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A simple model of anticompetitive vertical integration*

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Abstract

The result of neutrality of vertical integration for competition postulated by the Chicago School can be supported by a benchmark model with (1) an upstream monopolist, (2) homogeneous goods downstream and (3) observable (two-part tariff) contracts. The result does not hold however, whenever any of the three assumptions is relaxed. In this paper we show first, that in presence of an alternative supply, vertical integration is profitable and leads to anticompetitive market foreclosure; second, under product differentiation, inefficient alternative supplies make vertical integration welfare improving, whereas it is profitable only for efficient enough second source supplies. As a consequence, a clear prescription for antitrust emerges: we should not allow for vertical integration.

J.E.L codes: L22, K21, D4

Keywords: Vertical integration, market foreclosure, two-part tariff contracts.

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1. Introduction

There has been a long debate on the competitive effects of vertical integration. One of the central issues in the debate involves vertical foreclosure: the vertical integrated firm may have an incentive not to to supply the input to the non-integrated downstream rivals or, at least, to worsen the supply conditions for those firms. The traditional market foreclosure theory, which was accepted in leading court cases in the 1950s through the 1970s, viewed vertical mergers as harming competition by denying competitors access to either a supplier or a buyer (Chen, 2001). This informal version of the foreclosure theory was criticized by The Chicago School. They revealed the logical flaws of the traditional theory and argued that a vertical integrated firm have no incentive to exclude its rivals and, if it did try to exclude them, rivals could protect themselves by contracting with other unintegrated firms. They subsequently defended that vertical integration was most likely to be pro-competitive or competitive neutral.(e.g., Bork, 1978 and Posner 1976). Their criticism had a major influence on antitrust activities and was largely responsible in the 1970s and 1980s for the dormancy of antitrust enforcement with vertical elements (Riordan, 1998).

The idea of neutrality of vertical integration can be supported by a benchmark model with an upstream monopolist, homogeneous goods downstream and two-part tariff observable supply contracts. In this case, both the integrated and disintegrated structures lead to full monopolization.

In a very influential paper, Rey and Tirole (1999) show, among other things, that the result of neutrality of vertical integration does not hold if we relax the assumption of observable contracts. Under secret contracts (and passive conjectures) the upstream firm cannot commit to restrict supplies to competitors, being unable to get the monopoly profits. This commitment capacity is restored by vertical integration.

In the present paper, we show that vertical integration is not neutral for competition whenever any of the other two assumptions of the benchmark model are relaxed. In particular, the result does not hold if we have either a second source supplier and/or differentiated goods. Interestingly, in the former case vertical integration is shown to be anticompetitive whereas under differentiated goods, whenever the alternative supply is not very efficient, it may increase social welfare.

With a second source supplier and homogeneous goods, in the disintegrated case the upstream firm has an incentive to stimulate market competition by setting low wholesale prices, in order to reduce the profits that downstream firms can attain using the second source supplier. Under vertical integration however, the upstream division of the integrated firm has an incentive to increase the wholesale price to supply the remaining independent downstream firms in order to reduce market competition as much as possible, protecting in that way its subsidiary's market profits.[1]As a consequence, vertical integration becomes profitable for the merging partners and welfare reducing.

By adding product differentiation, the incentive of the integrated firm to (partially) foreclose rival downstream firms is attenuated both because consumers value variety and because competition is less intense given that the goods are differentiated. In this framework, we show that only efficient enough alternative supplies make vertical integration profitable for the merging partners whereas for inefficient enough second source supplies a vertical merger becomes welfare improving. Thus, if we consider that the antitrust authorities can approve or reject only mergers that are proposed by the merging partners (i.e., profitable mergers), a clear prescription emerges. In our context, vertical mergers should not be allowed.

There is a nice policy application of the model to the network industries. In particular, to the discussion on whether the owner of the network should be allowed to participate in the competitive activities or, on the contrary, it should be forced to divest from its subsidiary. Our model suggest that vertical separation should be always enforced.

Our paper can be placed in the so called the *new* market foreclosure theory. Following the Chicago School criticism, this new school of thought attempts to place vertical foreclosure theory on a firmer theoretical ground with game theoretic foundations (Choi and Yi, 2000).

[1] This result has the flavour of the foreclosure tradition in that the profitability of vertical integration comes from the fact that the remaining downstream firms are supplied at a higher price, which has the effect of increasing the share of downstream profits that the vertical structure may extract. The main difference is that we obtain the result without imposing that the vertical structure commits not to supply independent downstream firms.

Among the most influential papers Ordover, Saloner and Salop (1990) present a successive oligopoly game that includes the possibility of a countermerger by the foreclosed firm and the holdout incentives that the target upstream firm may have in the acquisition process. Their model however, has been criticized because in order for foreclosure to be an equilibrium they need that the merged firm is able to commit not to compete aggressively with the remaining unintegrated supplier to supply the other downstream firms. That is, it is supposed to be an Stackelberg price leader, changing the nature of the input pricing game.

On the other hand, in Salinger (1988) market foreclosure is also obtained as an equilibrium outcome of a successive oligopoly game. The result is obtained by assuming that integrated firms commit not to supply the remaining unintegrated downstream firms.[2]

More recently, some authors obtain market foreclosure as a consequence of a technological decision made by integrated firms regarding the use of a specific, non-standard input that commits those firms not to supply the remaining unintegrated downstream firms (See Choi and Yi (2000), Avenel (2000) and Church and Gandal (2000).

It is interesting to notice the strong analogy between our model and the patent licensing literature. In particular, the problem faced by the integrated firm is akin to that of an internal to the industry patentee who licenses a cost reducing innovation to rival firms (see Faulí-Oller and Sandonís (2002b)). On the other hand, the case of the disintegrated upstream firm resembles that of an external patentee (for an application of this model to the patent licensing literature see Sandonís and Faulí-Oller (2002)).

The rest of the paper is organized as follows. Next section is devoted to analyze the case of homogeneous goods with an alternative supply. Section 3 deals with product differentiation. Section 4 discusses the competitive effects of vertical integration. We conclude in section 5.

2. Homogeneous goods with an alternative supply

We consider an upstream firm, denoted by U, that produces an input at cost c_u and two downstream firms, denoted by $D_i, i = 1, 2$, that transform the intermediate good into an

[2] Other important contributions are Bolton and Whinston (1993) and Hart and Tirole (1990)

homogeneous final one on a one-for-one basis and at zero marginal cost. There also exists an alternative second source (competitive) supply of the input at a price equal to c. Inverse demand for the final good is given by $P = a - bQ$, where $a > c \geq c_u$. We are going to compare in terms of profits and social welfare the case in which the firms remain independent and the one in which firms U and one of the downstream firms (say firm 1) decide to merge. We start by the first scenario.

2.1. The disintegrated case

The timing of the game is the following: in the first stage firm U offers two-part tariff supply contracts to downstream firms. In the second stage they decide whether to accept or reject the contract. Finally, both firms compete à la Cournot in the final market. We look for the subgame perfect Nash equilibrium of the proposed game, solving it by backward induction. A contract offered to firm i includes a fixed fee f_i and a per unit charge w_i. We do not consider negative fixed fees.

If both firms accept the contract, in the third stage the equilibrium outputs and market profits are given by:

$$q_i(w_i, w_j) = \max\{\min\{\frac{a - w_i}{2b}, \frac{a - 2w_i + w_j}{3b}\}, 0\}, i, j = 1, 2, i \neq j,$$
$$\pi_i(w_i, w_j) = bq_i^2.$$

In order to obtain the equilibrium if firm i has not accepted the contract, one has to replace w_i by c in the expressions above.

In the second stage, firm i accepts the contract whenever $f_i \leq \pi_i(w_i, g_j) - \pi_i(c, g_j)$, where $g_j = w_j$ if firm j accepts and $g_j = c$ otherwise. In the first stage firm U designs the supply contracts taking into account that it is never optimal that a downstream firm is supplied by the competitive market. Therefore, it will set a pair of contracts that will be accepted by both firms, in order to maximize:

$$Max_{w_i,f_i}\ \sum_{i=1}^{2}\{(w_i-c_u)q_i(w_i,w_j)+f_i\}$$
$$s.t.\ 0\le f_i\le \pi_i(w_i,w_j)-\pi_i(c,w_j),\ i,j=1,2,\ i\neq j.$$

Observe that the restriction that f_i cannot be negative implies that $w_i \le c$. On the other hand, the right hand side of the constraint implies that both firms accept the contract.[3]

As it is in firm U's interest to charge as high an f_i as possible, the right hand side of the constraint is binding and the previous maximization program can be rewritten as follows:

$$Max_{w_i}\sum_{i=1}^{2}\{(w_i-c_u)q_i(w_i,w_j)+\pi_i(w_i,w_j)-\pi_i(c,w_j)\},$$
$$s.t.\ w_i\le c,\ i,j=1,2,\ i\neq j.$$

Solving the maximization program we obtain the following result[4].

Proposition 2.1. *The optimal contracts are given by:*

$$w_1^*=w_2^*=w^*=\min\{\tfrac{4c+3c_u-a}{6},\ \tfrac{a+3c_u}{4}\},$$
$$f_1^*=f_2^*=f^*=\pi_i(w^*,w^*)-\pi_i(c,w^*).$$

Observe that the upstream firm faces a maximization program which is composed of market profits minus the external options of downstream firms. Solving that program involves the balance of two opposite effects: by increasing the wholesale prices market profits increase but, at the same time, the profits to be obtained by downstream firms by using competitive supply ($\pi_i(c,w_j)$, $i=1,2$) also increase. The balance of the two effects leads to

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[3]Given that $\dfrac{\partial^2\pi_i}{\partial w_i\partial w_j}<0$, we have that $\pi_i(w_i,c)-\pi_i(c,c)>\pi_i(w_i,w_j)-\pi_i(c,w_j)$. Then, the constraint $f_i\le\pi_i(w_i,w_j)-\pi_i(c,w_j)$ implies that the only equilibrium in the second stage is that both firms accept the contract.

[4]The only situation we have not excluded as optimal is the one in which firm U offers two contracts such that only one firm accepts and the other does not produce. However, this situation is equivalent to another where the firm that was not producing is offered a contract including a zero fixed fee and the lowest wholesale price that keeps that firm out of the market. But those contracts are already considered in the maximization program we solve.

an optimal wholesale price that falls short of the one that would maximize market profits ($w^* = \dfrac{a+3c_u}{4}$), except when the competitive supply is so inefficient ($c \geq \dfrac{5a+3c_u}{8}$) that would lead downstream firms to get zero profits if supplied by it.[5] In this case, the maximization problem would imply maximizing market profits and then the upstream firm could obtain the full monopoly profits.

2.2. The integrated case

Next, we analyze the case where the upstream firm is vertically integrated with firm 1. In this case, the timing of the game is as follows: first, the integrated firm $U-D_1$ offers a supply contract to downstream firm 2. In the second stage this firm decides whether to accept or reject the contract. Finally, both firms compete à la Cournot in the final market.

The third stage equilibrium outputs and profits are given by the same expressions as in the disintegrated case where we replace w_1 by c_u. In the second stage, firm 2 accepts the contract whenever $f_2 \leq \pi_2(w_2, c_u) - \pi_2(c, c_u)$.

In the first stage, the integrated firm chooses the contract to maximize:

$$\begin{aligned} &Max_{w_2,f_2}\{\pi_1(c_u, w_2) + (w_2 - c_u)q_2(w_2, c_u) + f_2\} \\ &s.t.\ 0 \leq f_2 \leq \pi_2(w_2, c_u) - \pi_2(c, c_u). \end{aligned}$$

As the right hand side of the constraint is binding in equilibrium, the previous maximization program can be rewritten as follows:

$$\begin{aligned} &Max_{w_2}\{\pi_1(c_u, w_2) + (w_2 - c_u)q_2(w_2, c_u) + \pi_2(w_2, c_u) - \pi_2(c, c_u)\} \\ &s.t.\ w_2 \leq c. \end{aligned}$$

[5] Observe first that the incentive to reduce the outside option of downstream firms may lead firm U to charge a wholesale price lower than its marginal cost c_u. This does not lead to negative profits given that it charges a fixed fee. Second, the optimal wholesale price is strictly lower than c, which implies that the constraint of non-negative fees is never binding.

Proposition 2.2. *The optimal contract is given by:*

$$w_2 = c,\ \ f_2 = 0.$$

From the maximization problem we can see that the wholesale price is set to just maximize market profits because the profits obtained by firm 2 when using the competitive supply do not depend on w_2. Then, the vertically integrated firm tries to reduce competition as much as possible, which explains the result in the above proposition. Observe that if $c \geq \frac{a+c_u}{2}$ we have $\pi_2(c, c_u) = 0$ and then, the vertically integrated firm obtains the full monopoly profits[6]. Note that this occurs for lower values of c than in the disintegrated case, which implies that within the interval $[\frac{a+c_u}{2}, \frac{5a+3c_u}{8})$, vertical integration increases the joint profits of firm U and firm 1. Below we show that the result also holds for lower values of c. We also show that the increase in market profits directly corresponds with a decrease in social welfare.

Proposition 2.3. *Vertical integration is profitable and reduces social welfare.*

Proof. In order to prove the result we first evaluate the difference in social welfare (measured as the sum of consumer surplus and market profits) between the disintegrated case and vertical integration. For $c \in [c_u, \frac{a+c_u}{2})$, the difference amounts to $\frac{(a-c)(5a+7c-12c_u)}{162b}$ which is positive. For $c \in [\frac{a+c_u}{2}, \frac{5a+3c_u}{8})$ it is also positive because the difference is decreasing in c and it amounts to zero when $c = \frac{5a+3c_u}{8}$. Finally, for $c \geq \frac{5a+3c_u}{8}$ the difference amounts to zero because in both cases we have the monopoly outcome.

As far as profits are concerned, for $c \in [c_u, \frac{a+c_u}{2}\ ]$ the difference is negative given that it is negative in the extremes of the interval and the difference is strictly convex in c. For $c \in (\frac{a+c_u}{2}, \frac{5a+3c_u}{8})$ the profits are higher for the case of vertical integration given that in this case the monopoly situation is attained while it is not in the disintegrated case. Lastly, for $c \geq \frac{5a+3c_u}{8}$ both cases yield the monopoly profits. ■

[6]This threshold value of c bounds the difference in marginal costs $(c - c_u)$ usually called "drastic" in the patent licensing literature.

In our model, analyzing the evolution of price is sufficient to know the effect on welfare given that goods are produced efficiently. Vertical integration reduces welfare because it increases the price paid by consumers. In the disintegrated case firm U stimulates market competition by reducing the wholesale prices charged to downstream firms in order to reduce their share of market profits. Under vertical integration, however, in order to protect its subsidiary's profits the integrated firm reduces competition as much as possible by reducing supplies to firm 2 up to the quantity it would buy anyway from the competitive supply. In other words, it raises the wholesale price up to the level of the competitive supply, producing what Salinger (1988) defines as market foreclosure.

3. Product differentiation with an alternative supply

In this section, we consider the case in which downstream firms sell differentiated goods to show that this characteristic may be crucial to determine the competitive effects of vertical integration. As we will see below, introducing product differentiation opens the possibility that vertical integration increases welfare.

Under product differentiation, we assume that downstream firm i sells good i whose demand is given by:

$$p_i = 1 - q_i - \gamma q_j, i, j = 1, 2, i \neq j,$$

where $\gamma \in [0, 1]$ represents the degree of product differentiation. These demands are derived from the maximization problem of a representative consumer (see Singh and Vives (1984)), endowed with a utility function separable in money (denoted by m) given by:

$$u(q_1, q_2) = q_1 + q_2 - \frac{q_1^2}{2} - \frac{q_2^2}{2} - \gamma q_1 q_2 + m.$$

Let us define the social welfare function by:

$$W(q_1,q_2) = u(q_1, q_2) - c_u(q_1 + q_2).$$

We are going to follow the same steps as in the previous section, namely, we successively analyze the cases of vertical separation and vertical integration and then proceed to compare them in terms of profits and welfare.

We directly start with the first scenario.

3.1. The disintegrated case

If both firms accept the contract, in the third stage the equilibrium outputs and market profits are given by:

$$q_i(w_i, w_j) = \max\{\min\{\frac{1-w_i}{2}, \frac{(2-\gamma)-2w_i+\gamma w_j}{4-\gamma^2}\}, 0\}, i, j = 1, 2, i \neq j,$$
$$\pi_i(w_i, w_j) = q_i^2.$$

In the second stage, firm i accepts the contract whenever $f_i \leq \pi_i(w_i, g_j) - \pi_i(c, g_j)$, where $g_j = w_j$ if firm j accepts and $g_j = c$ otherwise.

In the first stage of the game firm U set the contracts to maximize:

$$\begin{aligned} &Max_{w_i,f_i} \;\; \textstyle\sum_{i=1}^{2}\{(w_i - c_u)q_i(w_i, w_j) + f_i\} \\ &s.t. 0 \leq \;\; f_i \leq \pi_i(w_i, w_j) - \pi_i(c, w_j), \;\; i, j = 1, 2, \;\; i \neq j. \end{aligned}$$

As the right hand side of the constraint is binding in equilibrium, the previous maximization program can be rewritten as follows:

$$\begin{aligned} &Max_{w_i,f_i} \textstyle\sum_{i=1}^{2}\{(w_i - c_u)q_i(w_i, w_j) + \pi_i(w_i, w_j) - \pi_i(c, w_j)\}, \\ &s.t. \; w_i \leq c, \;\; i, j = 1, 2, \;\; i \neq j. \end{aligned}$$

Solving the maximization program we obtain the following result.

Proposition 3.1. *The optimal supply contracts are given by:*

$$\begin{aligned} &w_1^* = w_2^* = w^* = \min\{\frac{\gamma + c_u(2+\gamma)}{2(1+\gamma)}, \frac{c_u(2-\gamma)^2 + \gamma(4c - \gamma(2-\gamma))}{2(4-2\gamma^2+\gamma^3)}\}, \\ &f_1^* = f_2^* = f^* = \pi_i(w^*, w^*) - \pi_i(c, w^*). \end{aligned}$$

As in the model with homogeneous goods, the maximization program involves the balance of two opposite effects, leading to an optimal wholesale price lower than the one that would maximize market profits ($w^* = \dfrac{\gamma + c_u(2+\gamma)}{2(1+\gamma)}$), except when the competitive supply is so inefficient ($c \geq \dfrac{4 + 2\gamma(1+c_u) - \gamma^2(1-c_u)}{4(1+\gamma)} = c^M$) that any downstream firm would get zero profits when using the competitive supply. In this case, the maximization problem implies maximizing market profits and the upstream firm can obtain the full monopoly profits.

Finally, let us compute the equilibrium profits obtained by the upstream firm and downstream firms, which will be useful to study the profitability of vertical integration. They are given respectively by[7]:

$$\Pi_u = w^*(q_1(w^*, w^*) + q_2(w^*, w^*)) + 2f^*,$$
$$\Pi_1 = \Pi_2 = \pi_1(w^*, w^*) - f^*.$$

3.2. The integrated case

The third stage equilibrium outputs and profits are given by the same expressions as in the disintegrated case where we replace w_1 by c_u. In the second stage, firm 2 accepts the contract whenever $f_2 \leq \pi_2(w_2, c_u) - \pi_2(c, c_u)$.

In the first stage the vertically integrated firm looks for the contract to be offered to firm 2 in order to maximize:

$$Max_{w_2, f_2}\{\pi_1(c_u, w_2) + (w_2 - c_u)q_2(w_2, c_u) + f_2\}$$
$$s.t.\ f_2 \leq \pi_2(w_2, c_u) - \pi_2(c, c_u).$$

As the restriction is binding in equilibrium, the previous maximization program can be rewritten as follows:

$$Max_{w_2}\{\pi_1(c_u, w_2) + (w_2 - c_u)q_2(w_2, c_u) + \pi_2(w_2, c_u) - \pi_2(c, c_u)\},$$
$$s.t. \qquad w_2 \leq c.$$

Next proposition gives us the optimal contract.

[7] Actual expressions are relegated to Appendix A

Proposition 3.2. *The optimal contract is given by:*

$$w_2^* = \min\{c, \frac{\gamma(2-\gamma)^2 + c_u(8-4\gamma-2\gamma^2-\gamma^3)}{2(4-3\gamma^2)}\},\ f_2^* = \pi_2(w_2^*, c_u) - \pi_2(c, c_u).$$

Notice first, that contrary to what happened in the homogeneous goods case, with differentiated goods the optimal wholesale price w_2^* may be lower than c for high values of this parameter (unrestricted case). The reason is that the integrated firm is now interested in supplying the competitor because the revenues obtained in market two compensates the integrated firm from the increase in market competition.[8] For low values of c, in the integrated case the upstream firm is constrained to set $w_2^* = c$, whereas in the disintegrated case however, we saw that the optimal wholesale prices are always below c. Second, we have that vertical integration increases the wholesale price paid by firm 2 ($w_2^* > w^*$). We call this phenomenon partial market foreclosure and it is the main anticompetitive effect of vertical integration.

Finally, we can compute the profits of the integrated firm. They are given by (actual expressions can be seen in Appendix A):

$$\Pi_{u1} = \pi_1(c_u, w_2^*) + w_2^* q_2(w_2^*, c_u) + \pi_2(w_2^*, c_u) - \pi_2(c, c_u).$$

4. The competitive effects of vertical integration

Next, we proceed to analyze the profitability of vertical integration as well as its effect on social welfare, with the aim to derive the optimal competition policy.

Regarding profitability we have to sign the difference between the profits of the integrated firm and the sum of the profits of the upstream firm and firm 1, namely, the sign of $\Pi_{u1} - (\Pi_1 + \Pi_u)$. We obtain the following result:

[8] This is true even for the case in which c is so high that $\pi_2(c, c_u) = 0$, that is, when the cost difference between the merged firm and firm 2 is "drastic" according to the classical meaning of the word from the patent licensing literature. This happens for $c \geq c^N = \frac{2-\gamma(1-c_u)}{2}$. In other words, the merged firm prefers a duopoly to a monopoly in its market.

Proposition 4.1. *Vertical integration is profitable whenever the alternative supply is not very inefficient, namely, when* $c \leq c_1$.

Proof. See Appendix B.

In order to grasp the main intuition of the proposition it is useful to discuss what happens when the alternative supply is so inefficient that the external option of downstream firms in the disintegrated case becomes zero. In this case, the upstream firm maximizes market profits by choosing two instruments (one contract for each firm), which allows the upstream firm to implement the monopoly outcome and get the monopoly profits. As the integrated firm is not able to implement the monopoly outcome given that it can only use one instrument (a contract for firm 2), a vertical merger between the upstream firm and firm 1 cannot be profitable.

When the alternative supply is not so inefficient, the comparison is not clear because a trade-off arises. Now, in the disintegrated case the upstream firm also cares about the profits that downstream firms can obtain when rejecting the contracts, namely, their external options. The size of the external option effect is decreasing in c. Thus, when the alternative supply is efficient enough the objective of the upstream firm is so distorted from profit maximization that, in spite of its lower flexibility, vertical integration becomes profitable.

Observe that we can extend the result in the above proposition to the case of homogeneous goods just by setting $\gamma = 1$. In that case, we get $c_1 = c^M$. This implies that vertical integration cannot be unprofitable because for $c > c^M$ we know that in both the integrated and disintegrated cases the monopoly outcome arises. Therefore, the result of the first section, namely, that vertical integration is profitable for the merging partners naturally emerges as a particular case of this more general case.

One implication of the result that for inefficient alternative supplies vertical integration becomes unprofitable is that the vertically integrated firm would find profitable to divest from its subsidiary firm. Although this may seem surprising, Rey and Tirole (1999) report the case of AT&T's 1995 voluntary divestiture of its manufacturing arm, AT&T (now Lucent) Technology, that took place when an increase in downstream market competition was expected. Observe that the divestiture can be explained in terms of our model as a commitment to treat all downstream firms equally in order to restrict the sales of its subsidiary.

So far we have analyzed the private incentives of firms for vertical integration. Given that any merger has to be approved by the competition authorities, it is very useful to know the effect of a vertical merger on social welfare. This is done in the next proposition.

Proposition 4.2. *A vertical merger is welfare improving whenever the alternative supply is not very efficient, namely, when $c > c_2$.*

Proof. See appendix B.

Vertical integration increases the wholesale price paid by firm 2 ($w_2^* > w^*$). This is the negative welfare effect of a vertical merger. There is however, a positive effect in that the subsidiary firm 1 is "supplied" at marginal cost c_u whereas, in the disintegrated case, it faces a wholesale price (w^*) higher than c_u. Whereas the positive effect of vertical integration ($w^* - c_u$) is increasing in c, the negative one ($w_2^* - w^*$) is decreasing in c[9]. This explains that for high values of c vertical integration turns out to be welfare improving.

We can also extend the result in the above proposition to the case of homogeneous goods just by setting $\gamma = 1$. In that case, we get $c_2 = c^M$. This implies that vertical integration cannot be welfare improving because for $c > c^M$ we know that in both the integrated and disintegrated cases the monopoly outcome arises. Again, the result of the first section naturally emerges as a particular case of this more general case.

In the particular case where the alternative supply is so inefficient that it is not a real option for downstream firms, we know from the above proposition that a vertical merger would increase welfare. There is a nice application of this result to horizontal merger policy by considering that a licensing contract and a merger are two substitutive instruments to transfer technologies. Assume we have a duopoly where one of the firms owns a patented process innovation. This firm could either license the technology to its competitor or to take

[9] Notice that this is not the case when $w^* = c$ (the restricted case) but, in this case, vertical integration is always welfare reducing.

the rival over. The licensing option is equivalent in that model to our integrated case whereas the merger option leads to the same market outcome as the disintegrated case whenever the innovation is drastic. Faulí-Oller and Sandonís (2002 a) obtain the counterpart of the result of Proposition 4.2 applied to the case of very inefficient alternative supplies, by showing that licensing is welfare superior to a merger.

If we consider that the antitrust authorities can approve or reject only mergers that are proposed by the merging partners (i.e., profitable mergers), in order to derive the optimal competition policy we have to combine the above proposition on welfare with the previous result on profitability.

It is direct to see that $c_2 > c_1$, which means that profitable vertical mergers are never welfare improving. Thus, the following corollary emerges:

Corollary 4.3. *The antitrust authority should forbid any vertical merger.*

Observe that it is possible that some unprofitable mergers increase welfare. However, compulsory action or subsidies to carry them through would go against the normal practices of antitrust policy.

5. Conclusions

In the present work we have shown that, contrary to the Chicago School arguments on the neutrality of vertical integration, a vertical merger affects competition whenever the upstream firm is not a bottleneck monopolist and the input can be also supplied by an alternative (competitive) supplier. In our two different frameworks vertical integration leads the integrated firm to worsen the supply conditions of the remaining non-integrated firms. This phenomenon is known in the literature as (partial) market foreclosure in the sense that the integrated firm reduces supplies to downstream competitors. However, whereas under homogeneous goods we obtain that vertical integration is always profitable and welfare reducing, under differentiated goods things are not so clear. The good news of vertical integration for welfare come from the fact that the integrated firm loses its commitment capacity to restrict own output, as it cannot credibly increase the marginal cost of its subsidiary firm, whereas in the disintegrated firm it could charge a high wholesale price to each downstream firm. On the other hand, given that under product differentiation competition is not so intense and that consumers value variety, the integrated firm is always interested in supplying the remaining unintegrated downstream firm a positive amount of output, charging a lower wholesale price in the contract than in the case of homogeneous goods. As a consequence, we show that a threshold value for the efficiency parameter of the alternative supply (c) always exists such that above that value a vertical merger becomes welfare improving. If we consider that the antitrust authorities can approve or reject only mergers that are proposed by the merging partners (i.e., profitable mergers),.in order to derive the optimal competition policy we had to analyze also profitability of vertical mergers.

Interestingly, under product differentiation only efficient enough alternative supplies make a vertical merger profitable. The intuition is as follows: vertical integration tends to be profitable because the integrated firm completely internalizes market profits whereas the disintegrated firm is also concerned about the external options of downstream firms, that is, the profits they get when supplied by the alternative suplier. These external options tend to zero as the alternative supply is more inefficient. Therefore, for inefficient alternative supplies the disintegrated upstream firm is also maximizing market profits, but it can do it using two instruments (one contract for each downstream firm) whereas the integrated firm can only use one instrument (a contract for firm 2). As a consequence, for inefficient alternative supplies a vertical merger cannot be profitable.

As we show in the paper, profitable mergers are always welfare reducing or, in other words, welfare improving vertical mergers are never profitable for the merging partners. Thus, if we consider that compulsory action or subsidies to carry vertical mergers through would go against the normal practices of antitrust policy, we can derive a clear prescription: vertical mergers should never be allowed in our context.

Our results have been obtained under two-part tariff contracts. This assumption turns out to be crucial for our results. In particular, solving the two models for the case of contracts including only a per unit charge, we obtain the standard, well known result that, given that it eliminates double marginalization, vertical integration is profitable and welfare improving.

Another possibility is to extend the model to price competition. This extension is straightforward for the case of differentiated goods without an alternative supply, where the same result is obtained that vertical integration reduces profits and increases welfare (in fact, this is a direct application of Proposition 1 in Faulí-Oller and Sandonís (2002a)). Introducing price competition in the model with an alternative supply is more complicated, and prevents us from getting explicit results. We are able, however, to obtain the basic intuitions of the model through some simulations. We characterize the results on welfare depending on the efficiency of the alternative supply (c). For high enough values of c, we obtain the same result as in the case without alternative supply, namely, that vertical integration is welfare improving. For intermediate values of c we get the same result as in the model with an alternative supply, namely, vertical integration reduces welfare. Finally, for low values of c, the upstream firm is constrained to choose the wholesale prices equal to c in both the integrated and the disintegrated case. Therefore, we have a symmetric duopoly with cost c in the disintegrated case whereas in the integrated case we have an asymmetric duopoly with the integrated firm producing efficiently. This implies that welfare is higher under vertical integration.

6. Appendix

6.1. Appendix A

In the disintegrated case, the upstream and downstream firms' equilibrium profits are given respectively by:

If $c \leq c^M$,

$$\Pi_u = \frac{1}{2(2+\gamma)^2(4-2\gamma^2+\gamma^3)} \begin{pmatrix} \gamma^4 - 16c^2(1+\gamma) + 8c(4+2\gamma-\gamma^2) + c_u^2(4-\gamma^2)^2 + \\ +8c_u c(2\gamma+\gamma^2) - 2c_u(16+8\gamma-4\gamma^2+\gamma^4) \end{pmatrix},$$

$$\Pi_1 = \Pi_2 = \frac{(2-\gamma)^2(4c(1+\gamma)-\gamma c_u(2+\gamma)-4-2\gamma+\gamma^2)^2}{4(2+\gamma)^2(4-2\gamma^2+\gamma^3)^2}.$$

If $c > c^M$,

$$\Pi_U = \frac{1-c_u}{2(1+\gamma)},$$
$$\Pi_1 = \Pi_2 = 0,$$

where $c^M = \dfrac{4+2\gamma(1+c_u)-\gamma^2(1-c_u)}{4(1+\gamma)}$.

The integrated firm's equilibrium profits are given by:

If $c \leq c_r$, then

$$\Pi_{u1} = \frac{(2-\gamma)^2 + c^2(-8+3\gamma^2)+c(8-4\gamma^2+\gamma^3)}{(4-\gamma^2)^2}.$$

If $c_r < c \leq c^N$, then

$$\Pi_{U1} = \frac{\begin{array}{c}-16c(2+\gamma(-1+c_u))(-4+3\gamma^2)+(2-\gamma)^2(16-8\gamma^2-4\gamma^3+\gamma^4)+ \\ +16c^2(-4+3\gamma^2)-2c_u(128-96\gamma-64\gamma^2+40\gamma^3+12\gamma^4-8\gamma^5+\gamma^6)+ \\ +c_u^2(128-128\gamma-64\gamma^2+64\gamma^3+12\gamma^4-8\gamma^5+\gamma^6)\end{array}}{4(4-\gamma^2)^2(4-3\gamma^2)}.$$

Finally, if $c > c^N$, then $\Pi_{U1} = \dfrac{(1-c_u)^2(8-8\gamma+\gamma^2)}{4(4-3\gamma^2)}$,

where $c_r = \dfrac{\gamma(2-\gamma)^2+c_u(8-4\gamma-2\gamma^2-\gamma^3)}{2(4-3\gamma^2)}$ and $c^N = \dfrac{2-\gamma(1-c_u)}{2}$.

6.2. Appendix B

Proof of Proposition 4.1

For $c \geq c^M$, the external option of the licensees when the laboratory is external to the industry becomes zero, which implies that the laboratory maximizes market profits by choosing two instruments (one contract for each firm). This allows the laboratory to implement the monopoly outcome and get the monopoly profits. As the internal patentee is not able to implement monopoly given that he can only use one instrument (a contract for firm 2), a merger between the laboratory and firm 1 cannot be profitable.

For $c^N \leq c < c^M$, the difference[10] $\Pi_{U1} - (\Pi_1 + \Pi_U)$ is a concave function of c with two roots c^+ and c^-. We have that $c^+ > c^M$ and $c^N \leq c^- < c^M$ whenever $\gamma \geq 0.94$ and $c^- < c^N$ whenever $\gamma < 0.94$. Therefore, a vertical merger is profitable in this region only when $\gamma \geq 0.94$ and $c < c^-$, where

$$c^- = \frac{\begin{array}{c} -64 - 32\gamma - 32c_u\gamma + 80\gamma^2 - 16c_u\gamma^2 + 16\gamma^3 + 32c_u\gamma^3 - 36\gamma^4 + \\ +8c_u\gamma^4 + 10\gamma^5 - 10c_u\gamma^5 + 9\gamma^6 + 3c_u\gamma^6 - 3\gamma^7 + 3c_u\gamma^7 + \\ +(1-c_u)\gamma(8 + 4\gamma - 4\gamma^2 + \gamma^4)\sqrt{16 - 16\gamma - 16\gamma^2 + 20\gamma^3 - \gamma^4 - 6\gamma^5 + 3\gamma^6} \end{array}}{4(-16 - 16\gamma + 16\gamma^2 + 12\gamma^3 - 7\gamma^4 + 3\gamma^6)}.$$

.

For $c_r \leq c < c^N$, the difference $\Pi_{U1} - (\Pi_1 + \Pi_U)$ is a convex function of c with two roots $\widetilde{c}$ and $\widehat{c}$. We have that $\widetilde{c} < c_r$ and $c_r < \widehat{c} \leq c^N$ whenever $\gamma \leq 0.94$. For $\gamma > 0.94$, we have that $\widehat{c} > c^N$. Therefore, a vertical merger is profitable in this region whenever $\gamma \leq 0.94$ and $c \leq \widehat{c}$, or when $\gamma > 0.94$, where

$$\widehat{c} = \frac{1}{4\gamma^2(-4+3\gamma^2)} \left(\begin{array}{c} 64 - 64c_u - 64\gamma + 64c_u\gamma - 64\gamma^2 + 48c_u\gamma^2 + 88\gamma^3 - 88c_u\gamma^3 - 8\gamma^4 + 20c_u\gamma^4 - \\ -26\gamma^5 + 26c_u\gamma^5 + 15\gamma^6 - 15c_u\gamma^6 - 3\gamma^7 + 3c_u\gamma^7 + (-16 + 16c_u + 16\gamma - 16c_u\gamma + \\ +4\gamma^2 - 4c_u\gamma^2 - 12\gamma^3 + 12c_u\gamma^3 + 6\gamma^4 - 6c_u\gamma^4 - \gamma^5 + c_u\gamma^5)\sqrt{16 - 20\gamma^2 + 6\gamma^4} \end{array} \right)$$

.

Finally, for $0 \leq c < c_r$, the difference $\Pi_{U1} - (\Pi_1 + \Pi_U)$ is a convex function of c with two roots c' and c''. We have that $c' < 0$ and $c'' > c_r$. Therefore, a merger between the laboratory and firm 1 is always profitable.

Summing up, the threshold value c_1 that appears in Proposition 4.1 is given by: $c_1 = \widehat{c}$ whenever $\gamma < 0.94$ and $c_1 = c^-$ otherwise.

[10] In this region the difference $\Pi_{u1} - (\Pi_1 + \Pi_U)$ is characterized by the fact that the outside option of firm 2 in the integrated case ($\pi_2(c, c_u)$) becomes zero, that is, the threshold value c^N bounds the region where the difference in marginal costs becomes "drastic".

Proof of Proposition 4.2.

If $c_r \leq c \leq c^M$, the difference between welfare under both the external and the internal scenarios is given by the expression:

$$W_n = \frac{\gamma}{8(2+\gamma)^2(4-3\gamma^2)(4-2\gamma^2+\gamma^3)^2}\left[\begin{array}{c} 256+64\gamma-384\gamma^2-16\gamma^3+192\gamma^4-16\gamma^5-32\gamma^6-2\gamma^7+2\gamma^8+ \\ +\gamma^9+32c^2\gamma(-4-4\gamma+3\gamma^2+3\gamma^3)-c_u^2(2+\gamma)^2(-64+16\gamma+ \\ +96\gamma^2-56\gamma^3-16\gamma^4+30\gamma^5-14\gamma^6+3\gamma^7)+2c_u(256+64\gamma- \\ -320\gamma^2-48\gamma^3+112\gamma^4+8\gamma^5-8\gamma^6-6\gamma^7-2\gamma^8+\gamma^9)+ \\ +16c(-4+3\gamma^2)(8-\gamma^2+\gamma^3+\gamma^4+c_u(2-\gamma)^2(2+3\gamma+\gamma^2)). \end{array}\right]$$

We have that W_n is a concave function of c with two roots c^+ and c^-. We have that $c^- < 0$ and $c_r < c^+ < c^M$. Therefore, a merger between the laboratory and firm 1 is welfare improving whenever $W_n \leq 0$. This holds when $c \geq c^+$, where

$$c^+ = \frac{1}{8\gamma(-4-4\gamma+3\gamma^2+3\gamma^3)}\left(\begin{array}{c} -\sqrt{-(1-c_u)^2(8+4\gamma-4\gamma^2+\gamma^4)^2(-32+16\gamma+36\gamma^2-16\gamma^3-9\gamma^4+3\gamma^5)} \\ \sqrt{2}+64-64c_u-32c_u\gamma-96\gamma^2+64c_u\gamma^2+8\gamma^3+16c_u\gamma^3+44\gamma^4- \\ -20c_u\gamma^4-6\gamma^5+c_u\gamma^5-6\gamma^6+6c_u\gamma^6 \end{array}\right).$$

When $c > c^M$, in the disintegrated case we have the monopoly outcome, whereas in the integrated case, outputs do not depend on c because the wholesale prices do not depend on c either. Therefore, the difference in welfare becomes constant in c and amounts to W_n evaluated in $c = c^M$. But we know from the analysis of the previous interval that a vertical merger is welfare improving at that point, which means that it is also welfare improving in the whole interval.

If $0 \leq c < c_r$, we have that the difference between welfare under both the disintegrated and integrated scenarios is given by the expression:

$$W_r = \frac{1}{4(2-\gamma)^2(2+\gamma)^2(4-2\gamma^2+\gamma^3)^2}\left(\begin{array}{c} (2-\gamma)^3\gamma^2(16-10\gamma^2+3\gamma^3+\gamma^4)+2c_u(2-\gamma)^2(-32+32\gamma-24\gamma^3+ \\ +16\gamma^4-4\gamma^5-\gamma^6+\gamma^7)+2c^2(64-144\gamma^2+32\gamma^3+88\gamma^4-48\gamma^5-8\gamma^6- \\ +12\gamma^7-3\gamma^8+c_u^2(384-512\gamma-96\gamma^2+384\gamma^3-160\gamma^4-16\gamma^5+ \\ +16\gamma^6+\gamma^8-\gamma^9)-4c(-128+128c_u+192\gamma-128c_u\gamma+96\gamma^2-128c_u\gamma^2 \\ -256\gamma^3+160c_u\gamma^3+56\gamma^4+92\gamma^5-60c_u\gamma^5-50\gamma^6+22c_u\gamma^6-2\gamma^7+ \\ +2c_u\gamma^7+6\gamma^8-2c_u\gamma^8-\gamma^9+(2-\gamma)^2(16-32\gamma^2+16\gamma^4-4\gamma^5-3\gamma^6+\gamma \end{array}\right.$$

In order to show that W_r is positive in the whole interval, it is sufficient to check first, that it is a quadratic, continuous function of c,which implies that it is either a convex or a concave function of c; second, that W_r is positive at both extremes of the interval. When W_r is a concave function of c both points imply that it is positive in the whole interval. When W_r is convex, we have additionally to check that its first derivative is positive at the origin of the interval, which completes the proof.

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