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Résumé: Nous examinons l'impact de la structure horizontale et verticale d'un marché sur les incitations à l'innovation et sur la variété des produits. Nous considérons le marché d'un bien homogène où un producteur peut innover pour étendre sa gamme de produits en créant un nouveau produit substitut. Le coût de lancement du nouveau produit est fixe, et réparti entre les activités de production et de distribution. Nous montrons qu'une chaîne intégrée verticalement offre une plus grande variété de produits qu'une chaîne de monopoles. Si le coût de lancement du nouveau produit est réparti équitablement entre les deux secteurs, ou supporté essentiellement par l'amont, une concurrence imparfaite dans le secteur aval ne restaure que partiellement les incitations à innover de la structure verticale. En revanche, si ce coût est supporté principalement par le secteur aval, la concurrence en aval peut amener plus d'innovation que dans une structure verticalement intégrée.

Abstract: We examine the impact of horizontal and vertical market structure on innovation and product variety. We consider a market for a homogeneous good where it is possible to innovate to launch a new substitute product. The cost of launching the new product is fixed and spread between the manufacturing and the retail industries. We show that a vertically intergrated firm offers a wider variety of products than a chain of monopolies. If the cost of launching a new product is equally shared among the vertical structure or mostly supported by upstream firms, retail competition partially restores the incentives to innovate of the vertical structure. Yet when the cost of launching a new product is mostly supported by the retail sector, downstream competition even leads to more innovation than vertical integration.

Mots clés : Concurrence, Distribution, Relation verticale, Variété des produits

Key Words : Competition, Retailing, Vertical structure, Product variety

Classification JEL: L13, L22, L40

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Retail structure and product variety

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Abstract

In this paper, we examine the impact of horizontal and vertical market structure on innovation and product variety. We consider a market for a homogeneous good where it is possible to innovate to launch a new substitute product. The cost of launching the new product is fixed and spread between the manufacturing and the retail industries. We show that a vertically intergrated firm offers a wider variety of products than a chain of monopolies. If the cost of launching a new product is equally shared among the vertical structure or mostly supported by upstream firms, retail competition partially restores the incentives to innovate of the vertical structure. Yet when the cost of launching a new product is mostly supported by the retail sector, downstream competition even leads to more innovation than vertical integration.

1 Introduction

The market structure of the retail sector is an important policy issue in most developed countries. Since the seventies, the emergence of new store formats and the development of large and increasingly international retail chains, through diversification and external growth, have considerably modified the retail landscape. The increasing concentration of the retail industry has resulted in an oligopolistic structure in most European countries: the 5 main retail chains control about 65% of the food sales in the UK, 80% in France, 65% in Germany, 56% in Spain and up to 98.5% in Norway. Large mergers among retail groups have occurred in the nineties. The 2000 merger between Carrefour and Promodès has given birth to the second largest

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worldwide retail group with sales above 70 billions euro. In 1999, the American giant Wal Mart acquired the British supermarket chain ASDA, but the same year, the European Commission set restrictive conditions to the merger of the German retailers REWE and Meinl. The Commission even prohibited merger of the Finnish groups Kesko and Tuko in 1996. This trend towards increasing retail concentration leads to increased buying power from the retailers, and thus induces a shift in the balance of power between retailers and their suppliers, which has generated many conflicts. The retail industry may be compared to the bottleneck of an hourglass, controlling the links between numerous manufacturers of consumer goods and their consumers.

Public authorities have debated over the last years issues related to the bargaining power between producers and retailers in order to assess the economic consequences of increasing retail concentration (see, for instance, the green book on vertical restraints published by the European commission in 1997 or the official report by the British Office of Fair Trading of 1999). Broadly speaking, arguments against large retailers relate to the fact that a marked disequilibrium in the bargaining power between suppliers and retailers can be detrimental to the survival of small producers and especially to the variety of products available to the consumers.

Both retailers and suppliers consider the breadth of the product line as a crucial point in the bargaining process. On the one hand, producers implement innovation strategies that segment the market in order to discriminate between different types of consumers. They thus tend to extend their product lines. On the other hand, retailers fear brand proliferation as it increases costs associated with inventory control and involves increasing marketing and promotion expenses. As a consequence, retailers often impose contracts that limit the number of products available on the shelves. Hence the economic incentives to produce and distribute a new variety differ according to the side of the vertical relation. While producers expect their new products to increase demand by building new niches, retailers fear market segmentation that increases distribution costs (Marvel and Peck, 2000). Upstream and downstream firms' goals can thus diverge and harsh commercial bargaining talks reflect these divergences.

In order to understand the economic forces behind the conflict, we analyze the incentives to supply variety in a vertically related industry between innovating producers, retailers and consumers. We determine the effect of the vertical relation on social welfare by studying the incentives to increase product variety according to the competitiveness of the downstream sector. We focus on two main points: the size of the innovation, i.e. its novelty, and the fixed costs of launching the new product, split up into production and retail costs related to inventory control and promotion. We study a vertical relation between a monopolist producer and a retail sector, which is successively monopolistic and oligopolistic. The producers develop a new product (that we will also refer to as "innovation") that is costly to develop and that generates distribution costs. We analyze how the way these fixed costs are shared between producers and retailers influence the incentives to offer a new variety.

It is difficult to assess the costs associated with the launching of a new product. Deloitte and Touche (1990) estimate that this cost is on average \$222 per item and per store for a producer. The cost can be broken down as follows: 18% comes from research and development, 66% from marketing expenses, and 16% in slotting allowances that can reach \$36.4 per item and per store. For a retailer, costs related to assessing the market potential of a product, changing the information processing system and inventory control are smaller (about \$13.5 per item and per store). However, these costs do not include the opportunity cost related to shelf space occupied by the product line that could have been granted to another product, nor the marketing efforts that are required to sell the new product, nor the cost of deleting another item from the catalogue that can reach, according to the same study, \$11 per item per store. Of course, these estimates must be taken with caution since these costs greatly vary according to the nature of the new product.

From an empirical perspective, the difficulty to correctly measure these costs and the strategic dimension of the issue certainly explain why there are few studies on this topic. A recent survey of German food producers (Weiss and Wittkopp, 2005) highlights a negative relationship between the bargaining power of large retailers and the introduction of new products. However, this effect is reduced by the market power of producers. While there is a huge literature on the economic analysis of vertical relationships on the one hand, and on innovation and incentives to innovate on the other hand, there has been little work on the incentives to innovate in a vertically separated industry. Yet most of the consumers' goods are sold through a vertical channel, and the producers have to deal with retailers to sell their products. Lariviere and Padmanabhan (1997) analyze slotting allowances paid by producers to distribute their products through retail channels. In a chain of monopolies, they show that a producer who is better informed on demand conditions than the retailer can set high wholesale prices in order to signal a high expected demand. The producer thus pays a slotting allowance that increases with the fixed distribution cost supported by the retailer. However, their analysis takes the innovation decision as given and does not take competition between retailers into account.

Brocas (2002) is closer to our analysis, but she deals with a process innovation and not a product innovation on the one hand, and on the other hand, the vertical structure that links the research unit to the producers does not include a retailer. Her article analyses the effect of competition and vertical integration between producers and the research units on the incentives to innovate. Research units license their process innovation that can be more or less substitutable. The efficiency of a vertical integration between research units and producers depends on the substitutability and the size of the innovation. We assume on the contrary that R&D activities are carried out in-house.

Product variety in a competitive and vertically structured setting also involves bargaining issues. Inderst and Shaffer (2003) analyze the effect of a horizontal merger between non-competing retailers (assuming for instance that they are operating on two distinct geographical areas) on the variety offered to consumers. They show that after the merger and in order to improve their bargaining power with the producers, retailers might have to remove some products from the shelves: making their product lines more uniform would enable them to get better bargaining terms with their suppliers. In this case, an increase in the bargaining of the retailers leads to a decrease in product variety. However, rather than looking at product line simplification, we address the question of launching new products when it incurs specific costs.

Our article contributes to the literature on three points. First, we show that a vertically integrated structure better internalizes the fixed costs of R&D and marketing than a chain of separated monopolies and offer a larger variety of products. This first result rests on a classical reduction of the inefficiency related to the double margin that limits product innovation. Next, we show that a situation in which retailers are competing gives more incentives to improve the product line than a chain of monopolies, mainly by reducing vertical inefficiencies. Finally, we show that competition between retailers can surprisingly lead to more product innovation than a vertically integrated structure when the cost of launching the new product is mainly borne by the upstream firm. This result stems from the fact that the producer might strategically reduce competition between retailers by charging them retail prices that force them to specialize. In this case, one of the retailers specializes in the new product, while the other only sell the old product. By reducing competition in such way, this situation allows the producer to reduce the costs associated with the new product, where a vertically integrated structure would not have innovated. In addition, we show that this increase in product variety is welfare-enhancing.

The remainder of the article is organized as follows. First, we study the decision of a producer who sells his products through a vertically separated chain of monopolies in Section 2. Next, we analyze in section 3 a situation where the same producer faces two retailers who compete for his products. The last section concludes the article.

2 The model

We consider a vertical relation between a producer P and her retailer D. We assume that the producer is unable to set up shop and sell independently. She initially produces a good A at a constant marginal cost c_A that we normalise to zero without loss of generality. The producer can invest a fixed cost Ω to innovate and then produces also a substitute good B with a constant marginal cost $c_B = c_A = 0$. Products A and B are horizontally differentiated: we consider here product innovation as a mean to improve product variety, not product quality. Inverse demand is linear and translates consumers' taste for variety, with P_I the unit price of good I, and q_I the quantity of good I on the market ($\{I, J\} = \{A, B\}$):

$$P_I(q_I, q_J) = 1 - q_I - cq_J$$

Parameter c, that we assume to be in [0,1[, measures the substitution between the two goods. The retailer distributes the product A without cost. However if he decides to introduce the new product on the final market, he has to incur a fixed cost of marketing and inventory control, noted F. The retailer also faces a constant marginal cost of distribution independent of the type of product that is distributed, which we normalise to zero. The exogenous parameters of the models are: c, Ω, F.

We compare the producer's incentives to invest the fixed cost of innovation Ω in two different cases: when the producer and the retailer are vertically integrated and when they are separated.

2.1 The benchmark case: vertically integrated monopoly

We first consider as a benchmark a situation in which the producer and the distributor are vertically integrated. The integrated unit only innovates and sells both products if it is profitable to do so. If the vertically integrated structure does not innovate, it sells only A in quantity $q_A = \frac{1}{2}$, and with profit $\Pi_A^{VI} = \frac{1}{4}$. As introducing the new product involves a fixed cost, the structure that innovates has to choose whether to continue selling product A in addition to product B or not (selling only B is a dominated strategy, as it would lead to a maximum profit of $\Pi_B^{VI} = \Pi_A^{VI} - \Omega - F$). If on the contrary the vertically integrated structure chooses to distribute both products, the profit-maximizing quantities are then $q_A = q_B = \frac{1}{2(1+c)}$, and the profit $\Pi_{A+B}^{IV} = \frac{1}{2(1+c)} - F - \Omega$.

The vertically integrated monopoly thus innovates and sells both products if and only if it leads to higher profits than without innovation, which is equivalent to the following condition:

$$F + \Omega \leq \frac{1-c}{4(1+c)}$$

Thus the new product is profitable to market as long as the total fixed cost of producing and retailing the new good are not above a threshold level that decreases with the substituability between products: as c tends to 1 and products become more substitutable, the firm is less likely to introduce the new product as its profits become smaller. In a vertically integrated structure, this classical cannibalisation effect is driving innovation decisions.

2.2 Product variety in a vertically separated chain

We now study how the innovation decisions of a vertically separated industry depend on how the total fixed cost is shared between the producer and the retailer. When the producer and the retailer are vertically separated, the innovation decisions are taken sequentially. Formally, the producer and the retailers play the following game: in the first stage, the producer decides whether to increase her product line and accordingly spends the fixed cost Ω. Then she sets the two wholesale prices w_A and w_B , each in[1] $[0, 1]$. In the second stage, the retailer decides which goods to sell to the consumers (and whether to pay the fixed cost F) and which quantities q_A and q_B to order. The last stage is consumption in the downstream market. We are looking for the subgame perfect equilibria of this game. Vertical separation, inducing a double margin externality, modifies the incentives to innovate for the producer.

[1]Any wholesale price above 1 would lead to a zero demand, and would thus not be rational, so that we can make this assumption without loss of generality.

2.2.1 Downstream listing and pricing strategy

In the second stage, the retailer chooses his listing strategy given the wholesale prices charged by the producer. If, on the one hand, he decides to distribute the old product only, he orders the optimal quantity $q_A = \frac{1-w_A}{2}$ and gets a profit $\Pi^D = \frac{(1-w_A)^2}{4}$ while the producer gets $\Pi^P = \frac{w_A(1-w_A)}{2}$, possibly less the fixed cost Ω. If, on the other hand, the retailer decides to distribute product B only, provided that the upstream firm has innovated, he has nevertheless to pay the fixed cost F. He then maximizes his profit by ordering the quantity $q_B = \frac{1-w_B}{2}$ and makes a profit of $\Pi_B^D = \frac{(1-w_B)^2}{4} - F$. Finally, if the retailer chooses to distribute both products, he orders quantities $q_I = Max\{0, \frac{1-w_I-c(1-w_J)}{2(1-c^2)}\}$ (with $\{I, J\} = \{A, B\}$).

Given the wholesale prices w_A and w_B, the retailer determines his listing strategy by comparing his profits with or without the new product. Regardless of w_A and w_B, the retailer always prefers to distribute both goods instead of only product B: the strategy of selling the new product only is dominated by the strategy of selling both products. In addition, if $w_B \geq 1 - c + cw_A$, the retailer would make losses if he sold both products, in which case he prefers to save on the fixed cost F and sell product A only. In the other cases, the optimal listing strategy depends on the fixed cost F. Finally, the retailer distributes the new product only if the fixed cost F of marketing is smaller than a threshold level that decreases with the wholesale price w_B:

$$F \leq \frac{(1-w_A)^2 + (1-w_B)^2 - 2c(1-w_A)(1-w_B)}{4(1-c^2)} - \frac{(1-w_A)^2}{4} \qquad (1)$$

The following figure illustrates the listing choice of the retailer in the (w_B, F) plane for a given value of w_A.

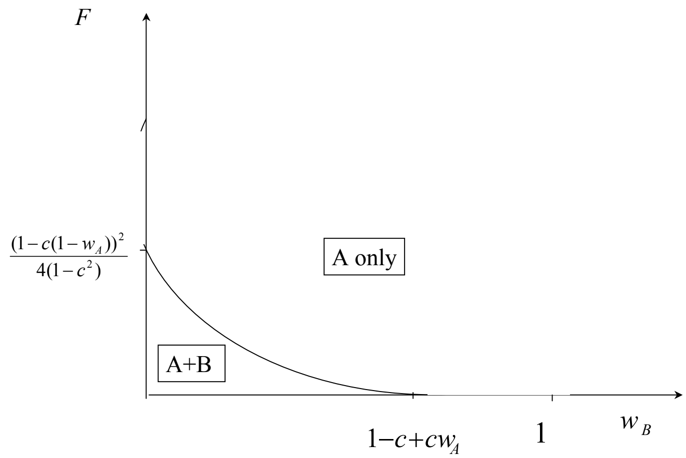

Figure 1: listing strategies of the retailer

2.2.2 Upstream strategy

In the first stage, the producer decides whether to innovate and sets the wholesale prices anticipating the outcome of the second stage. If she does not innovate, she sets a wholesale price of $w_A = \frac{1}{2}$ that corresponds to a maximal profit of $\Pi_A^P = \frac{1}{8}$. If on the contrary she innovates, she has to make sure that the retailer will list the new product as she would make at most $\Pi_B^P = \frac{1}{8} - \Omega$ otherwise. She then sets the two wholesale prices in order to maximize her profit under the constraint (1), which guarantees that the retailer will list both products. The only interior solution is $w_A^* = w_B^* = \frac{1}{2}$ as long as $F \leq \frac{1-c}{16(1+c)}$. For higher values of the fixed cost of distributing the new product, the producer has to adopt a limit-pricing strategy that induces the retailer to sell both products. The corner solution is to set a price $\widetilde{w}_A = \frac{1}{2}$ for the old product and $\widetilde{w}_B = 1 - \frac{c}{2} - \sqrt{4F(1-c^2)}$ for the new one. Finally, the comparison of the expected profits in each case determines the optimal strategy of the producer in the first stage (see appendix 1 for the details). Figure 2 compares the resulting equilibria with the corresponding solution under the vertically integrated structure. The necessary condition under which a chain of monopolies innovates is more binding than the corresponding condition for a vertically integrated structure.

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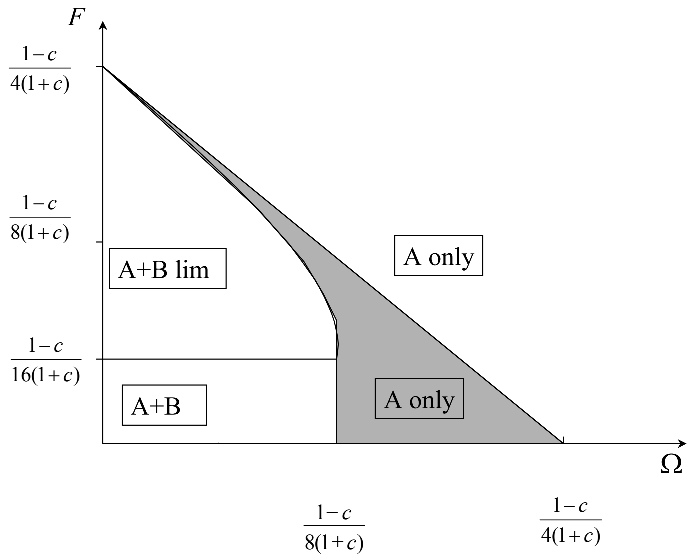

Figure 2 : Comparison of innovation strategies

The grey area indicates the values of fixed costs for which a separated chain of monopolies would not innovate even though an integrated firm would.

Proposition 1 *Vertical separation in a chain of monopolies can reduce product variety.*

In other words, an integrated structure has better incentives to distribute a new product than a separated structure. This results from the double margin externality: the standard issue of coordination in a non-integrated vertical relation generates a new form of inefficiency by reducing the profitability of the new product.

Notice that in this simple case, a two-part tariff associated to a tying contract, or a two-part tariff with a fixed fee independent of the range of products sold by the retailer, would be sufficient to restore the incentives: when innovation increases total profits, the upstream firm can set wholesale prices equal to the marginal costs (here, zero) and get the whole profit[2] through the fixed fee. However, if the two goods have to be priced singly, with two-part tariffs w_A, F_A and w_B, F_B, the upstream producer is not able to get all the profit anymore because she has to leave a rent to the retailer in order to have him selling the two goods. The producer has to give the retailer

[2]This point relies on the assumption that the producer has all bargaining power, and is only to enable a comparison with the classical principal-agent literature on double margin. Of course, this assumption would be unrealistic in most industries, including the music sector.

an incentive to list both products rather than only one of them, which requires the following incentives constraints to be satisfied, where Π_D^I is the variable part of the retailer's profit (excluding the payment of the fixed costs) : $\Pi_D^{A+B} - F_A - F_B \geq \Pi_D^A - F_A$ and $\Pi_D^{A+B} - F_A - F_B \geq \Pi_D^B - F_B$, which implies that $2\Pi_D^{A+B} - \Pi_D^A - \Pi_D^B \geq F_A + F_B$. Yet $\Pi_D^{A+B} < \Pi_D^A + \Pi_D^B$ because the products are substitutes. Thus $F_A + F_B < \Pi_D^{A+B}$: finally, even if the producer can delegate the optimal choices to the retailers by setting variable prices to her marginal costs of production, she cannot get the whole profit of the vertical structure through the fixed part $F_A + F_B$.

Furthermore, it is interesting to observe that the incentives to distribute the new product are more sensitive to the fixed cost of production Ω than to the fixed cost of distribution F. Indeed, when the latter is high, the producer can adapt her wholesale price by setting a limit price that leads the retailer to distribute both products. On the contrary, when the fixed cost of production is high, the retailer cannot commit to share the cost spent by its vertical supplier who unilaterally decides not to introduce the new variety.

3 Competition in the retail industry

We have seen in the first part that vertical separation of the activities of production and distribution can reduce product variety. However, it is well known that downstream competition reduces double margin problems: we address here the question of how retail competition can affect product variety, when variety brings about fixed costs at both levels. We thus analyze the effect of imperfect competition between two retailers on the incentives of an upstream firm to introduce a new variety. We look now at the following situation: two retailers D_1 and D_2 sell producer P 's production to the consumers. The 3-stage game is as follows. In the first stage the producer decides whether to innovate or not and sets the wholesale prices. In the second stage, the retailers simultaneously decide whether to invest the fixed cost to be able to sell the new product. This cost is sunk. In a third stage, as the outcome of the investment decisions are made public, the retailers simultaneously order the quantities of the two goods they are going to put on their shelves, and the prices on the final market are determined by the consumer inverse demand. Retail competition is thus à la Cournot. The fixed cost F is sunk and represents a commitment[3] of the retailers on their listing

[3] In a previous version of this article, we solved the game without this commitment effect of the sunk cost, considering that stages 2 and 3 were simultaneous. This led to more equilibria: for a

choices: if a retailer does not pay F in the second stage, he will not be able to sell the new product in stage 3. We solve this game for subgame perfect equilibria.

3.1 Downstream quantity competition

In this section we determine the equilibrium outcome of downstream competition, given wholesale prices (w_A, w_B) and the investment decisions of the second stage. We assume that wholesale prices are smaller than 1, a necessary condition for products to be profitable to market. At the third stage of the game, retailers are already committed to their listing strategies, and there are three different subgames to analyze (plus the symmetric ones): either both retailers have invested the sunk cost F, or one only, or none of them.

3.1.1 No retailer has invested

In this first subsection, only one good is distributed: A. Downstream competition is thus a simple monoproduct Cournot game. There exists a unique equilibrium where the two retailers sell the same quantity of the old product A: $q_A^1 = q_A^2 = \frac{1-w_A}{3}$. Both retailers make profit $\Pi_A^D = \frac{(1-w_A)^2}{9}$.

3.1.2 Both retailers have paid the fixed cost

In this configuration, each retailer chooses two quantities (possibly setting them to zero). Solving the Cournot game leads to the following strategies according to the values of the wholesale prices (technical details are given in the Appendix). If the wholesale price of good B is too high, only good A is distributed. On the contrary, for small values of w_B, only the new good is distributed. Finally, there exists an equilibrium in which both goods coexist on the shelves for intermediary values of w_B. In addition, the set of values of w_B for which both products are distributed shrinks with c, the degree of substitutability of the two products: the lower bound on w_B below which the retailers only distribute B increases with c, while the upper bound above which the retailers only sell the old good decreases with c. Indeed, for high values of c, products are highly substitutable and compete for shelf space, in which case the retailers prefer to only distribute the most profitable good. We also show

given configuration of retail costs, several equilibria existed. However, our results were qualitatively similar.

that the same set of values of w_B shrinks with w_A. However, now, both the upper and the lower bounds of the interval shift to the right as w_A increases. This shift translates the fact that the profitability of A decreases with w_A regardless of whether product B is also distributed or not. We should also point out that in this subgame, none of the asymmetric market configurations arises at equilibrium, although they were *a priori* possible.

3.1.3 Asymmetric configuration: one retailer only has paid the sunk cost

In this subgame, one of the retailers can only sell product A. We refer to this retailer as retailer 2. The other retailer chooses his listing strategy. We completely solve the downstream Cournot subgame in the Appendix. There are 4 configurations to analyze according to the values of w_B. Only good A is distributed if the wholesale price of B is too high, and this threshold is identical to the one found in the previous subsection. For values of w_B slightly below this threshold, both goods are distributed by the retailer who has invested the fixed cost of marketing the new product. For even smaller values of w_B, this retailer only distributes good B while his competitor is constrained to sell only good A. Finally, for very small values of w_B, the retailer who did not spend the fixed cost to distribute the new good must exit the market, leaving his competitor in a monopoly situation in the market for good B. Notice that in that case, retailer 1 still leaves good A out of the shelves to avoid cannibalization of the sales of good B. As in the previous subsection, the set of values of w_B for which the new product is distributed shifts to the right as w_A increases and the size of the interval decreases as parameter c increases.

It is interesting to observe that asymmetric equilibria with downstream specialization are due to the commitment value of the sunk cost F. Indeed, in a Cournot game without this commitment effect, the retailers do not have incentives to specialize: a retailer who did not pay the fixed cost could always deviate from the equilibrium strategy by reducing the quantities of A on the shelves and by offering a small but positive quantity of B. When the fixed cost F is sunk, the retailer who has paid it knows that, at the last stage of the game, his competitor can not sell good B. Under this assumption, for small values of w_B, distributing good A will only cannibalize sales from good B and this retailer prefers to leave his competitor in a monopoly position on the market for good A, while enjoying a monopoly position on the market for good B.

We can now analyze the investment decisions of the retailers at the second stage of the game.

3.2 Investment decisions

This stage of the game is only played if the producer has developed the new product. Retailers have to choose whether to invest the fixed cost or not in order to distribute the new product. They take wholesale prices w_A and w_B as given and anticipate downstream market outcomes.

There are five market configurations in this subgame. In the symmetric equilibria each retailer only sells the new good, or only the old one, or both. In the first asymmetric configuration, each retailer specializes in only one good. In the second asymmetric case, one retailer only sells the old good and his competitor sells both goods. The following figure summarizes these configurations, which are detailed in appendix 2.

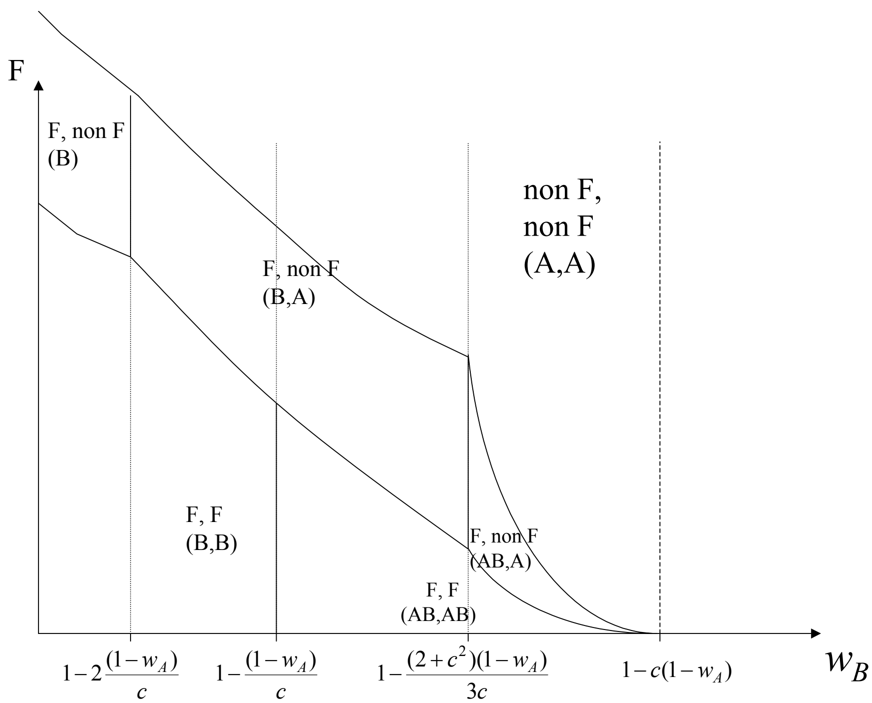

Figure 3 : downstream subgame equilibria with competition

For given values of the wholesale prices, equilibria in which good B is sold disappear as the fixed cost of marketing the new product increases. Moreover, the higher the value of w_B the lower the profits generated by sales of B. These results confirm the intuition that for low values of the wholesale prices and of the fixed costs, both retailers invest to distribute good B, while for high values of F and w_B, the total cost of distributing the new product is too high and both retailers symmetrically choose to stick to the old product. The commitment value of the sunk cost F has an interesting implication: for intermediate values of F, retailers adopt a "specialization" strategy that is characterized by the fact that only one retailer invests in the distribution of the new good (possibly together with product A) and the other retailer only distributes the old product.

3.3 Innovation decision

In the first stage of the game, the producer decides whether to introduce the new variety and determines the wholesale prices. She anticipates the strategies of the retailers in stage 2 and sets her product lines and the wholesale prices in order to maximize her profits. The subgame perfect equilibrium outcomes are detailed in Appendix A4 where we also compare profits of the different players with those obtained in the chain of monopolies. The main results are summarized in proposition 2.

Proposition 2 *A producer facing a competitive downstream market innovates more often than if she faced a single retailer.*

Proof : see appendix A4. ■

More precisely, when the fixed costs of introducing the new variety are such that the chain of monopolies innovates, a producer who faces a competitive downstream market also innovates. However, there are parameter configurations in which the chain of monopolies does not innovate whereas the downstream competition leads to innovation. This situation occurs in two areas where one of the fixed costs is large and the other is small (see Figure 4). In the first area, the total cost of introducing the new variety is mainly supported by the producer. When the downstream fixed cost is relatively small ($F \leq \frac{1-c}{36(1+c)}$ and $\Omega \in \left[\frac{1-c}{8(1+c)}, \frac{1-c}{6(1+c)}\right]$), a chain of monopolies does not introduce the new product, while downstream competition allows the producer to charge wholesale prices that are below the unconstrained optimum $(w_A = w_B = 1/2)$. Donwstream competition increases the quantities of both goods sold by the producer who can then bear a larger fixed cost of innovation than when she faces a single retailer. For larger values of F, the producer reduces the wholesale price of the new product to give incentives to the retailer to distribute it. This limit-pricing strategy is profitable as long as the fixed cost is not too large and as retailers keep distributing the new product, i.e. until $F = \frac{1-c}{16(1+c)}$. In the area being discussed, the competitive downstream market has a higher innovation rate mainly because competition reduces the double margin externalities, which makes the new product more profitable to introduce for the producer.

For intermediate values of the fixed costs, downstream competition does not lead to more product introduction than the chain of monopolies: the area in which the new product is marketed is the same under the two structures. Indeed, competition between retailers reduces profits and make it harder to support the fixed costs. As a matter of fact, in this area, only one retailer distributes the new product, while both retailers keep distributing the old product. The quantity of good B sold under this configuration is the same as in the vertically separated monopoly case; the profits generated by sales of good B are also identical. It would be too costly for the producer to charge wholesale prices that give more incentives to the retailers to distribute the new product, as the producer also faces a fixed cost of innovating. Thus, the producer facing a competitive downstream market has the same innovation incentives as when he only faces a single retailer.

On the contrary, as the fixed distribution cost increases even more and the share of the total cost supported by the producer shrinks, downstream competition leads to a new area where the competitive structure innovates more than the chain of monopolies. This area only exists when the products A and B are rather close substitutes (for $c \geq 1/2$). In this case, for F in the interval $[\frac{1-c^2}{36c^2}, \overline{F}]$ where $\overline{F} \geq \frac{1-c}{4(1+c)}$, product B is distributed when Ω is relatively small. This area is larger under downstream competition than in the chain of monopolies. Indeed, the fixed cost of innovating of the producer being small, she can afford a lower wholesale price w_B that leads one of the retailers to distribute the new good. This product line extension increases total demand. In this area, the commitment value of the fixed cost F analyzed in the second stage of the game leads the retailers to specialize: each retailer sells only one of the goods and has a monopoly position on its market. This market configuration leads to a paradoxical outcome. When the fixed cost F is large, retailers specialize in the distribution of only one good, which increases the profitability of the new product but limits competition between retailers. It is worth stressing that the strategy of specialization is only feasible when both products are relatively close substitutes, i.e. when products are competing for shelf space. This implies that the retailer who chooses to distribute the new product gives up the old product to avoid cannibalization.

To summarize, downstream competition increases the rate of innovation through two mechanisms: a classical mechanism related to a reduction in the vertical externality and a strategic mechanism related to the specialization of the retailers, which is conditioned by the commitment value of the fixed cost of marketing the new product. We can now compare the incentives to innovate when retailers are competing to the incentives of a vertically integrated structure.

Proposition 3 *If the two goods are poor substitutes ($c \leq 1/2$), a producer selling her products through a competitive downstream sector introduces less variety than a vertically integrated monopoly;*
If the two goods are close substitutes ($c \geq 1/2$), a competitive retail industry innovates less than a vertically integrated monopoly except when the share of the total fixed cost of introducing the new variety supported by the producer is small ($F >> \Omega$).

Proof: see appendix A.5. ■

We illustrate Proposition 2 and 3 in the following figure in the (Ω, F) plane (for $c \geq 1/2$).

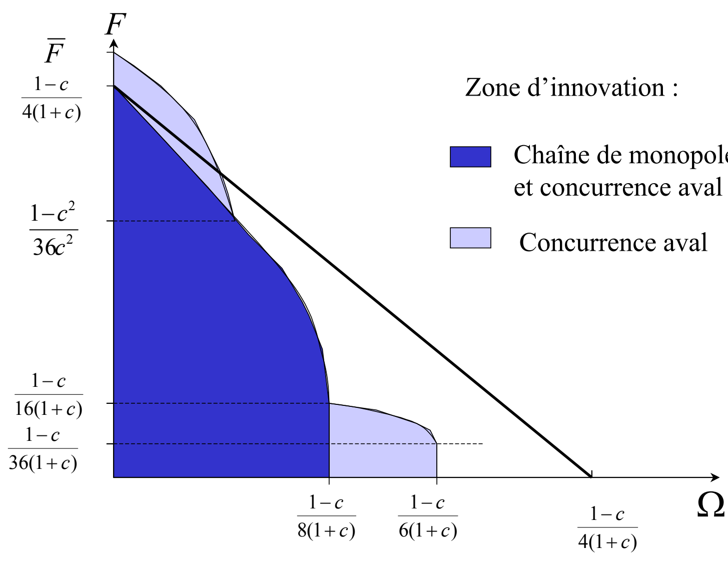

Figure 4 : comparison of equilibrium innovation strategies

Even if downstream firms are competing, the vertical externality related to the double margin remains and lowers the incentives to innovate of the producer. This effect dominates when the distribution cost (F) is low. In this case, the vertically separated structure innovates less than a vertically integrated monopoly. However, an opposite vertical effect appears when the new product is less profitable to market (i.e. when F is large compared to Ω) and is a close substitute to the old product (i.e. c is large). Now, the upstream firms soften downstream competition by setting wholesale prices so as to enforce an asymmetric retail market in which one firm distributes the old product and another firm distributes the new product. Hence, specialized firms do not directly compete for the new product. This market environment can sustain innovation when a vertically integrated firm would not innovate.

Proposition 3 has several implications. First, from an empirical perspective, the strategy of the upstream firm of relaxing the competitive pressure in the downstream market is observed for a new product that is costly to distribute and that strongly substitutes to the older product. In this case, even if retailers specialize, downstream competition is relatively strong (at the second stage of the game). Secondly, competition authorities do not generally frown upon vertical mergers because of the vertical externality. In our model, a vertical integration can have a negative effect on innovation strategies if the innovation is costly to market but relatively cheap to produce (incremental innovation), whereas a vertically integrated structure innovates more when the innovation is costly to produce but not too costly to market (radical innovation).

Finally, total surplus (net of the fixed costs) is defined as $W(Q_A, Q_B; c) = Q_A + Q_B - \frac{1}{2}(Q_A^2 + Q_B^2) - cQ_AQ_B$. It is easy to show that the total welfare at equilibrium, $W^*(c) = W(Q_A^*(c), Q_B^*(c))$, is decreasing in c for $0 < c < 1$ in each product configuration. Moreover, for almost each equilibrium listing strategy, total surplus is higher under vertical integration, followed by downstream competition and then vertically separated monopolies. In the case in which a competitive retail sector distributes the new product but the vertically integrated structure does not, total surplus is higher when there is innovation: competition increases social surplus by increasing the variety offered to consumers, when the cost of launching the new product is mainly supported by the upstream firm, and when the new product is a close substitute to the old one.

4 Conclusion

We have explained how a market's vertical and competitive structures influences endogenous product variety choices, when the launching of a new product involves fixed costs of distribution as well as fixed costs of production. We have highlighted several mechanisms -both horizontal and vertical- behind this influence. First of all, the profit-cutting effect of double marginalization reduces the incentives to invest in the launching of a new product. In a chain of monopolies, vertical integration thus favours the adoption of a new product that increases the scope and the variety of products distributed to consumers with heterogeneous tastes. Thus, vertical separation of the production and the distribution activities may generate conflicts of interest between the vertically related firms, which translates into a lower innovation effort and leads to too few products distributed to the consumers. To restore the vertical efficiency, two-part tariffs with a franchise fee independant of the range of products distributed, or sophisticated contracts including full-line forcing clauses would be necessary.

Downstream competition may however soften the vertical inefficiencies. When we analyze a more complex framework with a producer launching a new product and two competing retailers, the effect of competition on the incentives to increase product variety depends on the degree of novelty of the new product, and also from the allocation of the fixed costs between upstream and downstream firms. If manufacturing and retail activities are vertically separated, then downstream competition leads to more variety than does retail concentration. In addition, vertical separation with downstream competition may lead to more or less innovation than vertical integration, depending again on the allocation of fixed costs and on the degree of product substitution. When the retail costs are less than the manufacturing costs of launching the new product, retail competition, by reducing downstream profits, lessens the retailer's ability to invest in the fixed cost, and thus hinders the development of the new product. In that case, a vertically integrated firm would launch the new product more often than an upstream monopoly facing two competing retailers. On the contrary, when the new product is more costly to sell than to manufacture, a vertically separated structure with downstream competition may innovate more than a vertically integrated monopolist because retailers are ready to sell the new product even with high costs in order to segment the downstream market. In terms of policy implications, our model stresses the necessity to preserve competition at the retail level to support innovation.

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A Appendix

A.1 Equilibrium in the chain of monopolies

Retailer's strategy If only product A is available, the retailer orders $q_A = \frac{1-w_A}{2}$, gets profit $\Pi^D = \frac{(1-w_A)^2}{4}$,and the producer's profit is $\Pi^P = \frac{w_A(1-w_A)}{2}$.

If the retailer lists both products, his maximum profit is:

$\Pi_{A+B} = \frac{(1-w_A)^2+(1-w_B)^2-2c(1-w_A)(1-w_B)}{4(1-c^2)} - F$ and is attained for the following quantities $(\{I,J\} = \{A,B\})$:

$$q_I^{A+B} = Max\{0, \frac{1-w_I-c(1-w_J)}{2(1-c^2)}\}$$

Producer's strategy The comparison of her anticipated profits gives the producer's optimal strategy in the first stage:

-if $F \leq \frac{1-c}{16(1+c)}$ and $\Omega \leq \frac{1-c}{8(1+c)}$, she innovates, sets the optimal wholesale prices $w_A^* = w_B^* = \frac{1}{2}$ and gets the interior optimal profit $\Pi_{A+B}^P = \frac{1}{4(1+c)} - \Omega$.

-if $F \geq \frac{1-c}{16(1+c)}$ and $\Omega \leq \sqrt{F(\frac{1-c}{1+c})} - 2F$, she innovates, sets the optimal wholesale price $w_A^* = \frac{1}{2}$ and the limit-price $\widetilde{w}_B = 1 - \frac{c}{2} - \sqrt{4F(1-c^2)}$, and gets profit $\widetilde{\Pi}_{A+B}^P = \frac{1-16F}{8} + \frac{\sqrt{F(1-c^2)}}{1+c} - \Omega$.

-if $\Omega \geq \frac{1-c}{8(1+c)}$ or $F \geq \frac{1-c}{16(1+c)}$ and $\Omega \geq \sqrt{F(\frac{1-c}{1+c})} - 2F$, she does not innovate, sets $w_A = \frac{1}{2}$, and gets profit $\Pi_A^P = \frac{1}{8}$.

A.2 Downstream competition : third stage of the game

If both retailers have paid the fixed cost F, downstream Cournot equilibrium are as follows, for given values of the wholesale prices :

- if $w_B \geq 1 - c(1-w_A)$, only A is sold.
- if $1 - c(1-w_A) \geq w_B \geq 1 - (1-w_A)/c$, each retailer sells both goods.
- if $1 - (1-w_A)/c \geq w_B$, only B is sold.

If only one retailer, say 1, has paid the fixed cost F, downstream Cournot equilibrium are as follows :

- if $w_B \geq 1 - c(1-w_A)$, only A is sold by both retailers.
- if $1 - c(1-w_A) \geq w_B \geq 1 - \frac{(1-w_A)(2+c^2)}{3c}$, retailer 1 sells both goods in quantities $q_A^1 = \frac{(2+c^2)(1-w_A)-3c(1-w_B)}{6(1-c^2)}$, $q_B^1 = \frac{1-w_B-c(1-w_A)}{2(1-c^2)}$ and his competitor sells only good A in quantity $q_A^2 = \frac{1-w_A}{3}$.

- if $1 - \frac{(1-w_A)(2+c^2)}{3c} \geq w_B \geq 1 - \frac{2(1-w_A)}{c}$, the retailers specialise in a narrower range of products: retailer 1 sells only B and his competitor only A .

- if $1 - 2(1 - w_A)/c \geq w_B$, there exists a unique equilibrium where the retailer who did not invest the fixed cost exits the market (or sells a zero quantity of good A) while the other one enjoys a monopoly situation over the two goods, but chooses not to sell good A in order to avoid cannibalisation of his sales of good B. Then he chooses to sell the monopoly quantity of the new product: $q_{B,\varnothing}^{1M} = \frac{1-w_B}{2}$.

A.3 Retailers' investment strategies

In the second stage, in the subgame where the producer has innovated, and given the wholesale prices w_A and w_B :

A.3.1 if $w_B \geq 1 - c(1 - w_A)$,

In that case, the wholesale price of new product is so high that even if a retailer pays the fixed cost F, he cannot sell the new product with profit, whatever his competitor's strategy might be. Thus both retailers decline to invest in the fixed cost, and in the following stage A will be the only product available.

A.3.2 If $1 - \frac{(1-w_A)(2+c^2)}{3c} \leq w_B \leq 1 - c(1 - w_A)$,

Anticipating the third stage outcomes, the second stage choices can be summarised in the following normal form game, where F denotes the choice of paying the fixed cost and non F the other strategy :

	F	non F
F	$\Pi_{AB,AB}^D, \Pi_{AB,AB}^D$	$\Pi_{AB,A}^1, \Pi_{AB,A}^2$
non F	$\Pi_{AB,A}^2, \Pi_{AB,A}^1$	$\frac{(1-w_A)^2}{9}, \frac{(1-w_A)^2}{9}$

Comparing these profits gives the following subgame equilibria :

if $F \leq \frac{(c(1-w_A)-(1-w_B))^2}{9(1-c^2)}$, both retailers pay F and sell both goods in the third stage;

if $\frac{(c(1-w_A)-(1-w_B))^2}{9(1-c^2)} \leq F \leq \frac{(c(1-w_A)-(1-w_B))^2}{4(1-c^2)}$, only one retailer invests F to sell both goods, and his competitor sells only A;

if $F \geq \frac{(c(1-w_A)-(1-w_B))^2}{4(1-c^2)}$, both retailers give up the selling of the new product: none pays F, and both sell A.

A.3.3 If $1-\frac{1-w_A}{c} \leq w_B \leq 1-\frac{(1-w_A)(2+c^2)}{3c}$

In that case the normal form game is as follows :

	F	non F
F	$\Pi^D_{AB,AB}, \Pi^D_{AB,AB}$	$\Pi^1_{B,A}, \Pi^2_{B,A}$
non F	$\Pi^2_{B,A}, \Pi^1_{B,A}$	$\frac{(1-w_A)^2}{9}, \frac{(1-w_A)^2}{9}$

Comparing these profits gives the following subgame equilibria :

if $F \leq \frac{(1-w_A)^2-2c(1-w_A)(1-w_B)+(1-w_B)^2}{9(1-c^2)} - \frac{(2(1-w_A)-c(1-w_B))^2}{(4-c^2)^2}$, both retailers pay F and sell both products;

if $\frac{(1-w_A)^2-2c(1-w_A)(1-w_B)+(1-w_B)^2}{9(1-c^2)} - \frac{(2(1-w_A)-c(1-w_B))^2}{(4-c^2)^2} \leq F \leq \frac{(c(1-w_A)-2(1-w_B))^2}{(4-c^2)^2} - \frac{(1-w_A)^2}{9}$, only one retailer invests F to sell only B, and his competitor sells only A;

if $F \geq \frac{(c(1-w_A)-2(1-w_B))^2}{(4-c^2)^2} - \frac{(1-w_A)^2}{9}$, no retailer pays F, both sell only product A.

A.3.4 If $1-\frac{2-2w_A}{c} \leq w_B \leq 1-\frac{1-w_A}{c}$

This zone may exist only if $w_A \geq 1-c$. In that case the normal form game is as follows :

	F	non F
F	$\Pi^D_{B,B}, \Pi^D_{B,B}$	$\Pi^1_{B,A}, \Pi^2_{B,A}$
non F	$\Pi^2_{B,A}, \Pi^1_{B,A}$	$\frac{(1-w_A)^2}{9}, \frac{(1-w_A)^2}{9}$

Comparing these profits gives the following subgame equilibria :

if $F \leq \frac{(1-w_B)^2}{9} - \frac{(2(1-w_A)-c(1-w_B))^2}{(4-c^2)^2}$, both retailers pay F and sell only B;

if $\frac{(1-w_B)^2}{9} - \frac{(2(1-w_A)-c(1-w_B))^2}{(4-c^2)^2} \leq F \leq \frac{(c(1-w_A)-2(1-w_B))^2}{(4-c^2)^2} - \frac{(1-w_A)^2}{9}$, only one retailer pays F to sell only B, his competitor sells only A;

if $F \geq \frac{(c(1-w_A)-2(1-w_B))^2}{(4-c^2)^2} - \frac{(1-w_A)^2}{9}$, no retailer pays F, both sell only A.

A.3.5 If $w_B \leq 1-\frac{2-2w_A}{c}$

This zone may exist only if $w_A \geq 1-\frac{c}{2}$. In that case the normal form game is as follows :

	F	non F
F	$\frac{(1-w_B)^2}{9} - F, \frac{(1-w_B)^2}{9} - F$	$\frac{(1-w_B)^2}{4} - F, 0$
non F	$0, \frac{(1-w_B)^2}{4} - F$	$\frac{(1-w_A)^2}{9}, \frac{(1-w_A)^2}{9}$

Comparing these profits gives the following subgame equilibria :

if $F \geq \frac{(1-w_B)^2}{4} - \frac{(1-w_A)^2}{9}$, no retailer pays F, both sell only A;

if $\frac{(1-w_B)^2}{9} \leq F \leq \frac{(1-w_B)^2}{4} - \frac{(1-w_A)^2}{9}$, only one retailer pays F, his competitor exits the market. The monopolist retailer sells only product B;

if $F \leq \frac{(1-w_B)^2}{9}$ both retailers pay F and sell only B.

A.4 Upstream choice: proof of proposition 2

In the first stage, the producer innovates if the profit she gets by selling the new product is higher than $\Pi_{AA}^P = \frac{1}{6}$, the profit she gets with product A only. If she innovates, her profit depends on the quantities sold by the retailers in stage 3. We summarize here the producer's optimal choices in equilibrium.

(i) If $F \leq \frac{1-c}{36(1+c)}$, she innovates if and only if $\Omega \leq \frac{1-c}{6(1+c)}$, and both retailers sell both goods in the interior optimum. For such values of F, the chain of monopolies would innovate only if $\Omega \leq \frac{1-c}{8(1+c)}$: downstream competition leads here to more innovation than a chain of monopolies would offer.

(ii) If $\frac{1-c}{36(1+c)} \leq F \leq \frac{1-c}{16(1+c)}$, the producer has to use a limit-pricing strategy in order to induce the two retailers to sell both goods each in equilibrium. The producer innovates if and only if $\Omega \leq 2\sqrt{\frac{F(1-c)}{1+c}} - 6F$, with $2\sqrt{\frac{F(1-c)}{1+c}} - 6F \geq \frac{1-c}{8(1+c)}$ for $F \in [\frac{1-c}{144(1+c)}, \frac{1-c}{16(1+c)}]$. For such values of F, the chain of monopolies would innovate only if $\Omega \leq \frac{1-c}{8(1+c)}$: downstream competition leads here again to more innovation than a chain of monopolies would offer.

(iii) If $F \geq \frac{1-c}{16(1+c)}$, the producer sets the wholesale prices in order to induce one of the retailers to list the new product, the other retailer selling only the old one. In that case, if $c \leq 1/2$, the producer chooses a limit-pricing strategy, denoted $\widetilde{AB, A}$, such that one only of the two retailers invests F and sells both goods, the other selling only good A. This strategy brings about more profit than no innovation for $\Omega \leq \sqrt{\frac{F(1-c)}{1+c}} - 2F$, which corresponds exactly to the frontier of innovation in the chain of monopolies case.

On the contrary if $c \geq 1/2$, this strategy is no more possible for $F \geq \frac{1-c^2}{36c^2}$, and the best the producer can do is then to set prices inducing the retailers to specialize, one of them paying F to sell only the new product B, and the other selling only A without investing. This strategy always dominates[4] the absence of innovation for fixed costs

[4]Notice that this particular pricing strategy is not necessary the optimal one, but it is enough to show that the optimal strategy will lead to innovation in this zone.

such that the chain of monopolies would innovate, and even in a wider zone defined by $\Omega \leq \Omega^{A,B}$ with $\Omega^{A,B} = -2F - \frac{7-c^2}{72} + \frac{c^2}{2}F + (1-\frac{c}{2})\sqrt{F + \frac{1}{36}}$, so $\Omega^{A,B} \geq \sqrt{\frac{F(1-c)}{1+c}} - 2F$. In other words, for such values of F and c, downstream competition leads here to more innovation than a chain of monopolies would offer.

A.5 Proof of proposition 3

If $c \geq 1/2$, proposition 2 showed that for $F \geq \frac{1-c^2}{36c^2}$, the strategy to develop the new product and set prices inducing the retailers to specialize dominates the strategy without innovation for $\Omega \leq \Omega^{A,B} = -2F - \frac{7-c^2}{72} + \frac{c^2}{2}F + (1-\frac{c}{2})\sqrt{F + \frac{1}{36}}$. In the plan (Ω, F), this frontier intersects the F axe in $\overline{F}^{A,B} \geq \frac{1-c}{4(1+c)}$ for any $c \geq 1/2$. Thus the zone in which retailers' specialization allows the development of the new product is wider than the zone in which the vertically integrated monopoly would innovate for such values of c.