Received: 13 January 2024 | Revised: 22 June 2024 | Accepted: 7 July 2024
DOI: 10.1002/mde.4328

RESEARCH ARTICLE

WILEY

Divisionalization in vertical structures

Lluís Bru[1] | **Ramon Fauli-Oller**[2] | **José-Manuel Ordóñez-de-Haro**[3]

[1]Departament d'Economia de l'Empresa, Universitat de les Illes Balears, Campus Cra. de Valldemossa, Palma de Mallorca, Spain

[2]Departamento de Fundamentos del Análisis Económico (FAE), Universidad de Alicante, Campus de Sant Vicent del Raspeig, Alicante, Spain

[3]Departamento de Teoría e Historia Económica, Universidad de Málaga, Málaga, Spain

Correspondence
José-Manuel Ordóñez-de-Haro, Departamento de Teoría e Historia Económica, Universidad de Málaga, Pl. El Ejido, s/n, 29013 Málaga, Spain.
Email: jmoh@uma.es

Funding information
Conselleria d'Educació, Investigació, Cultura i Esport, Grant/Award Number: Prometeo/2021/073; Spanish Ministry of Economy and Innovation, Grant/Award Numbers: PID 2020-115018RB-C33, PID2021-127736NB-I00, PID2022-142356NB-I00; Funding for open access charge: Universidad de Málaga / CBUA

Abstract

We evaluate the incentives to create within-industry independent divisions once the vertical structure of the industry is considered. Divisionalization allows a firm to gain market share in the final market, but it also leads to an increase in total payments to the input supplier. The less competitive the upstream market, the more important the second effect will be, and this reduces the profitability of divisionalization. As a consequence, a less competitive upstream segment leads to a lower total number of divisions in equilibrium and a less competitive final market, harming end consumers who will face higher prices.

JEL CLASSIFICATION
L10, L11, L20

1 | INTRODUCTION

A firm's organizational design influences its competitive advantage in two ways: first because the efficient use of its resources and capabilities is necessary to create value and, second, as noted by Sengul (2018), because organizational design influences its ability to capture value in the presence of rivalry in the market. One aspect of organizational design important for the strategy of a firm is whether it adopts an organizational structure with multiple independent divisions. The industrial organization literature has investigated the incentives of firms to create divisions that compete independently in the same market. If a firm creates multiple divisions, value creation is reduced because head-to-head competition for sales by divisions of the same firm leads to lower prices. Yet, it increases the value captured by the firm because the overall market share of the firm increases. Therefore, divisionalization is a profitable strategic decision for the firm. However, taking into account the strategic decision of all firms in the market to divisionalize, Corchón (1991), Baye et al. (1996), and Corchón and González-Maestre (2000) obtained the counterintuitive result that as divisionalization costs tend to zero and divisions sell a homogenous good, Cournot competition leads to a perfectly competitive outcome, that is, to the full dissipation of the oligopoly rents, even when there are only two firms in the industry. This equilibrium outcome is the same obtained with Bertrand competition.[1]

In this paper, we re-evaluate the incentives to divisionalize when one considers the vertical structure of an industry. Retail firms must

Lluís Bru, Ramon Fauli-Oller, and José-Manuel Ordóñez-de-Haro contributed equally to this work.

buy a basic input from upstream firms. We assume unobservable contracts in the intermediate market,[2] as in Rey and Tirole (2007), and two suppliers of the input, one more efficient than the other. Downstream firms may create divisions without any fixed setup cost.

As noted above, firms have a strategic incentive to divisionalize in an oligopoly because the creation of independent divisions commits a firm to more aggressive behavior that increases its market share at the expense of rivals. In a vertical relationship, however, we show below that there is a countervailing effect: divisionalization reduces the value of alternatives when a division receives contract proposals from suppliers; therefore, incentives to divisionalize in a vertical structure are drastically reduced. In a downstream duopoly, the equilibrium number of divisions is always finite, and therefore, a perfectly competitive outcome is never attained. In some circumstances, firms do not divisionalize at all.

The fact that we explicitly model the vertical structure of the industry allows us to analyze the connection between upstream and downstream markets. When competition upstream increases, downstream firms obtain better deals from suppliers. In that case, the vertical relationship loses importance, and downstream firms focus on the advantages of divisionalization to gain market share in the final market. Therefore, a less competitive upstream segment ends up causing a less competitive downstream segment as well.

The amount of literature on downstream mergers in a vertical structure is vast (e.g., Dobson & Waterson, 1997; Fauli-Oller & Bru, 2008; Inderst & Wey, 2003; Lommerud et al., 2006; Symeonidis, 2010). Of the existing literature on merger incentives, the paper most similar to ours is that by Fauli-Oller and Bru (2008). These authors study the profitability of exogenous mergers in the same vertical setting as the one considered in the present paper. They find that mergers are profitable if the second source of the input is inefficient enough.

While divisionalization can be seen as the reverse of a merger, Mizuno's (2009) study is, to the best of our knowledge, the only one to examine incentives to divisionalize within a vertical organizational structure. Nevertheless, the context in that study differs significantly from ours: In Mizuno (2009), there is quantity competition both upstream and downstream, upstream firms use the same technology, and divisionalization incurs a fixed cost. In contrast, our framework is based on a two-part tariff competition among upstream firms, with asymmetric technology and divisionalization not associated with a fixed setup cost. Note also that in Mizuno (2009), the number of divisions goes to infinity when the cost of creating a division converges to zero. Therefore, when division creation is costless, the number of divisions in Mizuno (2009) has the same properties as in Corchón (1991), Baye et al. (1996), and Corchón and González-Maestre (2000).

We will show below that in our model the existence of market power in the intermediate market reduces the incentives to create divisions downstream, and as a consequence, the equilibrium number of divisions is finite even though we assume that divisions are costless. Consequently, the market equilibrium we obtain differs from the competitive outcome obtained in the aforementioned studies.

The previous literature on divisionalization has shown that our setup is not the only one that leads to equilibria different from the perfectly competitive outcome, even with zero fixed costs per division. Ziss (1998) examines interfirm product differentiation and finds that, in equilibrium, firms create a finite number of divisions; and this equilibrium number of divisions is decreasing with the degree of product differentiation (see also Yuan, 1999). A finite number of divisions is also obtained if one considers homogenous products with increasing marginal costs (Zhou, 2013). González-Maestre (2000) considers the situation where after firms choose the number of divisions, the divisions choose the weight given to sales in the incentive packages of the managers running the divisions. He finds that no divisionalization takes place in duopoly. In Tesoriere (2021), firms decide on the number of divisions and then invest a fixed amount, F, to obtain a drastic cost-reducing innovation. For intermediate values of F, firms do not divisionalize and do not invest because if one firm divisionalizes, the competitor will find it profitable to invest and the divisionalized firm will be expelled from the market.

In Section 2, we briefly revisit the framework of unobservable contracts we use to model the vertical relationship between firms and present the main result of the paper. In Section 3, we study the effect of upstream competition on the relevant equilibrium market variables. Section 4 analyzes how alternative contract settings affect our results. In Section 5, we provide the main conclusions of our analysis.

2 | THE MODEL AND ITS MAIN RESULT

We consider a downstream market in which two firms, $i = A, B$, transform one unit of input into one unit of final product without additional costs of production.[3] The final product they sell is homogeneous, and its demand is given by $P(Q) = \alpha - Q$. The downstream firms buy the intermediate input from upstream firms. There is an upstream firm U that produces the input at marginal cost $\underline{c} \geq 0$. There also exists a (less efficient) alternative source for the input[4] at marginal cost $\bar{c}$. Apart from a scale effect, all equilibrium variables will depend on $z \equiv \frac{\bar{c} - \underline{c}}{\alpha - \underline{c}}$, which stands for the difference in costs between the alternative supply and firm U, $\bar{c} - \underline{c}$, relative to the measure of market size, $\alpha - \underline{c}$. We will interpret increases in z as a reduction in the level of competition in the input market and assume that $0 < z < \frac{2}{3}$.[5]

Upstream and downstream firms set vertical contracts that establish the terms under which inputs are transferred. We model this vertical relationship following the framework in Rey and Tirole (2007), where contracts are secret (or unobservable) and firms have passive conjectures. After contracts are set, downstream firms choose the amount of output they produce.

We want to address how the process discussed above is affected by the decision of downstream firms to act through divisions. These divisions will be independent both (i) in dealing with suppliers and (ii) deciding the level of sales in the final market. In contrast to previous work on divisionalization that concentrates on point (ii), we want to stress the importance of the interaction of both decisions. Downstream firms may create as many independent divisions without any fixed setup cost, as they find it is in their private interest. The full game we consider has the following stages:

Stage 1: Downstream firms A and B decide their firm structure, namely the number of divisions, n_A and n_B.
Stage 2: Upstream firms secretly offer each division a contract; each division chooses a supplier, orders a quantity of input, and pays accordingly.
Stage 3: Divisions transform input into final products and compete in the final market à la Cournot.

Notice that we assume that the level of divisionalization is chosen before supply contracts are settled. We believe that divisionalization is a decision that affects firms and market structure and so is a decision that cannot be easily changed. However, supply contract terms are easier to modify and adapt. The order of the stages we propose here reflects these considerations.

Upstream firms offer two-part supply contracts. When supply contracts are secret and divisions have passive conjectures, the equilibrium in the final product market is unique and characterized by the Cournot quantities with $n = n_A + n_B$ players that produce at marginal cost $\underline{c}$, because in equilibrium U serves all divisions and sets a two-part tariff that has a marginal wholesale price $w = \underline{c}$ (see Appendix A for an explanation of this result). Thus, in equilibrium each division produces the Cournot quantity $q^c(n)$ and obtains Cournot profits $\pi^c(n)$.

Downstream firms always have the option to use the less efficient input and produce at marginal cost $\bar{c}$. Competition between upstream firms drives down payments for input until downstream firms are indifferent between producing at high and low marginal costs. More specifically, the efficient firm U supplies all divisions for a fixed fee equal to the following expression:

$$\pi^c(n) - \max_{q \geq 0} \{P((n-1)q^c(n) + q) - \bar{c}\}q \tag{1}$$

and hence each division has net profits equal to the profits it would obtain off the equilibrium path with the second source of input,[6]

$$\pi^D(n) \equiv \max_{q \geq 0} \{P((n-1)q^c(n) + q) - \bar{c}\}q \tag{2}$$

With linear demand $P(Q) = \alpha - Q$, each division's production in equilibrium is $q^c(n) = \frac{\alpha - \underline{c}}{n+1}$, and in case of disagreement with U,[7] each division produces the quantity that solves the problem in (2),

$$\begin{aligned} q^{off}(n) &= \arg \max_{q \geq 0} \{P((n-1)q^c(n) + q) - \bar{c}\}q \\ &= \max\left\{0, (\alpha - \underline{c})\left(\frac{1}{n+1} - \frac{z}{2}\right)\right\} \end{aligned} \tag{3}$$

The firm's net profits are then

$$\pi^D(n) = \left(q^{off}(n)\right)^2 \tag{4}$$

Therefore, to evaluate the profits of each division, downstream firms must consider the effect of the total number of divisions n in $\pi^D(n)$. In the earliest stage of the game, each downstream firm chooses its optimal number of divisions; that is, each chooses the number of divisions that solves:

$$\max_{n_i} \Pi^i(n_i, n_j) = n_i \pi^D(n_i + n_j) \quad \forall i = \text{A, B and } i \neq j \tag{5}$$

The optimal number of divisions satisfies the first-order condition (FOC) of the problem in (5). The marginal revenue for a downstream firm with an additional division has two terms, the increase in revenues from an additional division and the reduction in profits per division due to the increase in competition in the final market:

$$\frac{\partial \Pi^i}{\partial n_i} = \pi^D + n_i \frac{\partial \pi^D}{\partial n_i} \tag{6}$$

The literature on divisionalization shows that with a linear demand the best-response function to the rival's number of divisions is $n_i = R(n_j) = n_j + 1 \ \forall i = \text{A, B}$ and $i \neq j$. The incentives to obtain a larger share in the market are so strong that in equilibrium firms dissipate all the rents through an excessive number of divisions.[8] In our model, the FOC (6) becomes

$$\frac{\partial \Pi^i}{\partial n_i} = \left\{ \left[P\left((n-1)q^c(n) + q^{off}\right) - \bar{c}\right] + \left[n_i P' \frac{\partial (n-1)q^c}{\partial n_i}\right] \right\} q^{off} = 0 \tag{7}$$

When we compare the marginal revenue of an additional division in our case and in the literature, we see that

i. The profits of a division are now affected by the efficiency of the second source because the rents that the more efficient upstream firm extracts to the division is increasing in $\bar{c}$; this is reflected in the first term in brackets in (7), the mark-up off the equilibrium path, which is the relevant one for downstream firms.
ii. However, the reduction in profits per division as the number of divisions increase occurs through the change in the production of rivals. This is the second term in brackets in (7). Rivals produce at low marginal costs ($\underline{c}$); this effect is basically the same in our model as in any other standard paper on divisionalization.

Thus, the vertical structure of the industry reduces the positive incentives to set divisions but does not change the negative incentives. For a linear demand, the FOC (7) becomes

$$\frac{\partial \Pi^i}{\partial n_i} = \left\{ (\alpha - \underline{c}) \left(\frac{n_j + 1 - n_i}{(n+1)^2} - \frac{z}{2} \right) \right\} q^{off} = 0 \tag{8}$$

where $q^{\text{off}} = (\alpha - \underline{c})\left(\frac{1}{n+1} - \frac{z}{2}\right)$, which leads to the best-response function:

$$n_i = R(n_j) = \frac{(1+4z(n_j+1))^{1/2} - (1+z(n_j+1))}{z} \tag{9}$$

Notice that $z>0$ implies that the optimal number of divisions $n_i = R(n_j)$ satisfies $R(n_j) < n_j + 1$.[9] The fact that $z>0$ decreases the mark-up of a division forced to produce under the alternative and $n_i P' \frac{\partial (n-1)q^c}{\partial n_i} = -\frac{2n_i}{(n+1)^2}(\alpha - \underline{c})$ is kept constant implies that increases in z reduce the incentives to divisionalize, $\frac{\partial R(n_j)}{\partial z} < 0$; $R(n_j)$ approaches $n_j + 1$ as z approaches zero (or $\bar{c}$ approaches $\underline{c}$),[10] that is, as the difference in costs between suppliers vanishes we obtain in the limit the standard result (see Baye et al., 1996; Corchón, 1991) that—when divisionalization has no fixed costs and the vertical structure of the industry is assumed away—each firm wants to set one more division than its rival, which drives them to the competitive outcome.

The strategic response to divisionalization by the rival firm is affected as follows: The impact of changes in n_j on the best-response function, $\frac{\partial R(n_j)}{\partial n_j} = \frac{2}{(1+4z(n_j+1))^{1/2}} - 1$, is positive only if $1 \le n_j < \frac{3-4z}{4z}$. Hence, for low levels of divisionalization, divisions are strategic complements, and a firm reacts to an increase of divisionalization by its rivals by also creating more divisions, while divisions become strategic substitutes for higher levels of divisionalization, and the maximum number of divisions that a firm will create is $R\left(\frac{3-4z}{4z}\right) = \frac{1}{4z}$. Figure 1 shows the best-response function when $z = 2/25$.

When we evaluate the equilibrium number of divisions under a linear demand, we obtain the following result.

Proposition 1. In equilibrium, downstream firms choose the number of divisions.

$$n_i^*(z) = \begin{cases} \frac{1}{\sqrt{2z}} - \frac{1}{2} & \text{if } z \in \left(0, \frac{2}{9}\right) \\ 1 & \text{if } z \in \left[\frac{2}{9}, \frac{2}{3}\right) \end{cases} \qquad \forall i = A, B$$

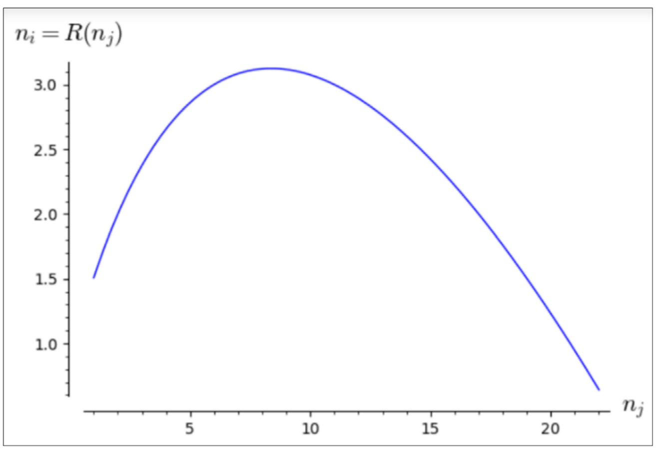

FIGURE 1 Best-response function $n_i = R(n_j)$ for $z = 2/25$.

For $z \in \left(0, \frac{2}{9}\right)$, firms create a finite number of divisions $n_i^*(z) > 1$.

When $z \in \left[\frac{2}{9}, \frac{2}{3}\right)$, firms do not divisionalize at all, $n_i^*(z) = 1$. In the equilibrium number of divisions, downstream firms obtain strictly positive profits.

Proof. With a linear demand, $\frac{\partial \Pi^i}{\partial n_i}$ is defined in (8) as

$$\frac{\partial \Pi^i}{\partial n_i} = \left\{(\alpha - \underline{c})\left(\frac{n_j + 1 - n_i}{(n+1)^2} - \frac{z}{2}\right)\right\} q^{\text{off}}$$

$\forall i = A, B$ and $i \neq j$. If $z \in \left(0, \frac{2}{9}\right)$ and we take the number of divisions as a continuum number $n_i, n_j \ge 1$, the equilibrium in divisions $n_A^* = n_B^* = \left[\frac{1}{\sqrt{2z}} - \frac{1}{2}\right]$ stated in Proposition 1 solves $\frac{\partial \Pi^i}{\partial n_i} = 0$. And this is indeed a global maximum of a firm's maximization because the term in brackets $(\alpha - \underline{c})\left(\frac{n_j+1-n_i}{(n+1)^2} - \frac{z}{2}\right)$ is decreasing in n_i, and therefore $\frac{\partial \Pi^i}{\partial n_i}$ is positive iff $n_i < R(n_j)$.[11] For $z \in \left[\frac{2}{9}, \frac{2}{3}\right)$, if $n_j = 1$, we have that $\left.\frac{\partial \Pi^i}{\partial n_i}\right|_{n_i=1} < 0$, and therefore firms do not divisionalize in equilibrium.

The literature on divisionalization has shown that in an oligopoly market, the strategic incentives to increase the market share of a firm lead to the full dissipation of oligopolistic rents through the excessive creation of divisions. To avoid perfect competition as the outcome of the divisionalization process, previous papers need to exogenously impose a restriction on the number of divisions that firms may create: an ad-hoc upper bound, fixed costs of divisionalization, and so forth. We obtain the same result by considering the vertical relationships within the industry.

Indeed, for a sufficiently inefficient alternative, in equilibrium, downstream firms do not divisionalize at all, but in any case, downstream firms choose a finite number of divisions. Figure 2 shows the best-response functions and the number of divisions in equilibrium, $n_A^* = n_B^* = 2$, when $z = 2/25$.

In Appendix B, for the case where $z \in \left(0, \frac{2}{9}\right)$ and firms divisionalize in equilibrium, we provide the equilibrium outcomes for the output of each division (q^*), total output (Q^*), marginal wholesale price (w^*), the equilibrium fixed fee (f^*), the profits of each downstream firm (Π^{i*}), and the profits of the upstream firm U (Π^{U*}). We also provide the graphs for the equilibrium outcomes as a function of z for the number of divisions (Figure B1), output for each division (Figure B2), total output (Figure B3), fixed fee (Figure B4), profits of each downstream firm (Figure B5) and profits of the upstream firm (Figure B6). This helps to visualize the effect of z on the equilibrium variables.

3 | THE COMPARATIVE STATICS OF MARKET PERFORMANCE

The result we obtain in Proposition 1 is the main one of this paper, and it allows us to analyze how changes in the values of parameters, summarized on statistic z, affect the overall performance of the industry.

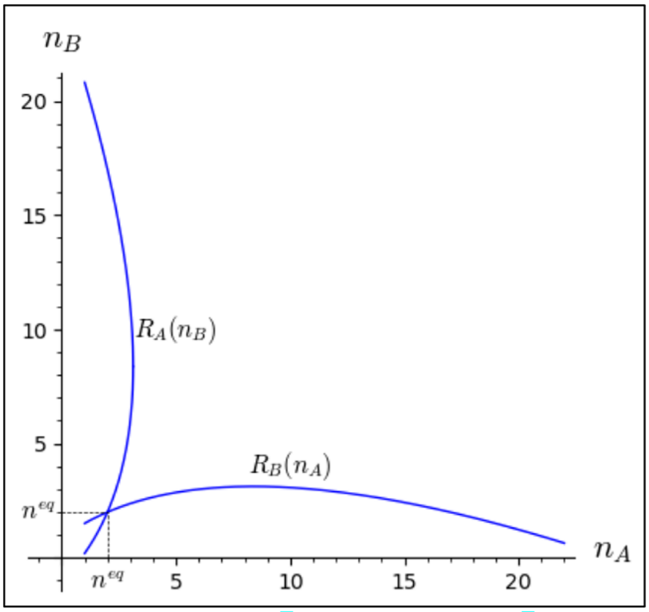

FIGURE 2 Equilibrium with a finite number of divisions for $z=2/25$.

We start by examining the comparative statics of the final price with respect to parameter z, which takes into account the differences in costs $(\bar{c}-\underline{c})$. This difference in costs measures the quality of input alternatives compared to the one supplied by U. The final price is $p=\frac{\alpha-\underline{c}}{n+1}+\underline{c}$, which is decreasing in the total number of divisions $n=n_A+n_B$. For the number of divisions in equilibrium, the final price becomes

$$p^*=\left\{(\alpha-\underline{c})\left(\frac{z}{2}\right)^{½+\underline{c}} if z\in\left(0,\frac{2}{9}\right)\left(\frac{\alpha-\underline{c}}{3}\right)+\underline{c}\, if z\in\left[\frac{2}{9},\frac{2}{3}\right)\right.. \tag{10}$$

When downstream firms are essentially dependent on a single source for obtaining the intermediate input (i.e., when $z\in\left[\frac{2}{9},\frac{2}{3}\right)$), we have the lowest level of downstream competition (no divisionalization at all), and the final price is the one obtained in a duopoly, $p^*=\left(\frac{\alpha-\underline{c}}{3}\right)+\underline{c}$. Without divisionalization, as in Rey and Tirole (2007), the final price does not depend on the alternatives upstream because input contracts are efficient. The only effect is that rents are redistributed from suppliers to downstream firms if the alternative source of input improves (i.e., z decreases).

However, when the alternative source (the less efficient upstream firm) becomes viable for obtaining the input, the increasing downstream competition resulting from divisionalization leads to lower final prices. Nevertheless, the final price is strictly above $\underline{c}$ when $z>0$, increases in z and only converges to the competitive price as z goes to zero. Therefore, we find that consumers benefit if the less efficient suppliers catch up with the efficient one and $\bar{c}$ approaches $\underline{c}$ because a better alternative upstream is reflected in the final price through an increase in competition downstream. In our model, input contracts are also efficient, and the result is obtained through the effect of upstream rivalry on the number of divisions. Given that the final price is always higher than marginal cost $\underline{c}$, social welfare evolves as consumer surplus, so that it is also decreasing with z. Therefore, we can state the following result:

Proposition 2. Final consumer surplus and social welfare decrease with z if $z\in\left(0,\frac{2}{9}\right)$.

We have seen that the existence of a better input alternative benefits consumers. However, this is not necessarily the case for downstream firms. If z decreases, U must charge downstream firms a lower fee, but then each division is more valuable, and downstream firms are more tempted to increase their market share, which reduces the overall level of industry profits. When evaluated at the equilibrium number of divisions stated in Proposition 1, if $z\in\left(0,\frac{2}{9}\right)$, downstream firms create divisions and have profits

$$\Pi^{i*}=n_i^*(z)\pi^D(z)=n_i^*(z)\left(q^{off}(z)\right)^2=(\alpha-\underline{c})^2\frac{z^2}{8}\left[\left(\frac{2}{z}\right)^{½-1}\right]^3,\ \forall i=A,B \tag{11}$$

and if $z\in\left[\frac{2}{9},\frac{2}{3}\right)$, they do not create divisions and have profits:

$$\Pi^{i*}=\pi^D(z)=\left(q^{off}(z)\right)^2=(\alpha-\underline{c})^2\left(\frac{2-3z}{6}\right)^2 \tag{12}$$

When we evaluate how profits in (11) and (12) evolve when z changes, we obtain the following result:

Proposition 3. The profits of downstream firms strictly increase in z when $z\in\left(0,\frac{1}{8}\right)$, strictly decrease when $z\in\left(\frac{1}{8},\frac{2}{3}\right)$ and reach a maximum at $z=\frac{1}{8}$.

Proof. In the values of z for which downstream firms create divisions in equilibrium, $z\in\left(0,\frac{2}{9}\right)$, we have for profits in (11) that

$$\frac{\partial \Pi^{i*}}{\partial z}=(\alpha-\underline{c})^2\frac{z}{16}\left[\left(\frac{2}{z}\right)^{½-1}\right]^2\left[\left(\frac{2}{z}\right)^{½-4}\right] \tag{13}$$

We can see that $\frac{\partial \Pi^{i*}}{\partial z}>0$ for $z\in\left(0,\frac{1}{8}\right)$, $\frac{\partial \Pi^{i*}}{\partial z}=0$ at $z=\frac{1}{8}$, and $\frac{\partial \Pi^{i*}}{\partial z}<0$ for $z\in\left(\frac{1}{8},\frac{2}{9}\right)$. For larger values of z, downstream firms do not create divisions, but their profits (12) decrease in z.

The endogenous determination of divisions changes the intuitive result obtained when the number of downstream competitors is fixed. One may tend to think that facing more powerful suppliers should hurt downstream firms because then the profits they can obtain using the second source supplier are lower. However, in our context, there is a countervailing force, namely that more powerful suppliers induce downstream firms to create fewer divisions, which reduces competition downstream and increases their profits. Proposition 3 states that this latter (strategic) effect dominates the former when suppliers are not very powerful (i.e., when z is not very high) and downstream firms are creating many divisions.

Comparing Proposition 2 with Proposition 3, one can conclude that the interests of consumers and downstream firms are not aligned as far as the optimal degree of competition upstream is concerned. Consumers prefer perfect competition upstream, while downstream firms prefer that the efficient supplier conserves some market power. This divergence can create controversy between both parties when the government must take measures that affect upstream competition.

For example, suppose that in the upstream sector apart from firm U we have two additional firms (1 and 2) whose marginal costs of production satisfy (in terms of $z_i \equiv \frac{\bar{c}_i - \underline{c}}{\alpha - \underline{c}}, \forall i = 1,2$), $0 < z_1 < z_2 \leq \frac{1}{8}$. Suppose that firm U and firm 1 want to merge and need permission from the Antitrust Authority to proceed. Downstream firms will then favor the merger, while consumer organizations will argue against the merger before the Antitrust Authority.

The result in our model that an increase in the (relevant) cost of the divisionalized firm may end up increasing its profits is akin to what happens in Baye et al. (1996). They consider a model where the divisionalized firm must bear a fixed cost per division. It turns out that the equilibrium profits of the divisionalized firm increases in the fixed cost: the cost increase (the fixed cost in Baye et al., 1996, or the increase in marginal costs if the alternative source of input is used in our model) limits the extent of divisionalization. The only difference is that this (paradoxical) result always holds in Baye et al. (1996), while in our case it only holds for low enough costs. Apart from that, the signs of the comparative statics of the other equilibrium variables with respect to the cost increase are the same in both models (see Baye et al., 1996, p. 229): the cost increase reduces output, the number of divisions, while it increases the output per division. These comparative statics are illustrated in Appendix B.

4 | ALTERNATIVE ASSUMPTIONS ABOUT THE CONTRACT SETTING

In this section, we study how the results in the previous section are affected by our assumptions about how upstream firm U and downstream firms interact. In particular, we first analyze the case of observable contracts and second the relevance of passive beliefs when contracts are secret.

4.1 | Observable contracts

Erutku and Richelle (2007) were the first to study the interaction between an efficient upstream supplier and downstream firms assuming observable contracts. They derived the optimal two-part tariff contract, which involves selling the input to all downstream firms. Fauli-Oller and Sandonis (2016), using their results, derived the profits obtained by downstream firms.[12]

Using the same notation as before, z stands for the cost difference between the alternative supply and firm U compared with the size of demand, and n stands for the total number of divisions $(n_A + n_B)$; then the profit of a downstream division can be written as

$$\pi^D = (\alpha - \underline{c})^2 \left(\frac{1 + (1 - 2z)n^2}{2(n^3 + 1)} \right)^2 \quad (14)$$

For this profit to be positive for any number of divisions n, we restrict attention to the case $z \leq \frac{1}{2}$. We have that division profits are decreasing in z. This makes sense, because their alternative is to source from the inefficient alternative supply at cost $\bar{c}$; If this cost increases, this outside option becomes less attractive.

Then, in the first stage, firm i, $(i = A, B)$ maximizes:

$$\Pi^i = (\alpha - \underline{c})^2 n_i \left(\frac{1 + (1 - 2z)(n_i + n_j)^2}{2\left((n_i + n_j)^3 + 1\right)} \right)^2 \quad \forall i = A, B \text{ and } j \neq i \quad (15)$$

Competition between downstream firms leads to the following result:

Proposition 4. If supply contracts are observable, firms do not divisionalize at all in the unique equilibrium of the divisionalization game, that is, $n_A^* = n_B^* = 1$.

Proof. See Appendix C.

In the divisionalization decision, there are always two opposite forces at work. On the one hand, the desire to gain market share at the expense of rivals (a business stealing effect). On the other hand, the intention to preserve the profits obtained by the existing divisions. In models where the (symmetric) cost of divisions is exogenously given (e.g., in one tier industries), the first effect dominates leading divisionalization to the perfect competition outcome (Corchón, 1991). When we have a vertical structure and contracts are observable, as we have just seen in Proposition 4, the second effect dominates, and downstream firms do not divisionalize at all: Competition is so destructive for profits, that firms limit it completely by not divisionalizing at all. The interest of the model presented in the main body of the paper is that it bridges these two extreme results by obtaining the whole array of intermediate cases depending on the value of z: As stated in Proposition 2, it is only for $z \geq \frac{2}{9}$ that firms do not divisionalize; as z decreases, firms increase steadily the number of divisions, reaching the perfect competition outcome when z converges to zero.

4.2 | The role of beliefs when contracts are secret

If U's offers are secret, as we assume in Sections 2 and 3, but downstream firms hold symmetric beliefs (i.e., they believe that the upstream firm makes the same offer to all divisions) instead of passive beliefs, then the upstream firm can offer to downstream divisions the same contract as under observable contracts, and the same result as in Proposition 4 is obtained. In other words, whether contracts are observable or not is irrelevant when downstream firms hold symmetric beliefs. But, as Rey and Tirole (2007, Section 2.1.2., p. 2160–2161) argue, in a framework of perfect information and constant marginal costs, it seems more reasonable to assume that downstream firms have passive beliefs, since the upstream firm has no incentive to change its offer to other divisions when it alters the contract offered to one of them.

5 | CONCLUDING REMARKS

This paper analyzed the incentives of downstream firms to create divisions when we consider the vertical structure of an industry. We show that firms divisionalize less than what was suggested in previous related work. Excessive divisionalization reduces the value of alternative sources of the input when a division receives a contract proposal from the more efficient supplier, and this effect countervails the usual strategic incentive to divisionalize to gain market share in the final market.

This result is in accordance with the evolution of different industries, for example, the US food sector, where there has been a parallel process of consolidation in food processing and retailing (Sexton, 2000, 2013). Kastrinaki and Stoneman (2011) also provide evidence from seven of the eight EU countries studied, indicating that merger activity in food manufacturing has led to merger activity in food retailing. They suggest that this phenomenon may be attributed to retailers' efforts, via consolidation, to bolster their countervailing market power to obtain better deals from suppliers.

In another industry quite distant from the food sector, Ben-Yosef (2005) highlights that the consolidation and concentration trend within US airlines during the 1990s was, in part, a response to mergers, acquisitions, and strategic alliances occurring within input markets, such as equipment manufacturing and related services. This parallel consolidation process also aligns with our findings.

As the strategic incentives to consolidate are like the ones to reduce divisionalization, it would be worthwhile analyzing changes in the level of divisionalization related to changes in market power along the chain supply. When we compare the model with vertical relations without divisionalization (see Caprice, 2005) and with divisionalization, a very important difference emerges. With divisionalization, the level of competition upstream reduces the price paid by consumers, while this effect is absent without divisionalization. Although in both situations downstream players are supplied by the efficient firm at its marginal cost, with divisionalization, upstream competition reduces final prices because it stimulates the creation of divisions by downstream parent firms.

As upstream competition is negatively affected by upstream consolidation, this different result in both models has important implications regarding the empirical predictions of the models and their policy implications. With divisionalization, upstream mergers between efficient suppliers will increase the cost downstream divisions pay if they do not reach an agreement with the dominant supplier and will trigger a process of consolidation downstream as downstream firms close down divisions. As previously mentioned, this parallel process of consolidation in both the upstream and downstream sectors has been documented in several studies.

However, if the objective of the Antitrust Authority is either consumer surplus or total welfare (in particular, it does not care about how producers' surplus is divided between the upstream and the downstream sectors), a very different antitrust policy is implied by the two models. The model without divisionalization implies a very lenient policy regarding upstream mergers because they do not affect final prices. On the contrary, in the model with divisionalization, upstream mergers (that increase the cost of the second source supplier) should be forbidden because they reduce competition downstream, and therefore final consumers end up paying a higher price.

ACKNOWLEDGMENTS

We would like to thank Luis C. Corchón, Begoña García, María del Carmen García-Alonso, and an anonymous referee for their helpful suggestions and comments on a previous version of this paper. Funding for open access charge: Universidad de Málaga / CBUA.

CONFLICT OF INTEREST STATEMENT

The authors declare no competing interests.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable as no new data were generated or the article describes entirely theoretical research.

ORCID

Lluís Bru https://orcid.org/0000-0002-5726-4977
Ramon Fauli-Oller https://orcid.org/0000-0003-0778-8921
José-Manuel Ordóñez-de-Haro https://orcid.org/0000-0001-8885-5107

ENDNOTES

[1] This equivalence with the Bertrand result extends to the case of cost-asymmetric firms: The divisions of the inefficient firm do not produce at all because in equilibrium price is equal to its marginal cost (Fauli-Oller, 2022).

[2] To highlight the importance of this assumption, we also present the results for the case where contracts are observable in Section 4.

[3] We could generalize the analysis to the case of more than two downstream firms and the main results would still hold. Therefore, for the sake of simplicity, we present the results for two downstream firms.

[4] This alternative source of input can be in-house production, a second upstream firm that competes with U on tariffs, or a competitive fringe. In any case, the relevant assumption is that divisions obtain this alternative source of input at marginal cost $\bar{c}$.

[5] Condition $0 < z < \frac{2}{3}$ ensures that without divisionalization, a downstream firm always earns strictly positive profits, even when it is forced to use the alternative source of input because there is no agreement with upstream firm U.

[6] Notice that rival divisions expect an agreement between U and each division and thus produce the aggregate quantity $(n-1)\,q^c(n)$.

[7] For a sufficiently high number of total divisions, each division faces a residual demand such that $P((n-1)q^c(n)) < \bar{c}$. In such a case, the second source is irrelevant; the efficient upstream firm may reap all the rents from the vertical relationship, and π^D is driven down to zero.

[8] This is a negative externality that Sengul (2018) refers to as structural cannibalization.

[9] The reaction function in (9) satisfies $R(n_j) = \frac{(1+4z(n_j+1))^{\frac{1}{2}-(1+z(n_j+1))}}{z} < n_j+1$ if $(1+4z(n_j+1))^{\frac{1}{2}<(1+2z(n_j+1))}$, which is indeed the case since $1+4z(n_j+1) < (1+2z(n_j+1))^2$.

[10] Note that $\text{limit}_{z\to 0} R(n_j) = \frac{0}{0} =$ (using l'Hôpital rule) $\text{limit}_{z\to 0}\left\{\frac{2(n_j+1)}{(1+4z(n_j+1))^{\frac{1}{2}}-(n_j+1)}\right\} = n_j+1$.

[11] We have $\frac{\partial^2 \Pi^i}{\partial n_i^2} < 0$ iff $n_i \in \left[1, \frac{2-z(n_j+1)}{1+z(n_j+1)}(n_j+1)\right)$, where $R(n_j) < \frac{2-z(n_j+1)}{1+z(n_j+1)}(n_j+1)$; and for $n_i \in \left[\frac{2-z(n_j+1)}{1+z(n_j+1)}(n_j+1), \frac{2}{z}-(n_j+1)\right]$ we have $\frac{\partial \Pi^i}{\partial n_i} < 0$ and $\frac{\partial^2 \Pi^i}{\partial n_i^2} > 0$, with $\Pi^i = 0$ at $n_i = \frac{2}{z}-(n_j+1)$ because for this value of n_i divisions cannot profitably produce using the alternative source of input. Therefore, $q^{off} = 0$.

[12] Erutku and Richelle (2007) focused, mainly, on the profits of the upstream firm.

REFERENCES

Baye, M., Crocker, K., & Ju, J. (1996). Divisionalization, franchising and divestiture incentives in oligopoly. *American Economic Review*, *86*, 223–236.

Ben-Yosef, E. (2005). The evolution of the US Airline Industry: theory, strategy and policy. In H. W. de Jong & W. G. Shepherd (Eds.), *Studies in industrial organization*, *25*. Springer Science & Business Media. https://doi.org/10.1007/b104927

Caprice, S. (2005). Incentive to encourage downstream competition under bilateral oligopoly. *Economics Bulletin*, *12*(9), 1–5.

Corchón, L. (1991). Oligopolistic competition among groups. *Economics Letters*, *36*, 1–3. https://doi.org/10.1016/0165-1765(91)90045-M

Corchón, L., & González-Maestre, M. (2000). On the competitive effects of divisionalization. *Mathematical Social Sciences*, *39*, 71–79. https://doi.org/10.1016/S0165-4896(98)00047-X

Dobson, P., & Waterson, M. (1997). Countervailing power and consumer prices. *The Economic Journal*, *107*, 418–430. https://doi.org/10.1111/j.0013-0133.1997.167.x

Erutku, C., & Richelle, Y. (2007). Optimal licensing contracts and the value of a patent. *Journal of Economics & Management Strategy*, *16*(2), 407–436. https://doi.org/10.1111/j.1530-9134.2007.00144.x

Fauli-Oller, R. (2022). Divisionalization with asymmetric production costs. *Mathematical Social Sciences*, *118*, 22–29. https://doi.org/10.1016/j.mathsocsci.2022.04.002

Fauli-Oller, R., & Bru, L. (2008). Horizontal mergers for buyer power. *Economics Bulletin*, *12*(3), 1–7.

Fauli-Oller, R., & Sandonis, J. (2016). Welfare effects of downstream mergers and upstream market concentration. *The Singapore Economic Review*, *61*(5), 1550056. https://doi.org/10.1142/S0217590815500563

González-Maestre, M. (2000). Divisionalization and delegation in oligopoly. *Journal of Economics and Management Strategy*, *9*, 321–338. https://doi.org/10.1111/j.1430-9134.2000.00321.x

Inderst, R., & Wey, C. (2003). Bargaining, mergers and technology choice in bilaterally oligopolistic industries. *The Rand Journal of Economics*, *34*(1), 1–19. https://doi.org/10.2307/3087440

Kastrinaki, Z., & Stoneman, P. (2011). Merger patterns in the European food supply chain. *International Journal of the Economics of Business*, *18*(3), 463–487. https://doi.org/10.1080/13571516.2011.618618

Lommerud, K. E., Straume, O. R., & Sørgard, L. (2006). National versus international mergers in unionized oligopoly. *The Rand Journal of Economics*, *37*(1), 212–233. https://doi.org/10.1111/j.1756-2171.2006.tb00013.x

Mizuno, T. (2009). Divisionalization and horizontal mergers in a vertical relationship. *The Manchester School*, *77*, 317–336. https://doi.org/10.1111/j.1467-9957.2009.02099.x

Rey, P., & Tirole, J. (2007). A primer on foreclosure. In M. Armstrong & R. H. Porter (Eds.), *Handbook of industrial organization* (Vol. 3) (pp. 2145–2220). Elsevier. https://doi.org/10.1016/S1573-448X(06)03033-0

Sengul, M. (2018). Organization design and competitive strategy: An application to the case of divisionalization. In *Organization design* (Vol. 40) (pp. 207–228). Emerald Publishing Limited. https://doi.org/10.1108/S0742-332220180000040007

Sexton, R. J. (2000). Industrialization and consolidation in the US food sector. Implications for competition and welfare. *American Journal of Agricultural Economics*, *82*, 1087–1104. https://doi.org/10.1111/0002-9092.00106

Sexton, R. J. (2013). Market power, misconceptions, and modern agricultural markets. *American Journal of Agricultural Economics*, *95*(2), 209–219. https://doi.org/10.1093/ajae/aas102

Symeonidis, G. (2010). Downstream merger and welfare in a bilateral oligopoly. *International Journal of Industrial Organization*, *28*, 230–243. https://doi.org/10.1016/j.ijindorg.2009.08.004

Tesoriere, A. (2021). Drastic innovation reduces firms' incentive to create divisions. *Economia Politica*, *38*, 971–994. https://doi.org/10.1007/s40888-020-00176-7

Yuan, L. (1999). Product differentiation, strategic divisionalization and persistence of monopoly. *Journal of Economics and Management Strategy*, *8*(4), 581–602. https://doi.org/10.1111/j.1430-9134.1999.00581.x

Zhou, W. (2013). Sequential divestiture and firm asymmetry. *Economics Research International*, *2013*(1), 352847. https://doi.org/10.1155/2013/352847

Ziss, S. (1998). Divisionalization and product differentiation. *Economics Letters*, *59*, 133–138. https://doi.org/10.1016/S0165-1765(98)00017-2

How to cite this article: Bru, L., Fauli-Oller, R., & Ordóñez-de-Haro, J.-M. (2024). Divisionalization in vertical structures. *Managerial and Decision Economics*, 1–10. https://doi.org/10.1002/mde.4328

APPENDIX A: EXPLANATION OF THE FACT THAT $w^* = \underline{c}$ WHEN CONTRACTS ARE SECRET AND DOWNSTREAM DIVISIONS HOLD PASSIVE BELIEFS

We assume that contracts are secret, and firms hold passive conjectures (beliefs) on out-of-equilibrium contracts received by rivals. This means that independently of the contract a division receives, it expects that rivals stick to their equilibrium outputs, because it expects that they are receiving the equilibrium contracts. Therefore, when the upstream firm U chooses the optimal contract $\{f, w\}$ for division i it solves.

$$\begin{gathered}\max_{f,w}\{(w-\underline{c})q(w)+f\}\\ \text{subject to } q(w) = \arg\max_{q_i}\{P(Q^*_{-i}+q_i)-w\}q_i \\ \text{and } f \le \{P(Q^*_{-i}+q(w))-w\}\,q(w)-\pi^D(n)\end{gathered} \tag{A1}$$

where $\pi^D(n)$ is division i profits at its outside option as defined in equation (2) and division i serves the downstream market as a monopolist of (residual) demand $P(Q^*_{-i}+q_i)$, with $Q^*_{-i}=\sum_{j\neq i} q^*_j$ the expected production of all the other divisions and q^*_j the equilibrium output of these divisions. U sets the fee to extract the extra rent created by the agreement, $f=\{P(Q^*_{-i}+q(w))-w\}\,q(w)-\pi^D(n)$, and then sets the marginal part of the tariff w to solve

$$\max_w \{\{P(Q^*_{-i}+q(w))-\underline{c}\}\,q(w)-\pi^D(n)\} \quad \text{(A2)}$$

But problem in (A2) is the maximization of the joint profits of the upstream firm U and division i, given (residual) demand $P(Q^*_{-i}+q_i)$, and for division i to choose the optimal production $q=\arg\max_{q_i}\{P(Q^*_{-i}+q_i)-\underline{c}\}q_i$, it is required that $w=\underline{c}$.

APPENDIX B: THE EQUILIBRIUM OUTCOMES WHEN $z\in\left(0,\frac{2}{9}\right)$

Number of divisions: $n^*_i=\frac{1}{\sqrt{2z}}-\frac{1}{2}$

Production per division: $q^*=\frac{\sqrt{z}}{\sqrt{2}}(\alpha-\underline{c})$

Total production: $Q^*=\frac{(\sqrt{2}-\sqrt{z})(\alpha-\underline{c})}{\sqrt{2}}$

Marginal wholesale price charged by the upstream firm U to each division: $w^*=\underline{c}$

Fee charged by the upstream firm U to each division: $f^*=\frac{(4-\sqrt{2z})z^{\frac{3}{2}}(\alpha-\underline{c})^2}{4\sqrt{2}}$

Profits of each downstream firm: $\Pi^{i*}=(\alpha-\underline{c})^2\frac{z^2}{8}\left[\left(\frac{2}{z}\right)^{\frac{1}{2}}-1\right]^3$

Profits of the upstream firm: $\Pi^{U*}=2n^*_if^*=\frac{(\sqrt{2z}-z)(2\sqrt{2z}-z)(\alpha-\underline{c})^2}{4}$

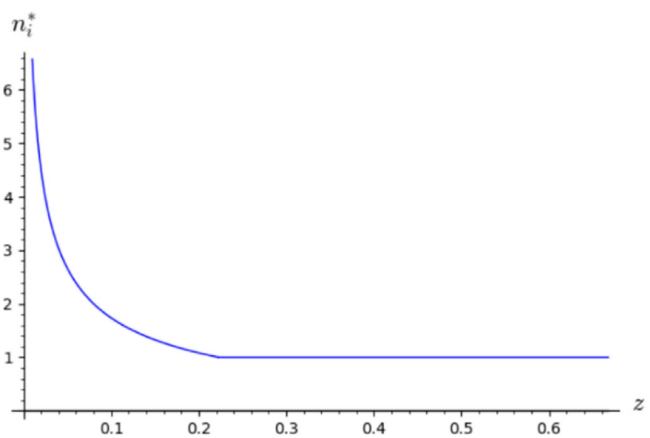

FIGURE B1 Equilibrium number of divisions per downstream firm.

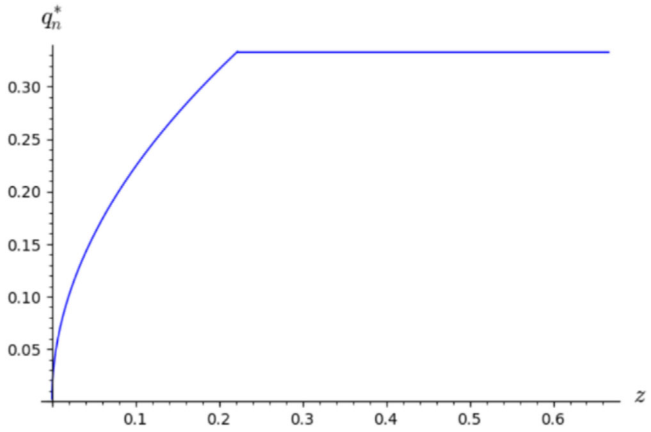

FIGURE B2 Production of each division, normalized, in equilibrium $q^*_n=\frac{q^*}{\alpha-\underline{c}}$.

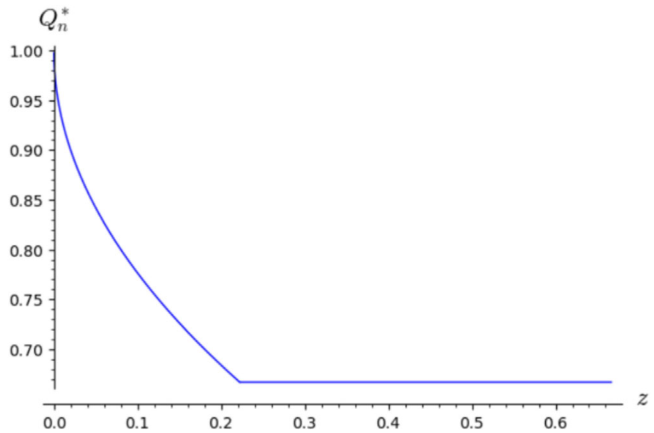

FIGURE B3 Total normalized production in equilibrium $Q^*_n=\frac{Q^*}{\alpha-\underline{c}}$.

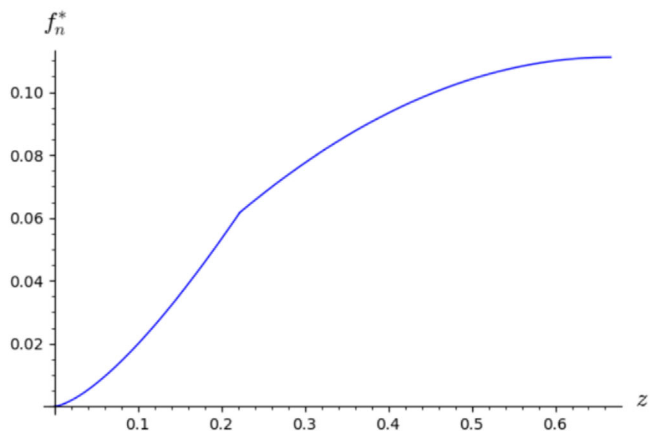

FIGURE B4 Normalized fee $f^*_n=\frac{f^*}{(\alpha-\underline{c})^2}$ charged to each division.

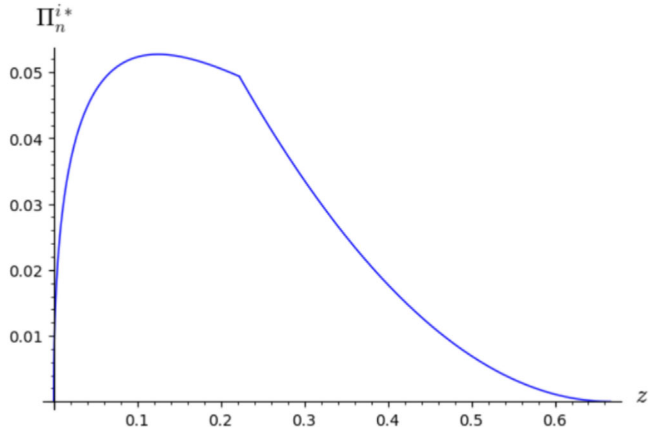

FIGURE B5 Normalized profits of a downstream firm, $\Pi_n^{i*} = \frac{\Pi^{i*}}{(\alpha - \underline{c})^2}$.

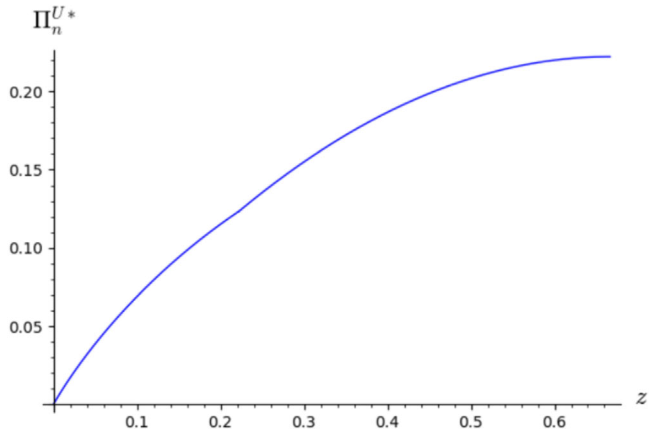

FIGURE B6 Normalized profits of the upstream firm $\Pi_n^{U*} = \frac{\Pi^{U*}}{(\alpha - \underline{c})^2}$.

All the equilibrium outcomes are plotted in the figures below along $z \in \left[0, \frac{2}{3}\right]$.

APPENDIX C: PROOF OF PROPOSITION 4

The profits of a division with observable contracts are given by

$$\pi^D(n,z) = (\alpha - \underline{c})^2 \left(\frac{1 + (1-2z)n^2}{2(n^3+1)}\right)^2 \text{ if } 0 \le z \le \frac{1}{2} \text{ where } n = n_i + n_j.$$

Then, the profits of downstream i are given by $\Pi^i(n_i, n_j, z) = n_i \pi^D(n,z)$ $\forall i = A, B$ and $i \neq j$. Firm i will choose the number of divisions n_i that solves

$$\max_{n_i} \Pi^i(n_i, n_j, z) \text{ subject to } n_i \ge 1 \tag{A3}$$

For an equilibrium where the number of divisions is interior, $n_i > 1$, $\forall i = A, B$, we must have

$$\frac{\partial \Pi^i(n_i, n_j, z)}{\partial n_i} = (\alpha - \underline{c})^2 \left(\frac{1 + (1-2z)n^2}{2(n^3+1)}\right) \left\{ \frac{1 + (1-2z)n^2}{2(n^3+1)} - \frac{n\left[3n + (1-2z)(n^3-2)\right]}{(n^3+1)^2} n_i \right\} = 0 \tag{A4}$$

For both conditions to be satisfied simultaneously, they require $n_i = \frac{(n^3+1)\left(1+(1-2z)n^2\right)}{2n[3n+(1-2z)(n^3-2)]}$ $\forall i = A, B$. Therefore, any equilibrium with divisionalization must be symmetric, $n_A = n_B$. But, when we evaluate $\frac{\partial \Pi^i(n_i, n_j, z)}{\partial n_i}$ at $n_i = n_j = n/2$, we have

$$\frac{\partial \Pi^i(n_i, n_j, z)}{\partial n_i}\Big|_{n_A = n_B = n/2} = -(\alpha - \underline{c})^2 \left(\frac{n\left(1 + (1-2z)n^2\right)}{4(n^3+1)^3}\right) \left\{(2n^3 - 1) - 3(1-2z)n^2\right\}, \tag{A5}$$

which is strictly negative for $n \ge 2$ and $0 \le z \le \frac{1}{2}$.

We can further check that, at $n_j = 1$, we have

$$\frac{\partial \Pi^i(n_i, 1, z)}{\partial n_i} = -(\alpha - \underline{c})^2 \frac{1 + (1-2z)(1+n_i)^2}{4\left(1 + (1+n_i)^3\right)^2} h(n_i, z) < 0. \tag{A6}$$

where $h(n_i, z) = (n_i^5 + 3n_i^4)(1-2z) + n_i^3(7-4z) + 2n_i^2(1+7z) - 2n_i(3-9z) - 4(1-z)$ is strictly positive for $n_i \ge 1$ and $0 \le z \le \frac{1}{2}$, since we have for $n_i \in [1, \tilde{n}_i]$ ($\tilde{n}_i \cong 1{,}553$ solves $n_i^3(2+n_i) = (2+7n_i)$) that $\frac{\partial h(n_i,z)}{\partial z} = -2(1+n_i)\left(n_i^3(2+n_i) - (2+7n_i)\right) > 0$ and $h(n_i, 0) = n_i^5 + 3n_i^4 + 7n_i^3 + 2n_i^2 - 6n_i - 4 > 0$; and for $n_i > \tilde{n}_i$, that $\frac{\partial h(n_i,z)}{\partial z} < 0$ and $h\left(n_i, \frac{1}{2}\right) = 5n_i^3 + 9n_i^2 + 3n_i - 2 > 0$.

Thus, as stated in the proposition, the equilibrium features no divisionalization, $n_A = n_B = 1$. QED.