Upstream Horizontal Mergers and Efficiency Gains

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Abstract

We study horizontal mergers in upstream markets and their potential efficiency gains. We explore the incentives for such mergers, their impact on R&D investments, as well as the interaction in terms of welfare between their potentially efficiency-enhancing effects and their anti-competitive effects. We show that when trading takes place through two-part tariff contracts, an upstream horizontal merger can give rise to two distinct efficiency-enhancing effects. It can increase the R&D investments and decrease the wholesale prices. Most of the times, when firms merge usually both of these efficiencies are realized and thus the merger is pro-competitive. When firms trade using wholesale price contracts, upstream firms always merge. There are two opposite efficiency effects in place then. The merger increases the effective R&D investments but it also aggravates the severity of the double marginalization problem. Which of the two effects prevails for the merger's welfare impact depends mainly on the intensity of downstream competition.

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1 Introduction

Horizontal mergers occur very often and in almost all markets. Typically such mergers are seen with suspicion by the antitrust authorities as they can be used as a way to reduce competition and increase prices. Horizontal mergers, however, may also alter firms' investment decisions and by doing so they can lead to efficiency gains. Since the latter could dominate the mergers' anti-competitive effects, their analysis is of significant policy importance.[1]

Horizontal mergers in real world markets often take place among suppliers of intermediate products dealing with final product manufacturers or among wholesalers dealing respectively with retailers.[2] In other words, horizontal mergers often occur between firms that operate in the upstream markets of vertically related industries. A special characteristic of horizontal mergers in vertically related industries is that they affect competition not only at the market level in which they take place but also at the other market level by altering, among other things, the terms of their contracts. The latter in reality take a number of different forms. For instance, while some firms trade using simple linear wholesale price contracts, others trade through two-part tariff contracts.

In this paper, we study horizontal mergers in the upstream markets of vertically related industries when both the mergers and the upstream firms' R&D investments are endogenous. We address a number of questions such as: Do mergers lead to efficiency gains? Are they mainly motivated by increased market power or by cost-synergies? How do they influence the trading with the downstream firms? Can their potential cost-savings dominate their anti-competitive effects in terms of welfare? What is the role of the contract types used?

We construct a model in which there are initially two upstream and two downstream firms. The upstream firms invest in cost-reducing R&D and the downstream firms produce differentiated goods. A four stage game is analyzed. In the first stage, the upstream firms decide whether or not they will merge. If they merge then they form an upstream monopolist. In the second stage, the R&D investments are chosen by the upstream firm(s). In the following stage, if the merger has occurred then the newly formed upstream monopolist chooses its terms

[1] The potential efficiency gains of mergers have recently started to be taken into account by both the European and the U.S. antitrust authorities (see e.g., US Horizontal Merger Guidelines, 1997, EC Horizontal Merger Guidelines, 2004/03).

[2] See e.g., the mergers of car equipment suppliers (Kolben-schmidt/Pierburg, Valeo/Engel), chemical substances producers (BASF/Engelhard), mobile phones manufacturers (Sony/Ericsson)

of trade with each of the downstream firms. Otherwise, each of the two independent upstream firms chooses its terms of trade with its exclusive downstream customer. In the last stage, the downstream firms compete in quantities. We analyze this game under two different contractual forms, a wholesale price contract and a two-part tariff contract.

We demonstrate that when trading takes place through two-part tariff contracts, an upstream horizontal merger gives rise to two distinct efficiency-enhancing effects when the products are differentiated enough and thus the downstream competition is not too strong. It increases the effective R&D investments and it decreases the wholesale prices. The intuition for the former is that a merged firm in contrast to a separated one sells its products to two instead of one downstream firms. Thus, the output of a merged firm exceeds that of a separated firm. Since the merged firm has a larger output it has stronger incentives to reduce its cost and thus to invest in R&D. The decrease in the wholesale prices occurs for two reasons. The first reason is that the lower cost faced by the merged firm arising from its higher R&D investments allows is to charge lower wholesale prices. The second reason is that when an upstream firm increases the wholesale price it charges to one downstream firm the rival downstream firm's output increases. Under two-part tariff contracts the downstream production is subsidized. Hence, the increase in the rival downstream firm's output constitutes a negative externality for the merged firm. Internalizing this negative externality, the merged firm decreases its wholesale prices. We note that the opposite occurs when the products are close substitutes and the R&D investments of a merged firm are lower than those of a separated firm. However, we find that firms merge only when products are sufficiently differentiated. Therefore, when firms merge usually strong efficiency gains are realized.

When firms trade using wholesale price contracts, the upstream firms always merge. There are two opposite efficiency effects in place then. The merger always increases the effective R&D investments but it also aggravates the severity of the double marginalization problem by leading to higher wholesale prices when the products are close substitutes. Which of the two effects prevails in the analysis of the merger's welfare impact depends mainly on the degree of product substitutability. We find that the merger is welfare-detrimental when the products are close substitutes. This happens because the double marginalization problem is more severe then in the merger case.

The bulk of the industrial organization literature on horizontal mergers has mainly con-

sidered one-tier industries.[3] This has started to change recently with more and more papers studying horizontal mergers in vertically related industries. Most of these have focused on the analysis of downstream horizontal mergers (see e.g., von Ungern-Sternberg, 1996, Dobson and Waterson, 1997, Inderst and Wey, 2003, Lommerud et al., 2005, Fauli-Oller and Bru, 2008, Symeonidis, 2008). To the best of our knowledge the only papers on upstream horizontal mergers are those of Horn and Wolinsky (1988), Ziss (1995), O'Brien and Shaffer (2003), Inderst and Wey (2003) and Milliou and Petrakis (2007). With the exception of Inderst and Wey (2003) none of these papers has examined the potential efficiency gains of upstream horizontal mergers. In examining, among other things, how an upstream horizontal merger affects R&D investments, Inderst and Wey (2003) have considered a quite restrictive environment in which there is no downstream competition and only one of the upstream firms can undertake a fixed R&D investment. We extend this literature by considering instead a market characterized by oligopoly both upstream and downstream, as well as by considering a number of different scenarios regarding the contractual arrangements used among the vertically related firms and allowing for an endogenous level of R&D investments. By doing so, we contribute in the literature by providing an in depth analysis of the relationship between upstream horizontal mergers and efficiency gains.

The remainder of the paper is organized as follows. In Section 2, we present our model. In Section 3, we analyze the merger effects and the merger incentives when firms trade using wholesale price contracts. In Section 4, we analyze what happens when firms trade instead through two-part tariff contracts. In Section 5, we perform a welfare analysis as well as we draw some policy conclusions. In Section 6, we discuss a number of extensions of our model. We conclude in Section 7. All the proofs are relegated to the Appendix.

2 The Model

We consider a vertically related industry with two upstream and two downstream firms denoted respectively by U_i and D_i, with $i = 1, 2$. There is an exclusive relation between U_i and D_i. Each downstream firm D_i obtains an input from its exclusive upstream supplier U_i, transforms it into a final product in a one-to-one relation and sells it to the final consumers facing the

[3] For a review of the literature on horizontal mergers in one-tier industries and efficiency gains see Roller et al. (2001).

following (inverse) demand function:

$$p_i = a - q_i - \gamma q_j, \quad i \neq j, \quad i, j = 1, 2, \quad 0 \leq \gamma < 1,$$

where q_i and p_i are respectively the quantity and the price of D_i's final product and γ measures product substitutability. The higher is γ, the closer substitutes the products of D_i and D_j are.

The two upstream firms can merge or they can remain separated. If they remain separated then each independent upstream firm U_i faces a variable production cost given by $(c - x_i)q_i$, where x_i are its cost-reducing R&D investments and c, with $a > c > 0$, is an exogenous unit cost. In line with d'Aspremont and Jacquemin (1988) and many others, we assume that the R&D investments are subject to diminishing returns, captured by the quadratic form of their cost, $mx_i^2/2$, with $m > 0$. Clearly, the higher is m the lower is the efficiency of the R&D investments.

If the two upstream firms merge, a monopolist, denoted by U, is formed in the upstream market. U's variable production cost is given by $(c - x_U)(q_1 + q_2)$, with x_U denoting U's R&D investments. Note that we assume that U's R&D investments decrease the production cost of the inputs that it sells to both downstream firms, i.e., its R&D investments are not firm-specific.[4] Similarly to the case of separate upstream firms, the cost of the R&D investments of the upstream monopolist is $mx_U^2/2$.

Each D_i faces no other cost than the cost of obtaining the input from its upstream supplier. This cost takes the form of a per-unit of input wholesale price, w_i, when linear wholesale price contracts are used for trading between the upstream and the downstream firms. When instead non-linear two-part tariff contracts are used then the cost includes besides w_i a fixed fee, f_i, which constitutes a transfer from D_i to its respective upstream supplier.

Competitive interactions are modeled as a four-stage game with complete information. In stage one, the upstream firms decide whether or not to merge horizontally. As mentioned above, when they merge they form an upstream monopolist. In stage two, the upstream firm(s) choose the level of their R&D investments. In the following stage, stage three, the upstream firm(s) make take-it-or-leave-it offers to the downstream firms regarding their terms of trade. Finally, in stage four, the downstream firms compete in the final market in quantities. The

[4] Alternatively U could undertake firm-specific R&D investments, x_1 and x_2, such that its variable production cost is $(c-x_1)q_1+(c-x_2)q_2$. In our setting, U earns higher profits when its R&D investments are not firm-specific than when they are firm-specific.

solution concept that we apply is the subgame perfect Nash equilibrium.

The above timing captures the idea that firms' merger decisions are strategic decisions with "longer run" characteristics than their decisions regarding R&D investments. This is a standard assumption in the literature (see e.g., Inderst and Wey, 2003, Fauli-Oller et al., 2007). The above timing also reflects our assumption that investments are noncontractible. In other words, we embody the standard incomplete contracts framework that corresponds to assuming that the specific contract terms are set after the investment stage. A standard justification for this assumption is the difficulty of contractually specifying all aspects of performance (see e.g., Grossman and Hart, 1986, Hart and Moore, 1988, Klein, 1988, Segal, 1999).

It is important to note that when the upstream firms merge then in the third stage of the game, under both wholesale price and two-part tariff contracts, the upstream monopolist makes its contract offers to the two downstream firms simultaneously and separately. The upstream monopolist can price discriminate among the downstream firms. That is, U can offer different contract terms to the two downstream firms.[5]

In order to guarantee that all the firms are active in the market in all the cases under consideration we assume the following throughout the paper:[6]

Assumption 1: $m > 1$.

For notational reasons we use superscripts S and M to denote respectively the equilibrium values when the upstream firms have remained separated and when they have merged.

3 Wholesale Price Contracts

In this Section, we examine what happens when linear wholesale price contracts are used. In the last stage of the game, each D_i chooses its output in order to maximize its profits:

$$\max_{q_i} \Pi_{D_i} = (p_i - w_i)q_i = (a - q_i - \gamma q_j - w_i)q_i. \tag{1}$$

[5] In Section 6 we briefly discuss what could happen if price discrimination was not allowed.

[6] The same condition is sufficient for the existence of a pure strategy equilibrium when there is an upstream monopolist which trades through two-part tariff contracts. For the potential non-existence of such equilibrium see e.g., McAfee and Schwartz (1994), Rey and Verge (2004).

The first order conditions give rise to the following reaction functions:

$$R_i(q_j, w_i) = \frac{a - w_i - \gamma q_j}{2}. \tag{2}$$

As you can see, a decrease in the wholesale price faced by D_i shifts its reaction function upwards and turns it into a more aggressive competitor in the final market. Solving the system of reaction functions (2), we obtain the Cournot equilibrium quantities expressed in terms of the wholesale prices:

$$q_i(w_i, w_j) = \frac{(2-\gamma)a - 2w_i + \gamma w_j}{4 - \gamma^2}. \tag{3}$$

In line with the above we note that an increase in the wholesale price offered to D_i decreases its output and at the same time it increases the output of its rival, D_j.

3.1 Separate Upstream Firms

When the upstream firms remain separated, there are two competing vertical chains in the market. In the third stage of the game, each upstream firm U_i chooses the wholesale price that it charges to its downstream customer D_i, given what happens to the rival chain, in order to maximize its own profits:

$$\max_{w_i} \Pi_{U_i} = w_i q_i(w_i, w_j) - (c - x_i) q_i(w_i, w_j) - \frac{m x_i^2}{2}. \tag{4}$$

From the system of first order conditions we obtain the equilibrium wholesale prices in terms of the R&D investments:

$$w_i(x_i, x_j) = \frac{(4+\gamma)[2c + a(2-\gamma)] - 2\gamma x_j - 8x_i}{16 - \gamma^2}. \tag{5}$$

Interestingly, the wholesale price that U_i charges decreases not only in its own cost-reducing R&D investments, $\frac{\partial w_i}{\partial x_i} < 0$, but also in its rival's R&D investments, $\frac{\partial w_i}{\partial x_j} < 0$.

In the previous stage, stage two, each U_i chooses the R&D investments that maximize its profits. We substitute (5) in (3) and then in (4) and we differentiate the latter in terms of x_i.

Doing so we obtain the equilibrium R&D investments:

$$x_i^S = \frac{4(a-c)(8-\gamma^2)}{\gamma^2(4-24m)+32\gamma m-2\gamma^3 m+\gamma^4 m-32(1-4m)}. \tag{6}$$

It is important to note that the higher is product substitutability (higher γ) and thus the fiercer is the downstream competition, the lower are the upstream R&D investments, $\frac{\partial x_i^S}{\partial \gamma} < 0$.

Substituting (6) into (5) we obtain the equilibrium wholesale prices:

$$w_i^S = \frac{2cm(32+16\gamma-2\gamma^2-\gamma^3)-a[32-\gamma^2(4-20m)-64m-\gamma^4 m]}{\gamma^2(4-24m)+32\gamma m-2\gamma^3 m+\gamma^4 m-32(1-4m)}. \tag{7}$$

Similarly to the R&D investments, the wholesale prices (7) also decrease with product substitutability, $\frac{\partial w_i^S}{\partial \gamma} < 0$. This occurs because when the downstream competition gets more intense an upstream firm by decreasing the wholesale price that it charges to its downstream customer it transforms it into a more aggressive competitor and "hurts" its rival.

Finally, substituting (6) and (7) into (4) and (1) we get the equilibrium upstream and downstream profits:

$$\Pi_{U_i}^S = \frac{2(a-c)^2 m[\gamma^4(36m-4)+256(4m-1)-\gamma^6 m+64\gamma^2(1-6m)]}{[\gamma^2(4-24m)+32\gamma m-2\gamma^3 m+\gamma^4 m-32(1-4m)]^2}; \tag{8}$$

$$\Pi_{D_i}^S = \frac{4(a-c)^2 m^2(16-\gamma^2)^2}{[\gamma^2(4-24m)+32\gamma m-2\gamma^3 m+\gamma^4 m-32(1-4m)]^2}. \tag{9}$$

3.2 Upstream Merger

When the upstream firms merge then the newly formed upstream monopolist U makes contract offers to both downstream firms. More specifically, in stage three, U faces the following maximization problem:

$$\max_{w_1,w_2} \Pi_U = w_1 q_1(w_1,w_2) + w_2 q_2(w_1,w_2) - (c-x_u)(q_1(w_1,w_2)+q_2(w_1,w_2)) - \frac{m x_u^2}{2}. \tag{10}$$

The resulting equilibrium wholesale prices expressed in terms of the R&D investments are:

$$w_i(x_u) = \frac{a+c-x_u}{2}. \tag{11}$$

Again, higher R&D investments and thus lower upstream cost translate into lower wholesale prices, $\frac{\partial w_i}{\partial x_u} < 0$.

In stage two, U chooses its R&D investments in order to maximize its profits which are now given after substituting (11) in (10):

$$\max_{x_u} \Pi_U = w_1(x_u)q_1(.) + w_2(x_u)q_2(.) - (c - x_u)(q_1(.) + q_2(.)) - \frac{mx_u^2}{2}, \tag{12}$$

where $q_1(.)$ is obtained after substituting (11) in (3).The resulting equilibrium R&D investments of the merged upstream firms are:

$$x_u^M = \frac{a-c}{m(2+\gamma)-1}. \tag{13}$$

Note that similarly to the no-merger case, the upstream R&D investments decrease with the intensity of downstream competition, i.e., $\frac{\partial x_u^M}{\partial \gamma} < 0$.

Comparing the "effective" R&D investments, that is, the cost-reduction that an upstream firm enjoys due to its R&D investments, when the upstream firms merge and when the remain separated we find the following.

Proposition 1 *Under wholesale price contracts, the effective R&D investments are always higher when the upstream firms merge than when they remain separated,* $x_u^M > x_i^S$.

Proposition 1 asserts that an upstream horizontal merger always reinforces firm's R&D investment incentives. Why is that? When the upstream firms are independent, each of them sells its input to one downstream firm. When instead the upstream firms merge, the upstream monopolist sells its inputs to two downstream firms. Clearly then the output of an independent upstream firm is smaller than that of a merged upstream firm. Since the merged firm produces a larger output its incentives to produce it facing lower cost are stronger than those of an independent upstream firm. Thus, a merged firm has more incentives to invest in R&D.

Substituting (13) into (11), (12) and (1) we obtain the equilibrium wholesale prices as well as the equilibrium profits:

$$w_i^M = \frac{1}{2}[a + c - \frac{a-c}{m(2+\gamma)-1}]; \tag{14}$$

$$\Pi_U^M = \frac{(a-c)^2 m}{2m(2+\gamma)-2}; \tag{15}$$

$$\Pi_{D_i}^M = \frac{(a-c)^2 m^2}{4[m(2+\gamma)-1]^2}. \tag{16}$$

Proposition 2 *Under wholesale price contracts, there exists* $\gamma_1(m)$ *such that the wholesale prices are higher when the upstream firms merge than when they remain separated,* $w_i^M > w_i^S$*, if and only if* $\gamma > \gamma_1(m)$*. Moreover,* $\partial\gamma_1/\partial m < 0$*.*

Horn and Wolinsky (1988) and Milliou and Petrakis (2007), in the absence of R&D investments, have found that the upstream merger always has a positive impact on wholesale prices under wholesale price contracts. As they have explained this is due to the fact that an increase in the wholesale price charged to D_i has an effect not only on D_i's output, but also on the output of D_j. It actually, has a positive effect on the latter. A merged upstream firm, in contrast to an independent one, internalizes this positive effect and sets higher wholesale prices. In contrast to them, we demonstrate in Proposition 2 that an upstream merger does not always lead to higher wholesale prices. This occurs because the upstream R&D investments are higher when the firms merge (Proposition 1). As a consequence, a merged firm enjoys higher cost-efficiency which in turn allows it to charge lower wholesale prices than a separated firm. When the products are differentiated enough, the effect of the R&D investments dominates the effect of the rival firm's output and the wholesale prices turn out to be lower in the merger case.

We turn now to the analysis of stage one, that is, we analyze the upstream firms' incentives to merge.

Proposition 3 *Under wholesale price contracts, the upstream firms always merge.*

Proposition 3 suggests that an upstream horizontal merger always takes place. Recall from above that such a merger has two distinct effects. First, it increases the effective R&D investments (Proposition 1). Thus, it leads to higher upstream cost efficiency. Second, it leads to higher wholesale prices at least when the products are close substitutes (Proposition 2) by allowing the internalization of the effect of the wholesale prices on the downstream rival's output. These two effects translate into higher upstream profits and lead to the materialization of the merger.

The following Remark informs us whether or not the downstream firms are better off when the upstream firms merge.

Remark 1 *Under wholesale price contracts, there exists* $\gamma_2(m)$ *such that downstream firm's profits are higher when the upstream firms merge than when they remain separated,* $\Pi_{D_i}^M > \Pi_{D_i}^S$*, if and only if* $\gamma < \gamma_2(m)$*. Moreover,* $\partial\gamma_2/\partial m < 0$*.*

We observe that from a downstream firm's viewpoint the upstream merger can be desirable. This occurs only when the goods are sufficiently differentiated. This finding is a straightforward implication of the fact that when the goods are sufficiently differentiated then the wholesale prices are lower when the merger occurs (Proposition 2). Having to pay lower wholesale prices in the merger case, the downstream firms enjoy higher profits.

4 Two-part Tariffs Contracts

In this Section, we derive the equilibrium when firms trade using two-part tariff contracts. The last stage of the game is identical to the respective one under wholesale price contracts. Thus, the equilibrium quantities are given again by (3).

4.1 Separate Upstream Firms

In stage three, each U_i has to choose now not only w_i but also f_i, taking as given w_j and f_j:

$$\begin{aligned} \max_{w_i, f_i} \ \Pi_{U_i} &= w_i q_i(w_i, w_j) + f_i - (c - x_i) q_i(w_i, w_j) - \frac{m x_i^2}{2} \\ s.t. \ \ \Pi_{D_i} &= (a - q_i(w_i, w_j) - \gamma q_j(w_i, w_j) - w_i) q_i(w_i, w_j) \geq f_i \end{aligned} \tag{17}$$

The participation constraint is binding. Hence, U's maximization problem can be rewritten in the following way:

$$\max_{w_i} \ \Pi_{U_i} = [a - q_i(w_i, w_j) - \gamma q_j(w_i, w_j)] q_i(w_i, w_j) - (c - x_i) q_i(w_i, w_j) - \frac{m x_i^2}{2}. \tag{18}$$

One can easily see from (18) that w_i is chosen in order to maximize the joint profits of U_i and D_i. The first order conditions result in:

$$w_i(x_i, x_j) = \frac{2c[8 - \gamma^2(4 + \gamma)] - 16 x_i + \gamma^2 \left[a(\gamma(2 + \gamma) - 4) + 8 x_i + 2\gamma x_j\right]}{16 - 12\gamma^2 + \gamma^4}. \tag{19}$$

Note that as expected, $\frac{\partial w_i}{\partial x_i} < 0$. That is,the wholesale price that U_i charges decreases in its own cost-reducing R&D investments. In contrast to the wholesale prices case though its wholesale price now increases in the rival's R&D investments, $\frac{\partial w_i}{\partial x_j} > 0$.

In the previous stage, stage two, each U_i chooses its R&D investments in order to maximize its profits which can be found now after substituting (19) in (18). The resulting equilibrium

R&D investments are:

$$\widehat{x}_i^S = \frac{4(a-c)(8-6\gamma^2+\gamma^4)}{m[4+(2-\gamma)\gamma]^2[4-\gamma(2+\gamma)]-4(8-6\gamma^2+\gamma^4)}. \tag{20}$$

Note that in contrast to the wholesale price contracts case, the R&D investments do no longer always decrease when the goods become closer substitutes (increase in γ). More specifically, they decrease in γ if $\gamma < 0.67$ and increase in γ otherwise. This means that there is a U-shaped relation between the intensity of downstream competition (measured by γ) and the investments in R&D. The U-shape comes from the interaction of two countervailing effects. An increase in the intensity of competition means lower profit-margin and thus weaker R&D investment incentives. At the same time, as competition gets stronger, the positive effect of increasing efficiency becomes more pronounced, increasing the R&D investment incentives. The U-shaped relation was not present under wholesale price contracts because, in contrast to the two-part tariffs case, the upstream firms then do not appropriate all the downstream profits.

Substituting (20) in (19), we find the equilibrium wholesale prices:

$$\widehat{w}_i^S = \frac{4a(8-6\gamma^2+\gamma^4)+m(16-12\gamma^2+\gamma^4)[a\gamma^2-2c(2+\gamma)]}{4(8-6\gamma^2+\gamma^4)+m[4+(2-\gamma)\gamma]^2[\gamma(2+\gamma)-4]}. \tag{21}$$

Note that $\widehat{w}_i^S < c - \widehat{x}_i^S$. In other words, the upstream firms subsidize their downstream customers through the wholesale prices. As mentioned above, an upstream firm, through a lower wholesale price transforms its downstream customer into a more aggressive behavior in the final product market. This means that the reaction curve of its downstream firm shifts out. When firms compete in quantities their reaction curves are downward slopping and due to the shift the quantity of the rival downstream firm decreases while the quantity and gross profits of the own downstream firm increase. The upstream firm transfers the higher gross profits upstream via the fixed fee since as we saw the constraint in (17) is binding.

Substituting (20) into (18) and (1), we obtain the equilibrium firms' profits:

$$\widehat{\Pi}_{U_i}^S = \frac{\left\{\begin{array}{c} 2(a-c)^2(2-\gamma^2)m\times \\ [\gamma^6(4-24m)+\gamma^8 m-128(1-2m)+128\gamma^2(1-3m)-8\gamma^4(5-22m)] \end{array}\right\}}{[32+\gamma^4(4-16m)-64m-32\gamma m+24\gamma^3 m-2\gamma^5 m+\gamma^6 m-8\gamma^2(3-8m)]^2}, \tag{22}$$

$$\widehat{\Pi}_{D_i}^S = \frac{4(a-c)^2(16-12\gamma^2+g^4)^2m^2}{[32+\gamma^4(4-16m)-64m-32\gamma m+24\gamma^3 m-2\gamma^5 m+\gamma^6 m-8\gamma^2(3-8m)]^2}. \tag{23}$$

4.2 Upstream Merger

In the event of merger with two-part tariffs things become more complicated. As we saw in the model description, the contract offers of the upstream monopolist to the two downstream firms are simultaneous and separate. As it has been noted by the literature in situations like this, the upstream monopolist "suffers" from a commitment problem.[7] The source of this problem is its opportunistic behavior. More specifically, when U makes its offer to D_i, it has an incentive to behave opportunistically. That is, it has an incentive to secretly reach a mutually favorable agreement that enhances D_i's competitive position at the expense of D_j. This opportunistic behavior is anticipated by D_j. Multiple equilibria can arise in such settings due to the multiplicity of the beliefs that the downstream firms can form when they receive out-of equilibrium offers.[8] As in Horn and Wolinsky (1988), Cremer and Riordan (1987), O'Brien and Shaffer (1992), and Milliou and Petrakis (2007) we obtain a unique equilibrium by imposing *pairwise proofness* on the equilibrium contracts.[9] That is, we require that a contract between U and D_i is immune to a bilateral deviation of U with the rival downstream firm D_j, holding the contract with D_i constant.

Given the above, in stage three, the upstream monopolist U chooses both the wholesale price w_i and the fixed fee f_i that it offers to D_i, taking as given its equilibrium contract offer to D_j. Denoting the latter by $(\widehat{w}_j^M, \widehat{f}_j^M)$, w_i and f_i are chosen to maximize U's profits:

$$\begin{aligned}
\max_{w_i,F_i} \Pi_U &= w_i q_i(w_i, \widehat{w}_j^M) + \widehat{w}_j^M q_j(w_i, \widehat{w}_j^M) - (c - x_u)(q_i(w_i, \widehat{w}_j^M) + q_j(w_i, \widehat{w}_j^M)) \quad (24)\\
&\quad -\frac{m x_u^2}{2} + f_i + \widehat{f}_j^{\,M} \quad (25)\\
s.t.\ \ \Pi_{D_i} &= (a - q_i(w_i, \widehat{w}_j^M) - \gamma q_j(w_i, \widehat{w}_j^M) - w_i) q_i(w_i, \widehat{w}_j^M) \geq f_i
\end{aligned}$$

The participation constraint is binding, so (24) can be rewritten in the following way:

$$\begin{aligned}
\max_{w_i,f_i} \Pi_U &= w_i q_i(w_i, \widehat{w}_j^M) + \widehat{w}_j^M q_j(w_i, \widehat{w}_j^M) - (c - x_u)(q_i(w_i, \widehat{w}_j^M) + q_j(w_i, \widehat{w}_j^M))\\
&\quad -\frac{m x_u^2}{2} + \Pi_{D_i}(w_i, \widehat{w}_i^M) + \Pi_{D_j}(\widehat{w}_i^M, w_j). \quad (26)
\end{aligned}$$

[7] For more details about the commitment problem see e.g., McAfee and Schwartz (1994), O'Brien and Shaffer (1992), Rey and Vergé (2004), Milliou and Petrakis (2007).

[8] For additional information see McAfee and Schwartz (1995).

[9] Pairwise proofness is closely related to the passive beliefs assumption (see e.g., Hart and Tirole, 1990, McAfee and Schwartz, 1994, and 1995, Rey and Verge, 2004,de Fontenay and Gans, 2005 and 2006).

Differentiating (26) with respect to w_i, we obtain the equilibrium wholesale prices expressed in terms of the R&D investments:

$$w_i(x_u) = \frac{4c - \gamma^2(a+c) - x_u(4-\gamma^2)}{2(2-\gamma^2)}. \tag{27}$$

As expected, higher R&D investments and thus lower upstream cost translate into lower wholesale prices, $\frac{\partial w_i}{\partial x_u} < 0$.

We substitute (27) into (26) and we move to the previous stage, stage two, where U chooses x_u in order to maximize (26). The resulting equilibrium R&D investments are:

$$\widehat{x}_u^M = \frac{(a-c)(4-\gamma^2)(1-\gamma)}{\gamma^4 m - 4 + 4\gamma + \gamma^2 - \gamma^3 + 4m - 4\gamma^2 m}. \tag{28}$$

It can be easily confirmed that as the goods become closer substitutes and thus the downstream competition becomes more intense, the investment incentives of the upstream firm get weaker, $\frac{\partial \widehat{x}_u^M}{\partial \gamma} < 0$.

Proposition 4 *Under two-part tariff contracts, the effective R&D investments are higher when the upstream firms merge than when they remain separated, $\widehat{x}_u^M > \widehat{x}_i^S$, if and only if $\gamma < 0.747$.*

According to Proposition 4, a horizontal merger in the upstream market could lead to higher R&D investments. This occurs when the final products are differentiated enough. Why is this so? As it was mentioned in the intuition of Proposition 1, a merged firm has stronger incentives than a separated firm to reduce its cost because it has a larger output. Besides though the output effect, there is an additional effect in action under two-part tariffs. It is the effect of an increase in downstream competition captured by an increase in product substitutability γ. We saw above that under two-part tariff contracts, an increase in product substitutability always has a negative impact on the R&D investments of a merged upstream firm. Its impact instead on the investments of a separated firm can be positive. The latter occurs only when the products are sufficiently close substitutes ($\gamma > 0.67$). Hence, when the products are sufficiently close substitutes, the effect of the increase in downstream competition can dominate the output effect and the investments of a separated firm can exceed those of a merged firm.

Substituting (28) into (27) and in the firms' profits expressions, we find the equilibrium

wholesale prices and profits:

$$\widehat{w}_i^M = \frac{2a(4-\gamma^2)(-1+\gamma)-(2-\gamma^2)m[(a+c)\gamma^2-4c]}{2[m(2-\gamma^2)^2-4+4\gamma+\gamma^2-\gamma^3]}; \quad (29)$$

$$\widehat{\Pi}_U^M = \frac{(a-c)^2 m(4-4\gamma-\gamma^2+\gamma^3)}{2(4-4\gamma-\gamma^2+\gamma^3-4m+4\gamma^2 m-\gamma^4 m)}; \quad (30)$$

$$\widehat{\Pi}_{D_i}^M = \frac{(a-c)^2 m^2(4-2\gamma-2\gamma^2+\gamma^3)^2}{4(4-4\gamma-\gamma^2+\gamma^3-4m+4\gamma^2 m-\gamma^4 m)^2}. \quad (31)$$

Similarly to the case of separated upstream firms, the wholesale prices are subsidies to the downstream firms, $\widehat{w}_i^M < c - \widehat{x}_i^M$. Why is this so? When U makes its contract offer to D_i, it cannot credibly commit to offer a high wholesale price w_j that will make the rival downstream firm D_j behave as a soft competitor in the final products market. As a consequence, D_i will not accept a wholesale price $w_i \geq c$, since D_i knows that in this case U has an incentive to make D_j an aggressive competitor in the final products market via a lower wholesale price. The upstream monopolist has such an incentive because, via a higher fixed fee - upstream transfer, it will not only recoup its losses from selling input below marginal cost to D_j but it will also obtain higher net overall profits.[10]

The following Proposition informs us about the impact of the upstream horizontal mergers on the equilibrium wholesale prices.

Proposition 5 *Under two-part tariff contracts, there exists $\gamma_3(m)$ such that the wholesale prices are lower when the upstream firms merge than when they remain separated, $\widehat{w}_i^M < \widehat{w}_i^S$, if and only if $\gamma < \gamma_3(m)$. Moreover, $\partial\gamma_3/\partial m > 0$.*

A merger leads to lower wholesale prices unless the products are sufficiently close substitutes. The intuition behind this result is as follows. An increase in the wholesale price w_i charged to D_i leads to a decrease in the output of D_i and an increase in the output of D_j. Recall now that the downstream production is subsidized under two-part tariffs. Thus, the increase in D_j's output, due to an increase in w_i, constitutes a negative effect for the merged upstream firm which sells to both downstream firms. Internalizing this negative effect, the merged upstream firm has weaker incentives to increase w_i than a separate upstream firm. As demonstrated in Milliou and Petrakis (2007), in the absence of R&D investments, this effect

[10] This is in the spirit of Rey and Tirole (2003) where an upstream monopolist offering two-part tariff contracts to two downstream firms cannot extract all the surplus in the case that the contracts are secret or can be privately renegotiated.

alone would lead to the wholesale prices in the case of merger always being lower than the respective ones in the no-merger case. However, in our setting R&D investments are present and they affect the wholesale prices since they reduce the cost of the upstream firm(s). More precisely, we saw in Proposition 4 that when the products are sufficiently close substitutes, the R&D investments are higher when the firms remain separated than when they merge. Clearly, this means that when the products are sufficiently close substitutes, a separated firm faces a lower cost than a merged firm and thus it can charge a lower wholesale price.

We turn now to the examination of the upstream firms' incentives to merge. Our main conclusion is included in Proposition 6.

Proposition 6 *Under two-part tariff contracts, there exists* $\gamma_4(m)$ *such that the upstream firms merge,* $\widehat{\Pi}_U^M > 2\widehat{\Pi}_{U_i}^S$*, if and only if* $\gamma < \gamma_4(m)$ *and* $\partial\gamma_4/\partial m < 0$*.*

Proposition 6 asserts that whether or not the upstream firms merge depend on the intensity of downstream product competition captured by the degree of product substitutability. The upstream firms merge when the final products are differentiated enough. Otherwise, they remain separated. Intuitively, when the final products are close substitutes and thus the downstream competition is fierce the intensity of the commitment problem faced by an upstream monopolist is stronger. On the other hand, when the products are not close substitutes, the merger leads to efficiency gains (Proposition 4). The merger's efficiency gains dominate the negative effect of the commitment problem which is anyhow weaker when products are sufficiently differentiated and the merger takes place. In a similar setting but without considering efficiency gains Milliou and Petrakis (2007) found that an upstream merger is never profitable under two-part tariff contracts independently of the degree of product substitutability. Therefore, the efficiency gains that can be realized when the merger takes place are pivotal for the profitability of a horizontal merger between upstream parties. In other words, it is the effect of the merger on the R&D investments that make the merger profitable. This is a novel finding of our paper.

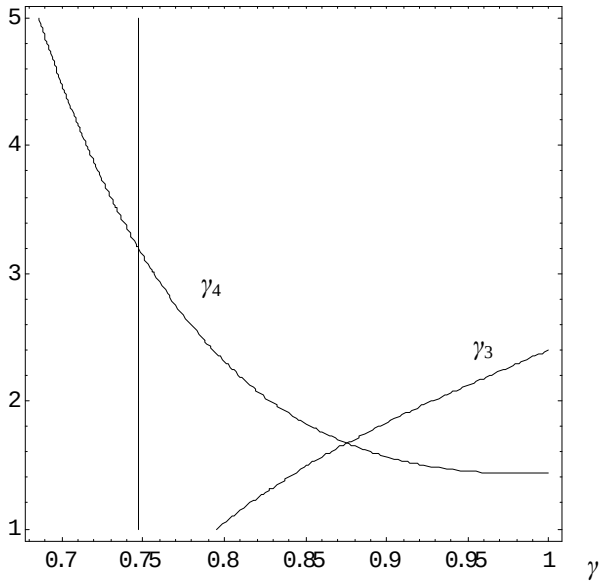

Figure 1: The critical values $\gamma = 0.747$, γ_3, γ_4

Remark 2 *Under two-part tariff contracts, there exists* $\gamma_5(m)$ *such that* $\widehat{\Pi}_{D_i}^M > \widehat{\Pi}_{D_i}^S$ *if and only if* $\gamma < \gamma_5(m)$ *and* $\partial\gamma_5/\partial m < 0$.

Remark 2 states that similarly to the wholesale price contracts case under two-part tariffs contracts the downstream firms are better off when the upstream merger takes place as long as their products are sufficiently differentiated.

5 Welfare Analysis

As we saw in the preceding Sections, a merger between the upstream firms alters the structure of the industry and affects firms' trading terms and R&D investments. Clearly, these changes do not leave welfare unaffected. In this Section, we investigate the impact of the merger on welfare, defining the latter as the sum of producers and consumers surplus.

Proposition 7 *There exist* $\gamma_6(m)$ *and* $\gamma_7(m)$*, with* $\partial\gamma_6/\partial m < 0$ *and* $\partial\gamma_7/\partial m > 0$ *such that,*

(a) under wholesale price contracts, welfare is higher when the upstream firms merge than when they remain separated, $W^M > W^S$*, if and only if* $\gamma < \gamma_6(m)$*,*

(b) under two-part tariff contracts, welfare is higher when the upstream firms merge than when they remain separated, $\widehat{W}^M > \widehat{W}^S$*, if and only if* $\gamma < \gamma_7(m)$*.*

Under two-part tariff contracts, a merger is welfare-enhancing when the goods are sufficiently differentiated. This is so because when the goods are sufficiently differentiated, the merger has two efficiency-enhancing effects. First, it increases the effective R&D investments (Proposition 4), and second, it decreases the wholesale prices (Proposition 5). The wholesale prices lead to higher downstream output and thus to lower prices for the consumers. In other words, when the goods are differentiated enough the merger is beneficial not only for the upstream and the downstream profits (Proposition 6 and Remark 2) but for the consumers as well. The reverse occurs when the goods are close substitutes. This is true because for highly substitutable goods the downstream competition becomes intense and the two efficiency-enhancing effects disappear. Therefore, an upstream merger by reducing the effective R&D and increasing the wholesale prices is becomes then welfare detrimental.

An upstream horizontal merger is materialized in the area to the left of the γ_4 curve in Figure 2 (areas A and D) as Proposition 4 asserts. We know from Proposition 7(ii) that welfare is being reduced by such a merger in the area to the right of the γ_7 curve in Figure 2 (areas D and C). It is clear then that a profitable merger reduces welfare only in area D in Figure 2, where m is low enough (high R&D efficiency) and γ is approaching one (close substitute goods). In all the other cases, when the merger takes place welfare is enhanced.

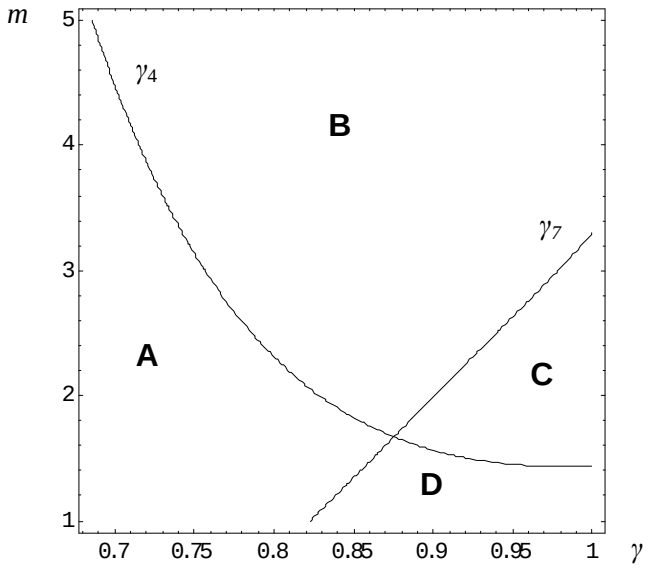

Figure 2: The critical values γ_4 and γ_7

Under wholesale price contracts, the merger is anti-competitive when the goods are close substitutes. Even though a merger always increases effective R&D, the wholesale price in this

case is much more probable to increase after the merger, thus a strong double marginalization effect is in place. As we have already explained in the intuition of Proposition 2, for fierce downstream competition the effect of the R&D investments is dominated by the effect of the rival firm's output. Hence the upstream monopolist charges higher wholesale prices and in this way it harms the final consumers. As we observe in Figure 3, under wholesale price contracts a merger enhances welfare in the area to the left of the γ_6 curve while under two-part tariff contracts in the area to the left of the γ_7 curve. Hence, it becomes clear that merger has a positive impact on welfare in a much smaller area under wholesale price contracts than under two-part tariff contracts. So, given that $\gamma\epsilon[0,1)$ a merger when wholesale price contracts are used should raise more serious concerns for the antitrust authorities.

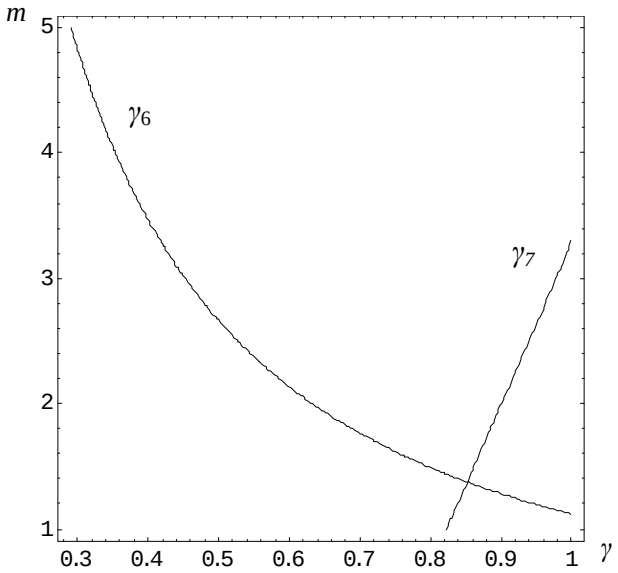

Figure 3: The critical values γ_6 and γ_7

The main difference between the two cases is that when the upstream firms use linear pricing they always have incentives to merger but this does not hold with non-linear two-part tariffs because in this case merger incentives occur only when efficiency gains are realized.

In terms of policy implications the above findings suggest that the antitrust authorities should indeed take into account the potential cost-synergies of mergers since they can overturn a merger's judgement. This is in line with the most recent Merger Guidelines both in the U.S. and in EU. According to the former, the US Department of Justice "...will not challenge a merger if efficiencies are sufficient to reverse the merger's potential to harm consumers in the relevant market" (US Horizontal Merger Guidelines, 1997, section 4). Similarly, according to

the new European Merger Guidelines "... [The Commission] may decide that, as a consequence of the efficiencies the merger brings about, there are no grounds for declaring the merger incompatible with the common market." (EC Horizontal Merger Guidelines, 2004/03, art. 77). When though is it more likely that they well turn an otherwise anti-competitive merger into a pro-competitive one? We point out that the antitrust authorities should be much more cautious when assessing horizontal mergers in industries in which trading occurs through wholesale price contracts and behave more leniently when two-part tariff contracts are used. This is so because when an upstream horizontal merger takes place it is much more probable sufficient efficiency gains to occur with two-part tariffs. Furthermore, the antitrust authorities should be more cautious with upstream horizontal mergers in industries in which the downstream competition is quite intense.

6 Extensions

In this Section, we consider two modifications of our basic model in order to discuss the robustness of our main results.

- *Uniform pricing:* In our analysis we have assumed that the upstream monopolist can price discriminate among the two downstream firms. However, one might wonder what would happen if the firms were operating in a restricted/regulated environment in which price discrimination was not allowed. Under uniform pricing and two-part tariff contracts, the behavior of an upstream monopolist would change drastically. This is true since the upstream monopolist would no longer suffer from the commitment problem. Its contract offers would be accepted if and only if the participation constraints of the downstream firms were satisfied. As a consequence, the upstream monopolist would have been able to charge a higher wholesale price. Under this setting, the merger would turn out to be always profitable and it would also leads to higher effective R&D investments.[11] Whether the merger would be desirable for the consumers and from a social viewpoint it would depend on the extent of the two opposite effects, the higher effective R&D investments and the higher wholesale prices.

- *Downstream R&D investments:* We have assumed throughout that R&D activities are undertaken by the upstream firm(s). Instead, one could investigate the situation where the

[11] The equilibrium analysis under two-part tariff contracts is available from the authors upon request.

downstream firms are the ones that invest in R&D. When wholesale price contracts are used then the downstream firms - by imposing their own mark-up - get positive profits. Hence, they have incentives to participate in R&D activities. However, it seems that an upstream horizontal merger, in the absence of upstream R&D investments, makes the downstream firms worse-off - it lowers their profits. This is so because an upstream monopolist is in a position to charge higher wholesale prices than an independent upstream firm. Consequently, the profit squeeze due to the merger, weakens the downstream firm's incentives to invest in R&D. It follows that an upstream horizontal merger in this case works to the detriment of consumers for two reasons. First, it increases the wholesale prices (double marginalization), and second it reduces effective R&D (lessens efficiency).[12] When two-part tariff contracts are used things become more complex since we should introduce some bargaining power to each party in order to be able to analyze the downstream firm's incentives to invest in R&D. This is necessary because if the downstream parties obey to any take-it-or-leave-it offers by the upstream firms then they are left with no surplus (the upstream firms obtain all the downstream firms' profits through the fixed fees) and any R&D incentives disappear.

7 Concluding Remarks

In this paper, we have examined whether or not horizontal mergers in upstream markets can lead to efficiency gains as well as whether the mergers' potential efficiency gains can overcome their anti-competitive effects in terms of welfare. We have done so in a setting where both the upstream firms' merger decision and R&D investments are endogenous.

We have shown that when firms trade through two-part tariff contracts, merger incentives are present as unless the goods are too close substitutes. This finding contrasts with the respective finding of Milliou and Petrakis (2007), according to which the upstream firms never merge under two-part tariff contracts. Our finding is driven by the presence of R&D investments and the positive impact of merger on them when the goods are sufficiently differentiated. In other words, when the downstream competition is not too strong the merger gives rise to efficiency gains. The higher R&D investments translate into higher upstream cost-efficiency and lower wholesale prices and the latter lead to lower prices for the consumers. Hence, when the goods are differentiated enough the merger is both profitable and pro-competitive.

[12] The equilibrium analysis under wholesale price contracts is available from the authors upon request.

We have also shown that under wholesale price contracts, even though the merger always leads to higher R&D investments, it can also lead to higher wholesale prices. The latter occurs when the products are close substitutes. The severity of the double marginalization problem increases then and the consumers end up paying higher prices. As a result, although the upstream firms always choose to merge, their merger is welfare-detrimental when downstream competition is strong and welfare-enhancing otherwise.

Our findings clearly suggest that in the treatment of horizontal mergers, the antitrust authorities should take into account the merger's impact on firms' investment incentives, i.e., its potential efficiency effects. However, their decision of whether or not they should allow horizontal mergers between upstream firms when there are potential efficiency gains should depend on a number of market characteristics such as the form of vertical contract and the intensity of downstream competition.

Throughout the paper we have restricted our attention to situations where the upstream firms have all the bargaining power and the relations between the upstream and the downstream firms, in the absence of merger, are exclusive. It would be interesting to extend our analysis by examining what would happen when the downstream firms negotiate over their trading terms as well when the separated upstream firms could deal with all the downstream firms.

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