}{\partial \rho} c(w,\rho)$ which are homogenous of degree zero. Recalling the function $\alpha(w/\rho)$ defined in equation (1) let us rewrite the labour demand as $l_i(w,\rho,q_d^*) = q_d^* \alpha'(w/\rho)$ and the demand schedule for the intermediate good as $y_i(w,\rho,q_d^*) = q_d^* \alpha(w/\rho) - q_d^* \frac{w}{\rho} \alpha'(w/\rho)$.

Knowing the conditional factor demand for the intermediate good we can calculate not only the equilibrium price of the intermediate good (which is the marginal cost) but also the equilibrium quantity produced by each of the two upstream firms. Each of them produces half of the demand. The total quantity demanded by the downstream sector is $y_1(w,\rho,q_d^*)+y_2(w,\rho,q_d^*) = 2q_d^*\alpha(w/\rho) - 2q_d^*\frac{w}{\rho}\alpha'(w/\rho)$. Substituting the upstream marginal cost ω/h for ρ we obtain the actual quantity produced in equilibrium $2q_d^*\alpha(hw/\omega) - 2q_d^*h\frac{w}{\omega}\alpha'(hw/\omega)$. Hence the labour demand from the upstream sector is

$$\lambda_d = \lambda_1 + \lambda_2 = \tfrac{2}{h}q_d^*\alpha\left(\tfrac{hw}{\omega}\right) - 2\tfrac{w}{\omega}q_d^*\alpha'\left(\tfrac{hw}{\omega}\right) \tag{3}$$

Therefore the aggregate labour demand of the industry is:

$$L_d^D(w,\omega,q_d^*) = q_d^*\tfrac{2}{h}\alpha\left(\tfrac{hw}{\omega}\right) - q_d^*2\tfrac{w}{\omega}\alpha'\left(\tfrac{hw}{\omega}\right) + q_d^*2\alpha'\left(\tfrac{hw}{\omega}\right) \tag{4}$$

Let us now analyse the labour market. As labour is homogenous and perfectly mobile the equilibrium wage will be unique and equal upstream and downstream. The equilibrium wage w_d^* is determined by $2q_d^*\alpha(h)/h = L$, i.e. $(a - c(w_d^*,\rho))/(2b+v) = Lh/(2\alpha(h))$ which means that it solves

$$c\left(w_d^*, \tfrac{w_d^*}{h}\right) = a - L\tfrac{h(2b+v)}{2\alpha(h)} \tag{5}$$

This establishes a first result:

PROPOSITION 1. *Equilibrium wage level in the dispersed configuration is given by equation (5).*

Before moving to the analysis of the duopoly configuration, let us consider the Cobb-Douglas production technology case.

Example 1. Assume that downstream production employs a Cobb-Douglas technology: $f(l_i,y_i) = \sqrt{l_i y_i}$. Then $\alpha(w/\rho) = c(w,\rho)/\rho = 2\sqrt{w/\rho}$ and $\alpha(h) = 2\sqrt{h}$.
Recall the labour-market equilibrium condition (5). Using the Cobb-Douglas specification above it becomes

$$2\sqrt{w(w/h)} = a - \tfrac{Lh(2b+v)}{4\sqrt{h}}$$

therefore the equilibrium wage is $w_d^* = \frac{1}{2}a\sqrt{h} - \frac{1}{8}Lh\,(2b+v)$.

4. The Vertically Integrated Duopoly

The vertically integrated production function maps total labour input (employed both in the upstream and in the downstream plant) into the final good: $q_i = F(L_i)$. It is obtained by plugging the upstream technology into the downstream technology: $F(L_i) := f(l_i, h\lambda_i)$ and $L_i = l_i + \lambda_i$. Recall the assumptions on $f(\cdot,\cdot)$: it is concave, exhibits constant returns to scale and does not allow for total substitution of one production factor with the other. However, these assumptions do not translate easily into properties of the vertically-integrated-production function $F(\cdot)$.

The ownership structure in the duopoly configuration is depicted in Figure 2 below.

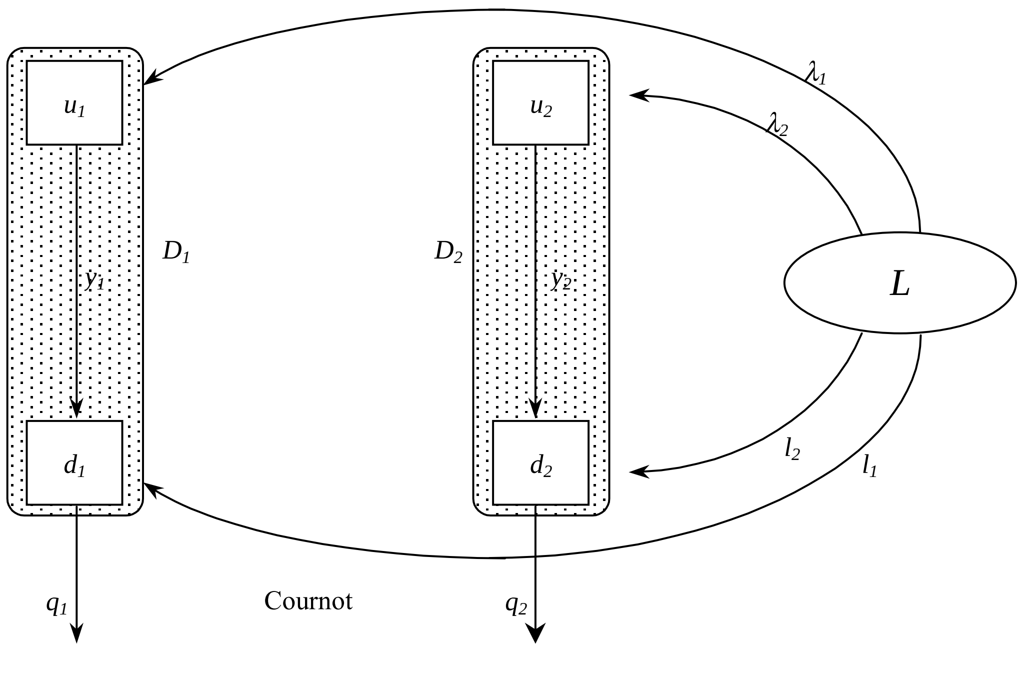

Figure 2: Duopoly

Now consider the cost function. Note that workers receive the same wage upstream and downstream. So the cost function is $Z(w, q_i) := C\left(w, \frac{w}{h}, q_i\right) = c\left(w, \frac{w}{h}\right) q_i$.

As before, the Cournot equilibrium is given by the solution of the system of the best responses $R_1(q_2) = \frac{a - vq_2 - c\left(w, \frac{w}{h}\right)}{2b}$ and $R_2(q_1) = \frac{a - vq_1 - c\left(w, \frac{w}{h}\right)}{2b}$. Hence

$$q_D^* = q_1^* = q_2^* = \frac{\left(a - c\left(w, \frac{w}{h}\right)\right)(2b - v)}{4b^2 - v^2} = \frac{a - c\left(w, \frac{w}{h}\right)}{2b + v}$$

and firms' profits are $\pi^* = \pi_1(q_D^*) = \pi_2(q_D^*) = b(q_D^*)^2$.

Using Shepard's Lemma again, the labour demand of each firm is then

$$\begin{aligned} L_i(w, q_D^*) = & \frac{\partial}{\partial w} Z(w, q_D^*) = \left(\frac{\partial}{\partial w} c\left(w, \frac{w}{h}\right) + \frac{1}{h} \frac{\partial}{\partial \rho} c\left(w, \frac{w}{h}\right)\right) q_D^* = \\ & = \left(\alpha'(h) + \frac{1}{h}\left(\alpha(h) - h\alpha'(h)\right)\right) q_D^* = \frac{1}{h} \alpha(h) q_D^* \end{aligned} \tag{6}$$

Thus the equilibrium wage is determined by $L_1(w, q_D^*) + L_2(w, q_D^*) = q_D^* \frac{2}{h} \alpha(h) = L$, i.e. by $(a - c(w, w/h)) / 2b + v = Lh / (2\alpha(h))$. So the equilibrium wage w_D^* solves the same equation (5) as in the previous case:

$$c\left(w_D^*, \frac{w_D^*}{h}\right) = a - L\frac{h(2b + v)}{2\alpha(h)} \tag{7}$$

We have therefore established the following result:

PROPOSITION 2. *Equilibrium wage level in the vertically integrated duopoly is given by equation (7).*

A simple comparison between equation (5) and equation (7) leads us to conclude that:

COROLLARY 1. *Simultaneous vertical (dis)integration does not affect the market outcome.*

These results are important as they establish the benchmark for the rest of the paper. In particular, note that the irrelevance result in Corollary 1 is not surprising because the model abstracts from all the reasons that traditionally give rise to vertically integrated structures such as increasing returns, scope economies, transaction costs, incomplete contracts, customised inputs, foreclosure and double marginalisation.

So far comparison has only been made between symmetric situations where firms are either both vertically disintegrated or both integrated. However, asymmetric configurations must also be considered. The result in Corollary 1 might well be only due to symmetry. Thus, in the next section the asymmetric configuration in which one vertically integrated entity competes with a chain of independent firms is analysed.

5. The Asymmetric Configuration

The configuration in which one vertically integrated entity competes with a vertical chain of independent firms is referred to as the asymmetric configuration. Without loss of generality assume that d_2 and u_2 merged in vertically integrated entity D_2. The ownership links and the interactions are depicted in the following Figure 3: the branch that goes from u_2 to the intermediate-good market is dashed since it might happen that the vertical firm only does in-house production.

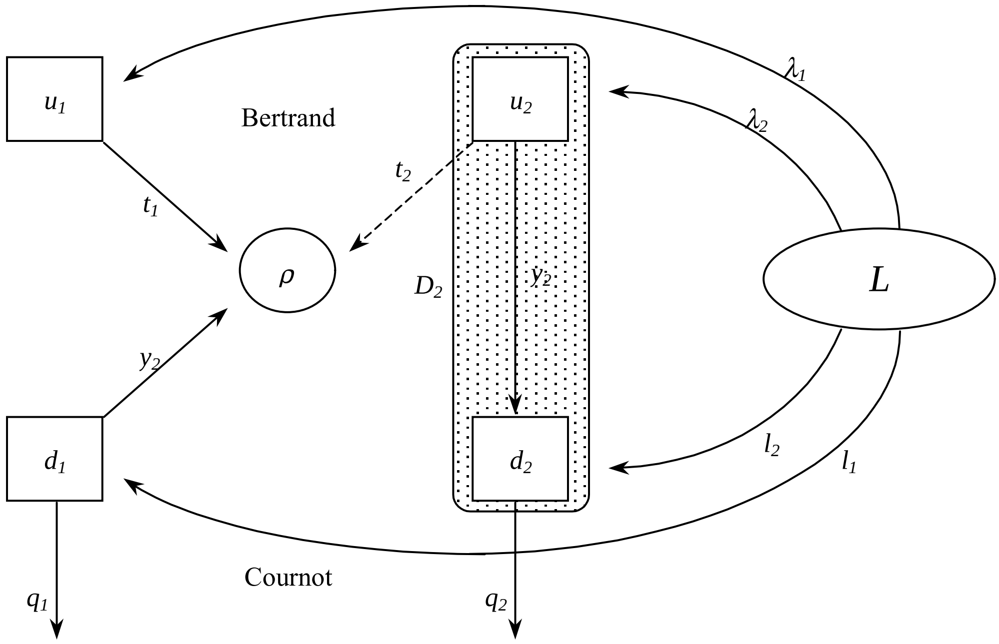

Figure 3: Asymmetric configuration

In the asymmetric configuration careful attention must be given to the order of the moves and to the observability assumptions. The results depend heavily on the different levels of observability. Let us recall the game form: I) downstream firms simultaneously choose whether to integrate or not with their own supplier; the resulting vertical integration is then observed; II) if vertically integrated then the firm decides whether to enter the intermediate-good market in addition to in-house production; III) upstream production and competition take place; and finally IV) downstream production and competition take place. Hence the following subsections analyse both cases of unobservable and of observable entry in the intermediate-good market.

5.1 *The Unobservable-Entry Case*

Assume that the independent upstream firm u_1 cannot observe whether or not the vertically integrated firm is active on the intermediate-good market. Note that since its decision is not observed by the independent intermediate-good producer, D_2 cannot credibly commit not to enter the market. Hence the independent upstream firm behaves as if the vertically integrated firm had announced that it is entering the market. Such a conjecture is correct as the vertically integrated entity is actually competing. So both u_1 and D_2 simultaneously choose the price for the intermediate good. Simultaneity implies that there are no incentives for either firm to price above the (common) marginal cost. If either firm were pricing above marginal cost the other would simply slightly undercut it and steal all the market, gaining all the profits. If the independent upstream firm prices at marginal cost it makes zero profits. Moreover, given u_1's strategy the vertically integrated firm is then indifferent to selling or not selling to the independent downstream firm d_1. However, if D_2 decided not to serve the independent final-good producer, d_1 would be subject to the independent upstream firm's monopoly pricing (this is the best response of u_1 to D_2's action "*Don't sell to* d_1"). It would then be profitable for D_2 to slightly undercut u_1 and steal its market share and (almost) all profits without (practically) changing its downstream profits. It is thus the unique equilibrium that both firms sell to d_1, competing à la Bertrand and sharing the demand for the intermediate good. Hence the equilibrium of the market is identical to the one found in the previous symmetric configurations. This actually means that when the decision of the integrated entity to enter the market for the intermediate good is unobservable, both firms are indifferent between vertical integration or disintegration.

PROPOSITION 3. *If the intermediate-good-market entry decision of the vertically integrated entity is not observable, the unique equilibrium in the subgame is that both* *the independent upstream firm and the vertically integrated entity serve the independent downstream firm pricing the intermediate good at the (common) marginal cost.*

PROOF. Let us proceed by backward induction. In the last stage of the subgame downstream Cournot competition takes place. The reaction functions for the two players are $R_{d_1}(q_{D_2}) = \frac{a - vq_{D_2} - c_{d_1}}{2b}$ and $R_{D_2}(q_{d_1}) = \frac{a - vq_{d_1} - c_{D_2}}{2b}$. The resulting equilibrium quantities are

$$q^*_{d_1} = \frac{a(2b-v) - 2bc_{d_1} + vc_{D_2}}{4b^2 - v^2} \quad \text{and} \quad q^*_{D_2} = \frac{a(2b-v) - 2bc_{D_2} + vc_{d_1}}{4b^2 - v^2}$$

and the equilibrium profits are $\pi^*_i = b\left(q^*_i\right)^2$ for $i = d_1, D_2$.

It is now important to observe that there is an asymmetry in the cost structure of the two competitors: D_2 only pays wages (because the upstream division is transferring downstream the intermediate good at the marginal cost) while d_1 pays both wages to workers and the price of the intermediate good ρ.

In taking the decision whether to supply the independent firm, the vertically integrated entity has to anticipate the outcome of the Cournot competition. It also anticipates that if it decides not to sell to d_1 then the independent upstream firm acts as a monopolist facing the inverse demand function $\rho = \varphi(y_{d_1})$, which is downward sloping by the law of supply as it is the inverse of the downstream firm's conditional factor demand for the intermediate good $y_{d_i}\left(w, \rho, q^*_{d_1}\right) = q^*_{d_1} \frac{\partial}{\partial \rho} c_{d_i}(w, \rho) = q^*_{d_1} \alpha(w/\rho) - q^*_{d_1} \alpha'(w/\rho) w/\rho$

The monopolist's problem is

$$\max_t \pi_{u_1} = (\varphi(t) - \omega/h)\, t \tag{8}$$

where ω is the upstream wage level. The solution t_0 solves the first-order condition $\varphi(t_0) + t_0\varphi'(t_0) = \omega/h$. The monopoly price is $\rho_0 = \varphi(t_0)$. Lemma 1 at the end of this proof shows that the monopoly price is greater than the internal transfer price within the vertically integrated entity.

The equilibrium is depicted in Figure 4 below. The figure depicts both Bertrand behaviour (t^*, ρ^*) and monopolistic behaviour (t_0, ρ_0) of an upstream firm.

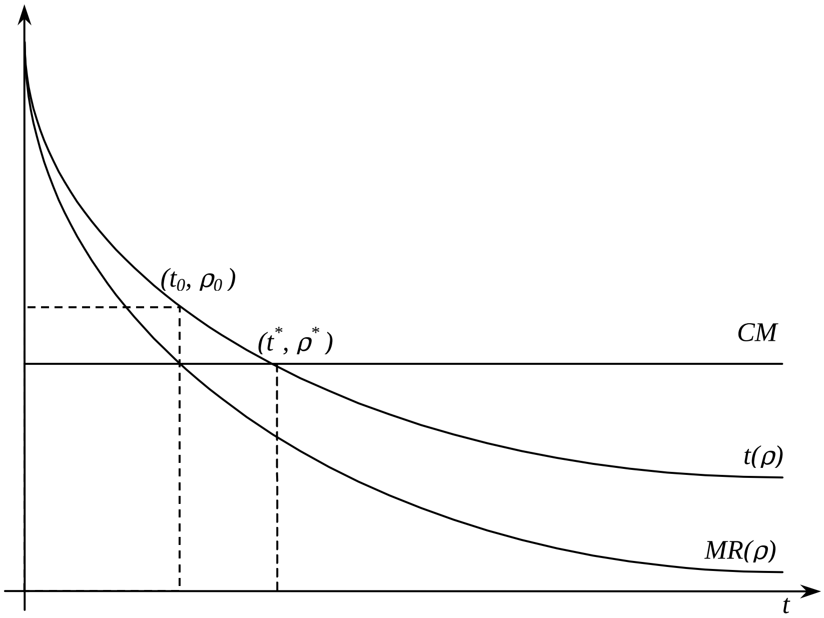

Figure 4: Monopolistic behaviour of upstream firm

However, (*Monopoly pricing, Don't sell to* d_1) is not an equilibrium because the vertically integrated entity has the profitable deviation to undercut slightly the independent upstream firm. By doing so D_2 gains all u_1's profits without changing practically the cost level of its competitor in the downstream market (i.e. keeping the downstream profits virtually unchanged). This reasoning generalises to any price level set by u_1 which is greater than its marginal cost. For any price $\rho' \in (\omega/h, \rho_0]$ charged by the independent upstream firm it is always profitable for D_2 to sell to d_1 at a price $\rho' - \varepsilon$ for some $\varepsilon > 0$. Therefore "*Don't sell to* d_1" cannot be an equilibrium action for D_2.

Given the argument above the only action of the vertically integrated firm that can be part of the equilibrium is "*Sell to the downstream firm* d_1 *at a price equal to the marginal cost*". The independent firm u_1 is then indifferent to any price (it makes no profits in any case). The unique equilibrium is then, by virtue of an argument symmetrical to the one developed above, to sell the intermediate good at a price equal to the marginal cost. ■

The next Lemma completes the proof of Proposition 3 showing that the monopoly price of the intermediate good is greater than the internal transfer price in vertical integration.

LEMMA 1. *The monopoly price is greater than the (marginal) cost at which the intermediate good is internally transferred from the upstream to the downstream division of the vertically integrated firm.*

PROOF. Monopoly price is generally greater than the marginal cost of the monopolist (Mas-Colell *et al.*, 1995, p. 385), i.e. it is greater than the competitive price. Given labour mobility and homogeneity the equilibrium wage is unique in our model. Therefore, the marginal cost of production of the intermediate good is equal for the two upstream plants. Thus we can conclude that $\rho_0 > \omega/h = w/h$. ■

Let us now conclude the analysis of the unobservable-entry case of the asymmetric configuration. Given the equilibrium found in Proposition 3 it is possible to calculate the equilibrium in the intermediate-good market. The price is then $\rho^* = \omega/\,h$ and the equilibrium quantity is $t^* = q^*_{d_1}\alpha\left(\frac{w}{\omega/h}\right) - q^*_{d1}\frac{w}{\omega/h}\alpha'\left(\frac{w}{\omega/h}\right)$. A fraction $\delta \in (0,1)$ is produced by the integrated firm's upstream plant and a fraction $1-\delta$ by the independent upstream firm. Hence, given the linear technology, the labour requirement of the upstream sector is

$$\begin{array}{l} \lambda_1 = \frac{1-\delta}{h}\left[q^*_{d_1}\alpha\left(\frac{w}{\omega/h}\right) - q^*_{d1}\frac{w}{\omega/h}\alpha'\left(\frac{w}{\omega/h}\right)\right] \\ \breve{\lambda}_2 = \frac{\delta}{h}\left[q^*_{d_1}\alpha\left(\frac{w}{\omega/h}\right) - q^*_{d1}\frac{w}{\omega/h}\alpha'\left(\frac{w}{\omega/h}\right)\right] \end{array}$$

where $\breve{\lambda}_2$ indicates the labour employed by the vertically integrated entity to serve the independent downstream firm. The vertically integrated firm also demands labour for its own production line:

$$\begin{array}{l} l_2 = \frac{\partial}{\partial w}c\left(w, \frac{w}{h}\right)q^*_{D_2} = q^*_{D_2}\alpha'\left(h\right) \\ \overline{\lambda}_2 = \frac{\partial}{\partial \rho}c\left(w, \frac{w}{h}\right)q^*_{D_2} = q^*_{D2}\frac{1}{h}\left(\alpha\left(h\right) - h\alpha'\left(h\right)\right) \end{array}$$

where $\overline{\lambda}_2$ indicates the labour employed to serve the integrated downstream plant. Finally, recall that the labour demand of the independent downstream firm is $l_{d_1} = q^*_{d_1}\alpha'\left(wh/\omega\right)$.

Labour homogeneity and mobility imply that there is only one wage; thus the aggregate demand for labour is

$$\begin{array}{rl} L^D_A := & \frac{1-\delta}{h}\left[q^*_{d_i}\alpha\left(h\right) - q^*_{d_i}h\alpha'\left(h\right)\right] + \frac{\delta}{h}\left[q^*_{d_i}\alpha\left(h\right) - q^*_{d_i}h\alpha'\left(h\right)\right] + \\ & +q^*_{d_1}\alpha'\left(h\right) + q^*_{D_2}\alpha'\left(h\right) + q^*_{D2}\frac{1}{h}\left(\alpha\left(h\right) - h\alpha'\left(h\right)\right) = \frac{1}{h}\alpha\left(h\right)\left(q^*_{d_i} + q^*_{D_2}\right) \end{array}$$

Since both final-good producers have the same costs, the equilibrium quantities are equal

$$q_A^* := q_{D_2} = q_{d_1} = \frac{a - c\left(w, \frac{w}{h}\right)}{2b+v}$$

Therefore, the aggregate labour demand is given by:

$$L_A^D = \tfrac{2}{h} q_A^* \alpha(h) \tag{9}$$

The competitive wage is then given by the usual condition that equates supply and demand $2q_A^*\alpha(h)/h = L$ which means that the equilibrium wage w_A^* solves:

$$c\left(w_A^*, \frac{w_A^*}{h}\right) = a - L\frac{h(2b+v)}{2\alpha(h)} \tag{10}$$

where the subscript A indicates asymmetric configuration with observable entry. Equation (10) determines the equilibrium wage in the unobservable-entry case of the asymmetric configuration. Note that it is identical to equation (5) for the dispersed configuration and to equation (7) for the vertically integrated duopoly.

These results can be summarised in the following proposition:

PROPOSITION 4. *In the equilibrium of the asymmetric configuration with unobservable entry the competitive wage is determined by equation (*10*).*

The comparison of the equilibrium wage level in the unobservable-entry case of the asymmetric configuration with market-clearing wages in the dispersed and in the duopoly configurations is given by the following corollary.

COROLLARY 2. *The competitive wage is equal to the corresponding wage levels of the dispersed and duopoly configurations.*

Note that the inability to commit not to undercut the independent upstream firm's monopoly pricing harms the vertically integrated firm. Modifications to the game form would make the strategy profile (*Monopoly pricing, Don't sell to* d_1) an equilibrium – in fact the unique equilibrium of the subgame. The vertically integrated firm's choice of serving its downstream competitor need only be observable by the upstream firm before it chooses the price. In this game with observable actions the unique equilibrium is indeed that the vertically integrated entity abstains from serving the independent downstream firm, so as to let the independent upstream firm monopolise the market for the intermediate good. This is the subject of the next section.

5.2 *The Observable-Entry Case*

Quite different results occur when the independent upstream firm has the possibility of observing whether the vertically integrated entity is active or not in the intermediate-good market. Two assumptions made in the set-up of the model in Section 2 play a role in producing this result: the absence of entry in the intermediate-good market and the impossibility for the independent upstream firm to use a two-part tariff rule such as unitary cost plus a franchise fee that extracts the profits from the independent downstream firm. As discussed above, vertical integration is motivated by the impossibility for downstream firms to initiate bargaining with suppliers on the price and quantity of the intermediate good.

In the observable-entry case the vertically integrated entity abstains from competing with the independent upstream firm. It therefore enjoys the fact that it is competing in the downstream market with a firm with higher marginal costs. Observability makes it possible to commit not to compete in the input market and thus it sustains the strategy profile (*Monopoly pricing, Don't sell to* d_1) as the unique equilibrium in the subgame.

As usual, solving the system of the best reply functions $R_{d_1}\left(q_{D_2}\right) = \frac{a-vq_{D_2}-c_{d_1}}{2b}$ and $R_{D_2}\left(q_{d_1}\right) = \frac{a-vq_{d_1}-c_{D_2}}{2b}$ one obtains the Cournot equilibrium quantities

$$q_{D_2} = \frac{2b\left(a-c_{D_2}\right)-v\left(a-c_{d_1}\right)}{4b^2-v^2} \quad \text{and} \quad q_{d_1} = \frac{2b\left(a-c_{d_1}\right)-v\left(a-c_{D_2}\right)}{4b^2-v^2} \tag{11}$$

Consider the independent upstream firm: it observes that the vertically integrated entity abstains from competing in the intermediate-good market. It thus becomes a monopolist. We already know that the monopolist's problem is (8) and its solution is (ρ_0, t_0). Lemma 1 shows that $\rho_0 > \rho^*$ and hence $t_0 < t^*$.

The following example shows that with Cobb-Douglas technology it is possible both to calculate the monopoly price and to show that the solution to the monopolist's problem always exists.

Example 2. Using the conditional factor demands, the monopolist's problem (8) can be rewritten as:

$$\max_{\rho} \left(\rho - \omega/h\right) y_{d_1}\left(w, \rho, q_{d_1}\left(w, \rho\right)\right) \tag{12}$$

and monopoly price ρ_0 solves the first-order condition:

$$y_{d_1}\left(w, \rho_0, q_i\left(w, \rho_0\right)\right) + \left(\rho_0 - \tfrac{\omega}{h}\right) \tfrac{\partial}{\partial \rho} y_{d_1}\left(w, \rho_0, q_{d_1}\left(w, \rho_0\right)\right) \left(1 + \tfrac{\partial}{\partial \rho} q_{d_1}\left(w, \rho_0\right)\right) = 0$$

By the law of supply, we know that factor demands are downward sloping (i.e. the necessary condition for the existence of the solution is satisfied). Graphically, the solution is the one depicted in Figure 4 above since equations (8) and (12) describe the same problem.

Consider again the Cobb-Douglas case: $f\left(y_i, l_i\right) = \sqrt{y_i l_i}$ $i = d_1,\ d_2$. The monopolist's problem becomes

$$\max_{\rho} \left(\rho - \tfrac{\omega}{h}\right) \frac{\left(2\sqrt{w/\rho} - \frac{w}{\rho} / \sqrt{w/\rho}\right)\left(2b\left(a - 2\rho\sqrt{w/\rho}\right) - v\left(a - \frac{w}{h} 2\sqrt{h}\right)\right)}{4b^2 - v^2}$$

From the first-order condition we obtain $-8bh^{\frac{3}{2}}\sqrt{w}\rho^{\frac{3}{2}} - va\sqrt{h}\omega + 2ab\sqrt{h}\omega + 2vw\omega + 2ba\rho h^{\frac{3}{2}} - va\rho h^{\frac{3}{2}} + 2vwh\rho = 0$ which is a polynomial of the form $-Ax^3 + Bx^2 + C$ where $x = \sqrt{\rho}$ and the coefficients are $A := 8b\sqrt{w}h^{\frac{3}{2}}$, $B := 2abh^{\frac{3}{2}} - vah^{\frac{3}{2}} + 2vwh$ and $C := va\sqrt{h}\omega + 2ab\sqrt{h}\omega + 2vw\omega$, all positive. The unique real root is $x^* = \frac{K}{6A} + \frac{2}{3}\frac{B^2}{AK} + \frac{1}{3}\frac{B}{A} > 0$ where $K := \sqrt[3]{108CA^2 + 8B^3 + 12A\sqrt{3}\sqrt{27C^2A^2 + 4CB^3}}$. This also shows that the solution always exists given the signs of the coefficients.

The following proposition characterises the equilibrium of the observable entry subgame building on the previous discussion.

PROPOSITION 5. *If entry in the market for the intermediate good is observable, then the upstream division of the vertically integrated entity only performs in-house production of the intermediate good and leaves the whole market to the independent upstream firm that therefore acts as a monopolist. In the market for the final good,* D_2 *competes in quantities with the independent downstream firm.*

PROOF. Given the discussion above one only need show that to $\pi^*_{D_2} > \pi^*_{d_1}$. Recall that Cournot profits are given by $\pi^*_i = b\left(q^*_i\right)^2$ for $i = d_1, D_2$. From equation (11) the Cournot quantities are

$$q^*_{d_1} = \frac{2b\left(a-c_{d_1}\right)-v\left(a-c_{D_2}\right)}{4b^2-v^2} \quad \text{and} \quad q^*_{D_2} = \frac{\left(2b\left(a-c_{D_2}\right)-v\left(a-c_{d_1}\right)\right)}{4b^2-v^2}$$

It can be trivially shown that $q^*_{D_2} - q^*_{d_1} = \frac{c_{d_1}-c_{D_2}}{2b-v}$. Therefore, to show that abstaining from competition is the equilibrium of the subgame, it is simply necessary to show that $c_{d_1} - c_{D_2} = c\left(w, \rho_0\right) - c\left(w, w/h\right) > 0$. Downstream production technology is convex and does not allow for total substitution of one production factor with the other, i.e. $l_i\left(w, \rho, q_i\right) > 0$ and $y_i\left(w, \rho, q_i\right) > 0$ for all w, ρ and q_i with $i = d_1$, D_2. This implies that using Shepard's lemma again the cost function $c\left(w, \rho\right)$ is strictly increasing in each of the arguments. We have established in Lemma 1 that the monopoly price of the intermediate good is greater than the marginal cost of the upstream division of the vertically integrated entity. Hence the average and marginal cost of the vertically integrated entity is smaller than that of the independent downstream firm.[11] Finally, the vertically integrated entity is better off when it competes with a firm which has higher costs than itself than with a firm which has equal costs. This is shown by the fact that $\frac{\partial}{\partial c_{d_1}} q^*_{D_2} > 0$. Similarly, the independent downstream firm is worse off than in any symmetric configuration, as $\frac{\partial}{\partial c_{d_1}} q^*_{d_1} < 0$. Therefore, the equilibrium quantity and profits of the vertical firm are greater than those of the independent final-good producer. ■

The equilibrium described in the above Proposition 5 completes the analysis of the subgames.

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[11] It should be noted that the assumption of a single labour market plays a crucial role in establishing this result. Indeed, the independent upstream firm reduces its labour demand, thus putting a downward pressure on the wage. The independent final-good producer may reduce its labour demand as well, causing a further decrease in the wage. However, since the labour market is unique the integrated entity will also benefit from such a decrease in the (unique) wage level.

6. The Merge-and-Compete Game

The analysis of the previous sections establishes the ranking of the pay-offs of the firms in each configuration. Thus the reduced form of the merge-and-compete game can be represented as in Figure 5. Note that observable entry implies that $\pi_{VI} > \pi_D = \pi_d > \pi_\Delta$ where the subscripts respectively stand for (asymmetrically) vertically integrated, duopoly, dispersed and independent downstream firm. Unobservable entry makes the game trivial since $\pi_{VI} = \pi_D = \pi_d = \pi_\Delta$.

	Integrate	Don't
Integrate	π_D,π_D	π_{VI},π_Δ
Don't	π_Δ,π_{VI}	π_d,π_d

Figure 5: The reduced-form game

Note that in the observability case the strategy "*Integrate*" is dominant for both players and that the profile (*Integrate, Integrate*) is a strict Nash equilibrium. This establishes the following result:[12]

PROPOSITION 6. *The merge-and-compete game in the case of observable entry has a unique equilibrium which is (*Integrate, Integrate*). This equilibrium is a strict Nash equilibrium. However, if entry in the intermediate-good market is not observable, firms are indifferent whether to vertically integrate or not*

Observable entry is a characteristic which is not rare in the real world. If the intermediate-good market is web-based, the opportunity or otherwise to buy on line the intermediate good on the website of the vertically integrated entity indicates whether the firm is indeed active or not in the intermediate-good market. Moreover, competitors might observe whether or not one firm sells its intermediate goods simply because they can observe the nature

[12] The appendix discusses the robustness of the result in Proposition 6 with respect to the wage-setting institution analysing the case of a monopolist trade union.

of the output which is shipped from the plants of the vertically integrated entity. A third example of observable entry is given by the periodical sectoral fairs in which firms launch new products and present themselves. If intermediate goods are not presented then it is likely that they will not be sold on the market. These last two examples are very important in the case of small and medium-sized enterprises which are – as mentioned in the introduction – often clustered in industrial districts and regularly participate in business fairs.

It is interesting to note that the strategic incentives for vertical integration are found in the context of perfect and symmetric information about the opponent's moves rather than in the unobservability scenario. As a matter of fact, it might have been more intuitive to obtain a result stating that players had an incentive to merge vertically if their actions were not observable by competitors. However, the reason why the vertically integrated entity enters the intermediate-good market in the unobservability scenario is that it "cannot resist the temptation" of stealing the market from the independent upstream firm. This makes it clear why observability sustains the strategic incentives to integrate vertically: it makes it possible to commit not to compete in the intermediate-good market.

7. Implications for Economic Policy

The analysis above has interesting policy implications. The strategic incentives for vertical integration found in Proposition 6 are based on the fact that no firm wants to be the independent downstream producer in the asymmetric configuration. However, in the EU these incentives would be inhibited by the Commission's competition policy unless the firms involved were so small as to be subject to national merger control rather than to the EU merger regulation or even exempt from any merger control because of their (small) size.

According to the EC Merger Regulation,[13] in the case of observable entry in the intermediate-good market the integrated entity becomes dominant through the vertical merger. So the European Commission can veto the vertical integration or at least impose a remedy. The ideal remedy is an obligation for the vertically integrated firm to be active (i.e. to compete)

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[13] Article 2(3) of the EC Merger Regulation: Council Regulation (EEC) No 4064/89 of 21 December 1989 on the control of concentrations between undertakings (OJ L 395, 30.12.1989; corrected version OJ L 257, 21.9.1990, p.13) with amendments introduced by Council Regulation (EC) No 1310/97 of 30 June 1997 (OJ L 180, 9.7.1997, p. 1, corrigendum OJ L40, 13.2.1998, p. 17).

in the intermediate-good market. In the observability case the vertically integrated firm enjoys a larger market share in the downstream market than the independent downstream firm and almost drives it out of the market. This is due to the fact that it abstains from competing in the intermediate-good market. It is exactly this abstention from competition that creates the dominant position of the vertically integrated firm which is what the Commission is concerned about. The Commission's action is legitimised[14] by the fact that consumers are worse off in the relevant market, which is the final-good market in the model. Indeed, prices for both varieties of final goods increase; moreover, the first variety (the one produced by the independent downstream firm) becomes rarer and in our model consumers value variety.

Recently the Tetra/Laval merger was not approved by the Commission using an argument similar to the one developed in this paper since it was also argued that it threatened to *indirectly* create a dominant position. Indeed, our model suggests that a merger may distort competition indirectly, i.e. through alteration of the strategic behaviour of other market participants even if the vertically integrated entity does not behave anticompetitively.

According to the Commission's decision C (2001) 3345 final of 30 October 2001 not only was the merger (directly) creating a dominant position – i.e. directly harming competition – its indirect consequences were also detrimental for competition in the relevant markets. The Court of First Instance did not confirm[15] the Commission's decision, affirming that the Commission had failed to provide sufficient evidence in support of its claim. However, it did state that the latter's reasoning was perfectly legitimate and correct in addressing the issue of the future and mediate (i.e. indirect) effects of a merger.[16] The Tetra/Laval judgement was therefore interpreted as the Court's establishing standards of proof higher than those used by the Commission.[17]

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[14] According to article 2(1)(b) of the EC Merger Regulation.

[15] Case T-5/02, Tetra Laval BV vs Commission of the European Communities, 25 October 2002.

[16] This is explicitly stated in the Court of First Instance's press release no. 87/02.

[17] In support of this interpretation see the wording used by the Court of First Instance in the judgment on the Tetra Laval case (T-5/02). In particular recital 336 thereof, which carries the conclusions on the conglomerate effects states that the Commission's "*contested decision does not establish to the requisite legal standard*" that the merger would have anticompetitive effects.

Finally, consider the United States of America where only active, or intentional, monopolisation of a market is prohibited under the Sherman Act.[18] There, the strategic incentives for vertical integration given by Proposition 6 hold. Indeed, the independent upstream firm does not attempt to monopolise the intermediate-good market but simply finds itself alone in the market because the vertically integrated entity voluntarily abstains from competing. Moreover, the independent upstream firm is by no means building barriers to entry in order to preserve its monopoly. On these grounds, the Sherman Act does not condemn the monopolisation of the intermediate-good market.

8. Conclusions

It is known that merging firms' performance generally declines in the post-merger period. The research of this paper is motivated by the following puzzle: why do firms merge if it is not profitable to do so? For this purpose we identify a possible new driver for vertical mergers: strategic incentives.

A simple model of four plants is analysed, in which none of the traditional reasons for vertical integration (such as scale or scope economies, transaction costs, incomplete contracts, input customisation, market foreclosure and double marginalisation) holds; here, vertical mergers only respond to purely strategic motives. The two upstream plants produce a homogeneous good that is a necessary input for downstream production. The two producers of the horizontally-differentiated final good compete in quantities, while upstream firms compete in prices.

In the model, downstream firms simultaneously have the opportunity to take over one input supplier. The resulting vertical integration is observed. Before production and competition take place, vertically integrated entities decide whether to enter the intermediate-good market or to perform only in-house production. Whether this market-entry decision is observable or not by competitors has a crucial impact on the results. If entry of the vertically integrated entity in the market for the intermediate good is not observable, firms are indifferent about vertical integration. However, if the market-entry choice is observable,

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[18] *15 U.S.C.A. § 2.* See Motta (2003), pp. 1-21 for a comparative discussion of European and US competition policies.

vertical integration is the unique equilibrium of the model. Observability makes it possible for the vertically integrated entity to commit not to enter the intermediate-good market. Thus in an asymmetric situation in which one integrated firm competes with a chain of independent enterprises, the independent upstream firm becomes a monopolist. This makes the independent downstream firm the worst-off and the vertically integrated entity the best-off, giving rise to the strategic incentives for vertical integration. Indeed, each firm has an incentive to integrate upstream because vertical integration represents a commitment to a strategy that puts the rival at a strategic disadvantage.

Observable market entry is not a remote hypothesis. Indeed, it happens all the time in *e*-business that everyone – competitors included – can observe what products are being offered on a firm's website. A more traditional channel of information flow is the concentration in a given area of the production plants of all the competitors, allowing direct observation of the specific nature of the commodities shipped out of the competitors' plants. Moreover, many firms regularly meet (together with wholesale dealers, suppliers, and other specialised agents) at business fairs where each firm launches the products it is basing its business plans upon. The last two examples are of great importance for small and medium-sized enterprises. These firms are often clustered in industrial districts and regularly take part in business fairs.

Finally, it is interesting to note that the European Union's merger regulation and the US Sherman Act have different impacts on the strategic incentives for vertical integration found in the model. The EU regulation would inhibit these incentives while the American anti-trust authorities would not intervene.

Appendix

Monopolist Union

This appendix analyses the merge-and-compete game when the labour market includes a monopolist union. Let us assume that the wage is negotiated between each firm and a monopolist trade union that aims to maximise the wage bill and is also endowed with all the bargaining power. The union maximises the wage bill subject to the aggregate labour demand by the firms and the condition that firms do not earn negative profits. The rationale behind the study of such a different labour-market institution is the comparison of its economic performance with that of the competitive labour market. Although it can be argued that a perfectly competitive labour market and a monopolist union are diametrically opposite models, the interest in doing this exercise lies in the fact that reality falls somewhere between the two. Indeed, the results of the paper are robust with respect to the institutional set-up of the labour market.

Labour is homogeneous and perfectly mobile so that the wage is the same both upstream and downstream, irrespectively of the configuration under study. Recall that the aggregate labour demand in the dispersed configuration is defined by equation (4):

(4) $$L_d^D\left(w, q_d^*\right) = q_d^* \tfrac{2}{h} \alpha\left(h\right)$$

In a duopoly it is given by the sum of each duopolist's labour demand (6), i.e. by:

(13) $$L_D^D\left(w, q_D^*\right) = q_D^* \tfrac{2}{h} \alpha\left(h\right)$$

In the unobservable-entry case of the asymmetric configuration the aggregate labour demand is in equation (9):

(9) $$L_A^D = \tfrac{1}{h} \alpha\left(h\right) \left(q_{d_i}^* + q_{D_2}^*\right)$$

The discussion in Sections 2, 3 and 5.1 shows that the equilibrium quantities are equal in all three configurations and therefore the monopolist union faces the same labour demand.

Let us now calculate the equilibrium wage. Consider, first, the dispersed configuration. The only firms making profits are the downstream ones. Thus, the monopolist union maximises the wage bill, anticipating that the upstream workers will also enjoy the same wage, which will be transferred downstream in the price of the intermediate good. Hence, the union maximises $w\alpha'(h)\, q_d^*\left(w, \frac{w}{h}\right)$

Thus the monopolist union solves

$$\begin{array}{l} \max_w w\, l\left(w, \frac{w}{h}, q_d^*\right) = w\alpha'(h)\, q_d^*\left(w, \frac{w}{h}\right) \\ \text{subject to } \pi_1 \geq 0 \text{ and } \pi_2 \geq 0 \end{array}$$

The first-order condition is:

$$\alpha'(h)\, q_d^*\left(w, \frac{w}{h}\right) + w\frac{\partial}{\partial w}\alpha'(h)\, q_d^*\left(w, \frac{w}{h}\right) + w\frac{\partial}{\partial \rho}\alpha'(h)\, q_d^*\left(w, \frac{w}{h}\right) = 0$$

i.e. $\hat{w}_d$ solves

$$q_d^*\left(\hat{w}_d, \frac{\hat{w}_d}{h}\right) + \hat{w}_d\frac{\partial}{\partial w}q_d^*\left(\hat{w}_d, \frac{\hat{w}_d}{h}\right) + \hat{w}_d\frac{\partial}{\partial \rho}q_d^*\left(\hat{w}_d, \frac{\hat{w}_d}{h}\right) = 0 \tag{14}$$

Consider, second, the vertically integrated duopoly. The monopolist union maximises the wage bill which is $wL_D^D(w, q_D^*) = w\frac{2}{h}\alpha(h)\, q_D^*$ subject to the fact that each firm does not have negative profits. Thus $\hat{w}_D$ solves

$$q\left(\hat{w}_D, \frac{\hat{w}_D}{h}\right) + \hat{w}_D\frac{\partial}{\partial w_D}q\left(\hat{w}_D, \frac{\hat{w}_D}{h}\right) + \hat{w}_D\frac{\partial}{\partial \rho}q\left(\hat{w}_D, \frac{\hat{w}_D}{h}\right) = 0 \tag{15}$$

exactly as in the dispersed configuration.

Consider, third, the unobservable-entry case of the asymmetric configuration. The only firms that make profits are the vertically integrated entity and the independent downstream firm. However, it has been observed above that both producers face the same costs (the same wage and the same price for the intermediate good equal to its marginal cost) and therefore produce the same quantity. Their profits are

$$\pi_{D_2}^*\left(w, \frac{w}{h}\right) = \pi_{d_1}^*\left(w, \frac{w}{h}\right) = b\left(q_A^*\right)^2 = b\left(\frac{(2b-v)(a-h\alpha(h))}{4b^2-v^2}\right)^2$$

Hence the monopolist union simply pools all the workers and maximises the wage bill subject to firms not running losses. In particular, using equation (9) which defines the aggregate labour demand

$$\begin{array}{l} \max_w w\frac{2}{h}q_A^*\alpha(h) \\ \text{subject to } b(q_A^*)^2 \geq 0 \end{array}$$

The first-order condition is

$$\frac{2\alpha(h)}{h}q^*\left(w,\frac{w}{h}\right) - w\frac{2\alpha(h)}{h}\left(\frac{\partial}{\partial w}q^*\left(w,\frac{w}{h}\right) + \frac{1}{h}\frac{\partial}{\partial\rho}q^*\left(w,\frac{w}{h}\right)\right) = 0$$

Hence, the monopolist union solves

$$q^*\left(\hat{w}_A,\frac{\hat{w}_A}{h}\right) - \hat{w}_A\left(\frac{\partial}{\partial w}q^*\left(\hat{w}_A,\frac{\hat{w}_A}{h}\right) + \frac{1}{h}\frac{\partial}{\partial\rho}q^*\left(\hat{w}_A,\frac{\hat{w}_A}{h}\right)\right) = 0 \tag{16}$$

Direct comparison of equation (16) with equations (14) and (15) leads to the following result:

PROPOSITION 7. *The wage set by the monopolist union is equal in the dispersed configuration, in the duopoly and in the non-observable-entry case of the asymmetric configuration.*

Therefore, we can conclude that labour-market institutions do not affect the incentives for vertical integration – rather the absence of these incentives – in the three cases studied above.

Unfortunately, if the intermediate-market entry is observable it is not possible to calculate a close-form solution for the monopolist problem of the asymmetric configuration. Thus, it is not possible to calculate the equilibrium labour demands of the three firms and in turn one cannot determine explicitly the wage chosen by a monopolist union. However, the wage-setting institution is not relevant in determining the qualitative features of the equilibrium of Proposition 5. In fact, in the proof of Lemma 1 – which is the basis for the proof of Proposition 5 – the one-wage result is used but the actual wage level and hence the wage-setting institution is not relevant provided the wage level does not drive any firm out of the market. Therefore, the results of this paper are robust with respect to the wage-setting institution.

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