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Product Variety and Retail Structure

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Abstract

We examine the impact of horizontal and vertical market structure on product variety. We consider a market for horizontally differentiated products where the cost of launching a new product is fixed and spread between the manufacturing and the retail industries. We show that a vertically integrated 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. Yet when this cost is mostly supported by the retail sector, downstream competition may lead to even more innovation than vertical integration. In both cases, retail concentration reduces product variety.

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 une gamme de produits horizontalement différenciés où le coût de lancement du nouveau produit est fixe et réparti entre les secteurs 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. Dans les deux cas, la concentration du secteur aval réduit la variété des produits.

Keywords: competition, retailing, vertical structure, product variety

JEL Code: L13, L22, L40

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Abstract

We examine the impact of horizontal and vertical market structure on product variety. We consider a market for horizontally differentiated products where the cost of launching a new product is fixed and spread between the manufacturing and the retail industries. We show that a vertically integrated 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. Yet when this cost is mostly supported by the retail sector, downstream competition may lead to even more innovation than vertical integration. In both cases, retail concentration reduces product variety.

1 Introduction

The market structure of the retail industry is currently an important policy issue in most developed countries. Since the seventies, the emergence of new store formats and the development, through diversification and external growth, of large and increasingly international retail chains have considerably modified the retail landscape[1]. 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

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[1]See Dobson Consulting (1999).

Norway. Large mergers among retail groups have occurred in the nineties. The 2000 merger between the two French chains Carrefour and Promodès has given birth to the second largest 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 also prohibited the merger of the Finnish retail groups Kesko and Tuko in 1996.

This trend towards increasing retail concentration may induce structural changes in vertically related industries. Over the last years, public authorities have debated issues related to the bargaining power between producers and retailers in order to assess the economic consequences of increasing retail concentration. For instance, the British Office of Fair Trading proposed in march 2006 to refer the grocery market to the Competition Commission. The report highlights trends in market structure that raise concerns about competition in the market, especially the fact that "market concentration at a local level limits the choice available to consumers in some areas". 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 to distribute a new variety differ. 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). The objectives of upstream and downstream firms thus diverge and harsh commercial bargaining talks reflect these divergences.

It is difficult to assess the costs associated with the launching of a new product. However, one of the strongest empirical evidence that emerges from existing studies is that the upstream cost of producing the new product is fixed, and that the distribution cost depends on the number of stores involved and may be best measured as a fixed cost per store. Of course, these costs can be shared among the vertical partners

through monetary transfers. Deloitte and Touche (1990) for instance estimate that the total cost of launching a new product 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 the assessment of the market potential of a product, to the changes in the information processing system and to inventory control are smaller (about \$13.5 per item and per store). However, these costs do not include the opportunity cost of keeping on the shelf a product line that could have been otherwise 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.

In this article, we analyze the incentives to supply variety in a vertically related industry between innovating producers, retailers and consumers. We study the incentives to increase product variety according to the competitiveness of the downstream sector and to the extent of vertical integration. We focus on two main points: the degree of horizontal differentiation between the old and the new product, and the distribution of the fixed costs of launching the new product between upstream and downstream firms. We study a vertical relation between a monopolist producer and one or two potential retailers. The producer develops a new product that is costly to produce and that generates fixed distribution and promotion costs for the retailers. We analyze how the distribution of the fixed costs of increasing variety between the producer and retailers influence the incentives to increase product variety.

The literature on product variety in a vertical structure is scarce. 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. From an empirical perspective, the difficulty to correctly measure the cost of launching a new product and the strategic dimension of the issue certainly explain why there are few studies on this topic. From a theoretical perspective, such studies are also very rare: while there is a huge literature on the economic analysis of vertical relationships on the one hand, and on innovation and incentives to increase product variety on the other hand, there has been little work on the incentives to increase variety in a vertically separated industry. 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 power 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. Furthermore, we consider retailers who compete on the downstream market, and whose transactions with the supplier result from a market process and not from bilateral negotiation.

Our article contributes to the literature on three points. First, we show that a vertically integrated structure better internalizes the fixed costs of production than a chain of separated monopolies and offers a larger variety of products. This first result rests on a classical reduction of the inefficiency related to the double margin that limits the introduction of new products. Next, we show that a producer facing competing retailers has more incentives to extend her product line than when facing a more concentrated retail industry: retail concentration thus reduces product variety by increasing vertical inefficiencies. Finally, we show that competition between retailers can lead to even more product variety than under a vertically integrated structure when the cost of launching the new product is mainly supported 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 sells the old product. By reducing competition in such a way, the producer can reduce the costs associated with the new product, where a vertically integrated structure would not have increased variety. In addition, we show that this increase in product variety is welfare-enhancing.

Although our model is rather general, it is best illustrated by the current crisis in the music industry. Over the recent years, sales of CDs have decreased by as much as 20 percent in some countries. According to statistics from the International Federation of the Phonographic Industry, world sales of recorded music (audio and video) for the year 2003 fell by 7.6 percent in value, marking a fourth consecutive year of slump. The global music market has thus declined by USD 6.2 billion since 1999, a fall of 16.3 percent in constant dollar terms. The reasons for this fall are

widely discussed among the actors of the industry. One of the most common culprits pointed at by the record companies is internet or file-sharing piracy. Yet another trend that is pointed at by some industry observers but overlooked by most analysts is the decrease in the number of new releases, and the possible role of the retail structure in this decrease in music variety. The Record Industry Association of America has strangely stopped producing the number of new releases after 2000. These reached an all-time high in 1999 with 38900 new releases according to Soundscan to drop to 31734 new releases in 2001. In Canada, the number of new releases decreased from 6728 in 1998 to 5619 in 2003. Similarly, in Australia, the four major record labels (Sony BMG, EMI, Universal and Warner) released 2906 albums in 2004 compared to 4480 in 2003, a 35 percent drop in 1 year, continuing the downward trend[2]. This recent decrease in music variety offered to consumers could be related to two factors: the increasing concentration of the retail segment with the emergence of large superstore selling to the masses that we already discussed and their increasing share in total music sales to consumers. In most of the OECD countries, an increasing share[3] of music sales occurs in large department stores or supermarket chains. Some analysts of the music industry have associated these two factors with the recent turmoil in sales of pre-recorded music, citing high turnover of titles due to competition for shelf spaces of other entertainment products such as DVDs, discount prices, availability of only most popular titles on shelves, reducing variety to consumers. For instance, according to the music and video director of Carrefour, music variety offered on the shelves was reduced by 30 percent over a couple of years, with the offer mainly concentrated on new releases and hit titles.[4] We suggest here that retail concentration could explain part of the decrease in variety in music production, and thus the fall in CD sales.

The remainder of the article is organized as follows. First, we study the decision of a producer who sells her products through a vertically separated chain of monopolies

[2]See "CD sales fall disguises a lack of choices" in The Register, September 15, 2005.

[3]In the US, share of music sold in department stores and hardware and Audio/Video stores has increased from 26 % in 1999 to 39 % in 2003 (See IFPI, 2004). Wal-Mart accounted for 13.5 % of music sales in 1998. Its share has increased to 34.8 percent in 2003 (see "Big stores make exclusive deals to bring in music buyers" in the New York Times, December 29, 2003). A similar trend is observed in the UK where share of music sales in supermarkets and big chains has increased from 29 percent in 1999 to 36 percent in 2003. In France, supermarket chains sell 38.5 percent of the CD in 2003, compared to 34.4 percent ten years before, and 37.7 percent are sold by large disc store chains (compared to 29 percent in 1993) owned by large retail groups, among which FNAC (part of the Pinault-Printemps-La Redoute retail group) accounted for 56% of the market and Virgin 20 percent.

[4]See Le Monde , January, 22, 2005.

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.

2 The model

We consider a vertical relation between a producer P who sells her products through a retailer D. We assume that the producer is unable to set up shop and sell independently. She initially produces product A at a constant marginal cost k_A that we normalize to zero without loss of generality. The producer can invest a fixed cost Ω to extent its product line and then produces also a substitute product B with a constant marginal cost $k_B = k_A = 0$. Products A and B are horizontally differentiated: we consider here product novelty as a mean to increase product variety and not to improve product quality. We consider a linear inverse demand function translating consumers' taste for variety, with P_I the price of one unit of product I, and q_I the quantity of product 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 products. The retailer distributes 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 distribution 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. Moreover, we assume that the size of demand for the new good is independant of the fixed costs invested by the firms. This simplifying assumption reduces the effect of investment to discrete decision and we view F and Ω as fixed costs rather than investment variables. The exogenous parameters of the models are: c, Ω, F.[5]

[5]This set of assumptions is reasonable in a large number of industries, especially in the music sector. It is well known that the costs of launching a new musical product are fixed, and are mainly related to recording, producing and pressing the CD on the one hand, and to expensive promotion and marketing campaigns (see Peitz and Waelbroeck, 2005, section 2.1). Following the example of the music industry, modelling the upstream industry as a monopoly is also a reasonable assumption. First, the music industry is very concentrated as four labels control more than 80% of the global market, which at an aggregate level is a lot more concentrated than the retail industry. Furthermore, the price of pre-recorded music is rather uniform across music labels. Finally, the music labels have

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

2.1 Benchmark: vertically integrated monopoly

We first consider as a benchmark a situation in which the producer and the retailer are vertically integrated. The integrated unit only extends its product line and sells both products if it is profitable to do so, regardless of the number of products distributed.

If the vertically integrated structure does not introduce a new variety, it only sells A in quantity $q_A = \frac{1}{2}$, and with profit $\Pi_A^{VI} = \frac{1}{4}$. Since introducing the new product involves a fixed cost, the structure that increases product variety 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 increases variety and sells both products if and only if it leads to higher profits than through selling only the old product, 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 is below a threshold level that decreases with the substitutability 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 cannibalization effect is driving product line decisions.

2.2 Product variety in a vertically separated chain

We now study how the investment decisions of a vertically separated industry depend on the distribution of the total fixed costs between the producer and the retailer.

even been accused of price coordination several times. Recently, the music labels settled a lawsuit on this matter out of court in 2002 in the US.

When the producer and the retailer are vertically separated, the product line 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) or not. Then she sets the two wholesale prices w_A and w_B , each in[6] $[0, 1]$. In the second stage, the retailer decides which products to sell to the consumers (and whether or not 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 look for the subgame perfect equilibria of this game. Vertical separation induces a double margin externality and modifies the incentives to increase product variety for the producer.

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. Given wholesale prices w_A and w_B, the retailer determines his listing strategy by comparing his profits with or without the new product (see appendix A1 for these profits). 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 distribution cost F is smaller than a threshold level that decreases with wholesale price w_B:

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

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

[6] Any wholesale price above 1 would lead to a zero demand, and would thus not be rational.

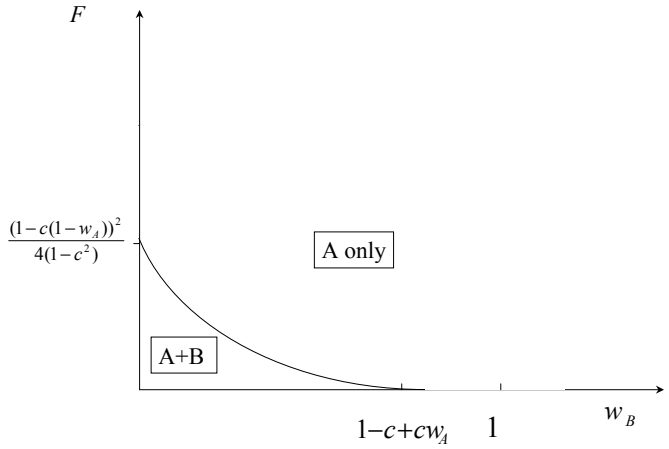

Figure 1

2.2.2 Upstream strategy

In the first stage, the producer decides whether to produce the new product and sets her wholesale prices anticipating the outcome of the second stage. If she only produces the old product, 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 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 between the profits in the two cases determines the optimal strategy of the producer in the first stage (see appendix A1 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 increases variety is more binding than the corresponding condition for a vertically integrated structure.

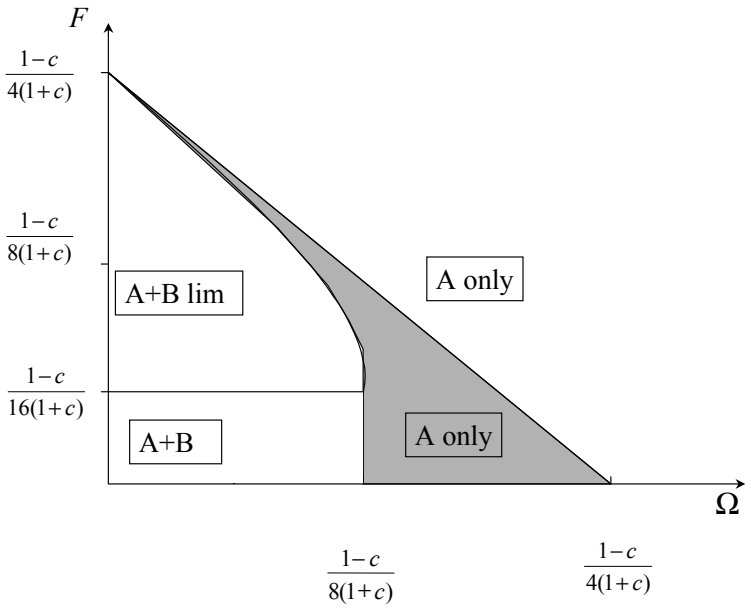

Figure 2

The shaded area represents the values of fixed costs for which a separated chain of monopolies would not innovate whereas 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 stems 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[7]. This effect of vertical market structure on product variety may be related to the literature on quality improvement in vertical structures. For instance, Economides (1999) shows that vertical separation might lead to lower quality on the market.

Although the mechanism of proposition 1 relies upon a double margin effect, two-part tariffs would not always be sufficient to restore the incentives to launch the new

[7]Applying this result to the music industry, we should observe that music labels who have their own retail stores should provide more music variety than the others. Although there are currently no such fully vertically integrated firms (Virgin Megastore being the closest to our example), we conjecture that compressed digital music production and distribution through a proprietary internet site could increase music variety offered to consumers.

product. Associated with a tying contract or with a fixed fee independent of the range of products sold by the retailer (i.e. a tariff in the form w_A, w_B, T), a two-part tariff would be sufficient to restore the incentives: when the new product increases total profits, the upstream firm can set wholesale prices equal to the marginal costs (here, zero) and get the whole profit[8] through the fixed fee. However, if the two goods have to be priced separately, two-part tariffs w_A, T_A and w_B, T_B would not allow the upstream producer to recoup all profits anymore. Indeed, the producer has to give the retailer an incentive to list both products rather than just one , 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): $\Pi_D^{A+B} - T_A - T_B \geq \Pi_D^A - T_A$ and $\Pi_D^{A+B} - T_A - T_B \geq \Pi_D^B - T_B$, which implies that $2\Pi_D^{A+B} - \Pi_D^A - \Pi_D^B \geq T_A + T_B$. Yet $\Pi_D^{A+B} < \Pi_D^A + \Pi_D^B$ because products are substitutes and thus $T_A + T_B < \Pi_D^{A+B}$. Even if the producer could 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 $T_A + T_B$.

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 distribution cost F. Indeed, when the latter is high, the producer can adapt its 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 can not commit to share the cost spent by his supplier who unilaterally decides not to introduce the new variety.

3 Competition between retailers

We have seen in section 2 that vertical separation of the activities of production and distribution can reduce product variety because of the double margin. However, it is well known that downstream competition reduces this vertical externality. We now address the question of how competition between retailers can affect product variety when variety involves 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 analyze the following situation: two retailers D_1 and D_2

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

sell producer P 's production to the consumers. The 3-stage game is set as follows. In the first stage the producer decides whether to launch the product 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. To simplify the analysis, we assume that this cost is sunk: however, we show in section 3.4 that our results are qualitatively robust to a change in this assumption. In a third stage, as the outcome of the investment decisions are made public, the retailers simultaneously order the quantities of the two goods that they will put up on their shelves. Prices on the final market are determined by the consumer inverse demands. Retail competition is thus à la Cournot. The fixed cost F is sunk and represents a commitment of the retailers on their listing 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 by determining its subgame perfect equilibria.

3.1 Downstream quantity competition

In this section we determine the equilibrium outcomes 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 only one , 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 single product 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 $\Pi_A^D = \frac{(1-w_A)^2}{9}$.

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 appendix A2). 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 that the same set of values of w_B shrinks with w_A. However, now, both the upper and the lower bound 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: only one retailer has paid the sunk cost

In this subgame, only one of the retailers can sell product B. We refer to this retailer as retailer 2. The other retailer chooses his listing strategy. We 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 distributing the new product. For even smaller values of w_B, and only if the wholesale price for good A is not too low ($w_A \geq 1 - \frac{3c}{2+c^2}$), this retailer only distributes good B while his competitor is constrained to sell only good A. Finally, for very small values of w_B, and only if the wholesale price for good A is rather high ($w_A \geq 1 - \frac{c}{2}$),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[9] of 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 length of the interval decreases as parameter c increases.

[9]Listing product A and selling a zero quantity of this good does not raise a credibility issue as there is no listing cost associated with the old product, so there is no commitment at the listing stage.

It is interesting to point to the emergence of asymetric equilibria with downstream specialization, which is a consequence of the fixed cost F. Indeed, in a Cournot game without fixed costs the retailers would have no incentive to specialize: a retailer could always deviate from this equilibrium strategy by reducing the quantities of A on the shelves and by offering a small but positive quantity of B. Here on the contrary, the retailer selling A cannot pay the fixed cost to introduce also product B on his shelves, as investment in the second stage of the game represents a commitment. Furthermore, the retailer specialized in good B prefers not to sell good A although this would incur no fixed cost for him: distributing good A would only cannibalize sales from good B, so that 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. Furthermore, in this equilibrium, rather surprisingly, the retailer selling good B gets a higher profit than his competitor specialized in good A, even if he has to incur the fixed cost F, because the wholesale price for good B is less than w_A : he thus sells a larger quantity of good B than the quantities of good A sold by his competitor. We will check in section 3.4 if such equilibria with specialization may exist even without this commitment effect, for pure profitability reasons.

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

3.2 Listing 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 good is sold by only one retailer. 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 A3.

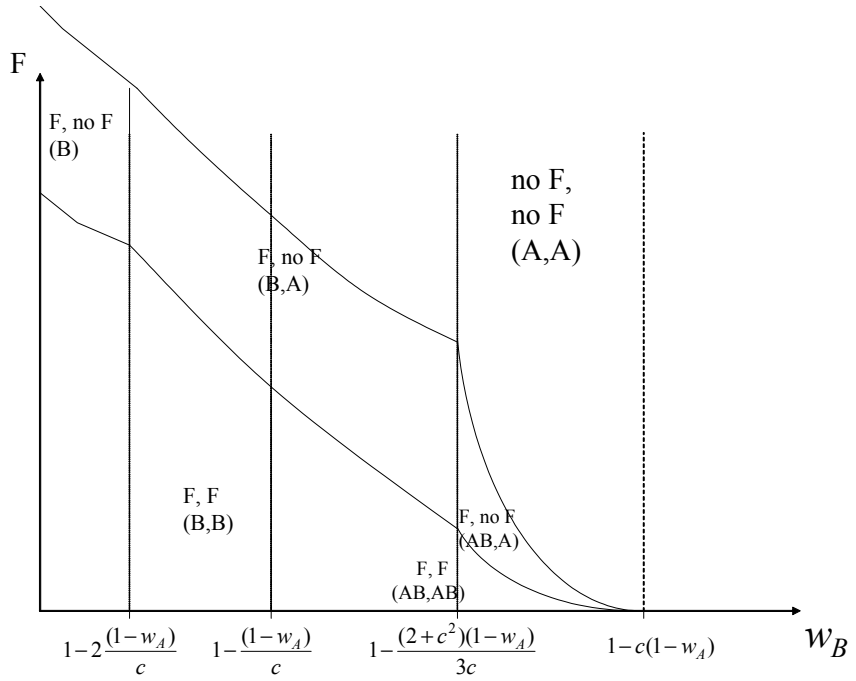

Figure 3

Intuitively, for given values of the wholesale prices, equilibria in which good B is sold disappear as the fixed cost F of distributing the new product increases. Moreover, the higher the value of w_B, the lower the profits generated by sales of the new product, and the maximum value of F sustainable to launch the new product. In consequence, 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 keep distributing only the old product. 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. We will discuss in section 3.4 the robustness of this strategy and show that it is not an artificial effect of the commitment value of the listing decision in stage two. Indeed, the specialization strategies emerge even without this commitment value.

Notice that, as the two goods become closer substitutes, launching the new product becomes less profitable. Comparative statics with respect to c shows that the lower frontier of the area where the new product is not launched decreases when c increases, indicating that for higher values of c, retailers stop investing for lower values of the fixed cost F. Similarly, the maximum wholesale price w_B above which the

new product will not be sold even with a zero fixed distribution cost decreases with c. Furthermore, the "asymmetric" zone where retailers adopt asymmetric strategies shrinks as c increases: the benefits from adopting this specialization strategy naturally decrease when the products become closer substitutes, as consumers' taste for variety will not generate sufficient profits for the retailer specialized in the new good to cover high fixed costs. Finally, all the frontiers increase with w_A: an increase in w_A means that the new product is relatively less expensive, and thus more profitable to sell for a retailer.

3.3 Product line 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, determines her product lines and sets the wholesale prices in order to maximize her profits. The subgame perfect equilibrium outcomes are detailed in Appendix A4 where we also compare the profits of the different players with those of the chain of monopolies. The main results are summarized in proposition 2.

Proposition 2 *A producer facing a competitive downstream market offers more product variety 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 extends its product line, a producer who faces a competitive downstream market also increases product variety. However, there are parameter configurations in which the chain of monopolies does not launch the new product whereas downstream competition leads to the introduction of a new variety. This situation occurs when one of the fixed costs of launching a new product is high whereas the other is small (see Figure 4).

Consider first situations where the total cost of introducing the new variety is mainly supported by the producer (Ω is large compared to F). 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, but a producer facing a competitive retail industry does: downstream competition increases quantities of both goods sold by the producer who can then bear a larger fixed cost of product introduction than when she faces a single retailer. For slightly larger values of F ($F \in [\frac{1-c}{36(1+c)}, \frac{1-c}{16(1+c)}]$)

, the producer has to reduce the wholesale price of the new product below the unconstrained optimum ($w_B = w_A = 1/2$) in order to give incentives to the retailer to distribute it. This limit-pricing strategy is profitable as long as the upstream fixed cost is not too large and as retailers keep distributing the new product, *i.e.* as long as Ω is less than a threshold concave in F (see Figure 4). In the area being discussed, the competitive downstream market leads to more product variety 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 lead to the same product variety than with 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 downstream profits, so that the downstream fixed costs become less sustainable. 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 sold by the chain of monopolies; the profits generated by sales of good B are also identical. It would be too costly for the producer to charge linit wholesale prices in order to give more incentives to the retailers to distribute the new product, as the producer also faces a rather high fixed cost of product introduction. Thus, the producer facing a competitive downstream market has the same incentives to increase product variety as when she only faces a single retailer.

On the contrary, as the fixed distribution cost of the new product 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 introduces more variety than the chain of monopolies. In that case, retailers specialize: each of them sells only one of the two goods and has a monopoly position on its market. This area only exists when products A and B are rather close substitutes (for $c \geq 1/2$). 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 donwnstream competition than with the chain of monopolies. Indeed, the fixed cost at the upstream level being small, the producer can afford a lower wholesale price w_B that leads one of the retailers to distribute the new good, and the product line extension increases total demand. Here, retailers' specialization is a way of limiting downstream competition. 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 product variety 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. We notice that total quantity sold is always larger with competition than in a chain of monopolies. We can now compare the incentives to increase product variety 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 its 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 $c \geq 1/2$).

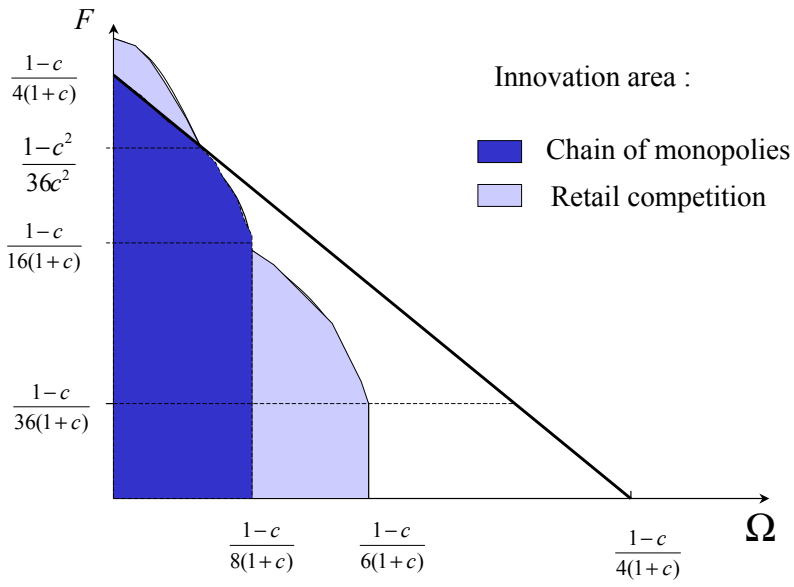

Figure 4

Even if downstream firms are competing, the vertical externality related to the double margin remains and lowers the incentives of the producer to extend its product line. 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 firm softens 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 even more product variety than a vertically integrated firm: a vertically integrated firm would avoid introducing the new product, as it would cannibalize the sales of the old one. This result holds even if the vertically integrated structure could set up two stores.It means for instance that in the music industry, increased competition could lead retail stores to specialize in different musical genres. This market structure would then support an additional artist who could have been turned down with a concentrated retail industry.

Proposition 3 has several implications. First, 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 is a strongly substitute 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 leading to the foreclosure of one retailer can have a negative effect on investment strategies if the new product is costly to market but relatively cheap to produce, whereas, on the contrary, it can increase product variety when the innovation is costly to produce but not too costly to market.

Finally, the total quantity sold on the market is always smaller with competition than with an integrated monopoly, unless in cases where the retailers adopt specialization strategies and the VI monopoly does not launch the new product. As a consequence, total welfare (net of the fixed costs), which is defined as $W(Q_A, Q_B; c) = Q_A + Q_B - \frac{1}{2}(Q_A^2 + Q_B^2) - cQ_AQ_B$, is decreasing in equilibrium with respect to c for $0 < c < 1$ in each market configuration. Moreover, for each equilibrium listing strategy, total surplus is higher under vertical integration followed by downstream

competition and then monopoly. However, in the case in which a competitive retail sector distributes the new product but a vertically integrated structure does not, total surplus is higher when product variety is largest: competition increases social surplus by increasing the variety offered to consumers especially 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. It is the only case where the welfare is greater with vertical separation and downstream competition than with vertical integration.

3.4 Robustness and discussion

In section 3 we assumed a sequential timing of the listing and pricing decisions of the retailers in order to analyze the influence of downstream competition on the innovation strategy of a vertically separated producer. This assumption simplifies the analysis of the game by making the listing decisions having a commitment value, thus reducing the range of possible deviations. As a matter of fact, a retailer who chooses not to pay the fixed cost in stage 2 is constrained in his strategies in stage 3 and cannot deviate from an equilibrium by introducing the new product on his shelves. Similarly, once he has paid the fixed cost in stage 2, a retailer can no longer save it in stage 3 even if he decides to sell a zero quantity of product B. This technical assumption thus simplifies the determination of downstream equilibria of the game by reducing the range of possible deviations from each equilibrium. We now discuss how our main findings would be modified without this assumption.

In appendix $A6$ we relax the sunk cost assumption and we study equilibrium outcomes when downstream fixed costs are paid at the time when the goods are priced and sold. In this new framework, stages 2 and 3 of the previous game are thus merged: a retailer has to pay the fixed cost at the time he sells product B, not before. In other words, the listing decisions of the former stage 2 have no commitment value anymore. In this setting, there are values of the wholesale prices and of the fixed cost F for which there are multiple downstream equilibria (see figure 5 in appendix A6). Indeed, the second stage of the game is similar to a preemption game where the retailer who invests in the fixed cost hinders his competitor from doing the same and receives a higher profit. Yet the specialization equilibrium still emerges in the downstream market: the strategic effect of retailers' specialization still leads to more product variety with downstream competition than with a vertically integrated monopolist.

More precisely, the decision of launching a new product is not affected by this

change of assumption for small values of the fixed cost F. For all listing configurations, the downstream equilibrium quantities and thus firm profits are the same with or without commitment: the only difference is the definition of the areas of existence of the different equilibria. For $F \leq \frac{1-c}{16(1+c)}$, the producer's choices are similar to the case with commitment, and the equilibria are the same, with the two retailers selling both goods. If $F \geq \frac{1-c}{16(1+c)}$, as in Section 3, both retailers are no longer able to sell both products at the same time, and the producer thus has to use a limit-pricing strategy to induce one retailer to sell a positive quantity of good B if she wants to launch the new product. The upper frontier of the zone of existence of downstream equilibrium (AB, A) where one retailer selles both goods and his competitor sells only the old one is the same than in the case with commitment, so that if $c \leq 1/2$, the producer chooses the same limit-pricing than in the previous setting. She launches the new product if $\Omega \leq \sqrt{\frac{F(1-c)}{1+c}} - 2F$, which still corresponds to the frontier of new product introduction with a chain of monopolies. However if $c \geq 1/2$, this strategy is no longer possible for $F \geq \frac{1-c^2}{36c^2}$, and the best the producer can do is to set prices inducing the retailers to specialize and implement the equilibrium with specialization (A, B). Now the problem of equilibrium selection may arise, reducing the area where downstream competition leads to more product variety than under vertical integration. Yet, we show in appendix $A6$ that this area still exists. This is sufficient to show that the stategy of downstream specialization exists without the commitment value of the investment strategy, and that it leads to more innovation than in the integrated monopoly case.

4 Conclusion

We have analyzed how retail concentration could reduce product variety that involves fixed costs of production and distribution. We have highlighted several mechanisms -both horizontal and vertical. First, the profit-cutting effect of the double marginalization reduces the incentives to launch a new product. In a chain of monopolies, vertical integration 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 shorter product line and leads to too few products distributed to the consumers. To restore the vertical efficiency, sophisticated contracts including full-line forcing clauses would be necessary. Downstream competition may

however reduce vertical inefficiencies. When we analyze a more complex framework with a producer releasing a new product to two competing retailers, the effect of competition on the incentives to increase product variety depends on the degree of substitution between the old and the new product and also on the distribution 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 variety than vertical integration, depending again on the distribution of fixed costs and on the degree of product substitution. When the retail costs are smaller than the manufacturing costs of launching the new product, retail competition, by reducing downstream profits, lessens a 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 in order to enhance product variety.

The effect of retail concentration on product variety can be illustrated by the current crisis of the music industry. Our results suggest that retail concentration could explain part of the decrease of the variety in the production of music, and thus the fall in CD sales. Increased competition between retail stores may lead to more music variety. Preserving competition at the retail level could thus help to promote cultural diversity and the emergence of new artists in a creative industry such as the music industry.

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A Appendix

A.1 Chain of monopolies

Retailer's strategy If, on the one hand, the retailer decides to only distribute the old product, 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 introduced the new product, 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 $\{I, J\} = \{A, B\}$), and his maximum profit is:

$\Pi_{A+B} = \frac{(1-w_A)^2+(1-w_B)^2-2c(1-w_A)(1-w_B)}{4(1-c^2)} - F$.

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, and for given values of the wholesale prices, downstream Cournot equilibria are as follows (the frontiers are determined by the limit values of the parameters above/below which deviations become profitable.) :

- 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. This zone exists only if $w_A \geq 1 - c$.

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 . This zone exists only if $w_A \geq 1 - \frac{3c}{2+c^2}$.

- 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 position in the two market segments, but chooses not to sell good A in order to avoid cannibalization of his sales of good B. Then he chooses to sell the monopoly quantity of the new product: $q_{B,\varnothing}^{1M} = \frac{1-w_B}{2}$ .This zone exists only if $w_A \geq 1 - \frac{c}{2}$.

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 :

1) if $w_B \geq 1 - c(1 - w_A)$:

both retailers decline to invest in the fixed cost, and in the following stage A will be the only product available.

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

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

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 new product: none pays F, and both sell A.

3) If $1 - \frac{1-w_A}{c} \leq w_B \leq 1 - \frac{(1-w_A)(2+c^2)}{3c}$ (this zone exists only if $w_A \geq 1 - \frac{3c}{2+c^2}$.)

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.

4) If $1 - \frac{2-2w_A}{c} \leq w_B \leq 1 - \frac{1-w_A}{c}$ (this zone may exist only if $w_A \geq 1 - c$),

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.

5) if $w_B \leq 1 - \frac{2-2w_A}{c}$ (this zone may exist only if $w_A \geq 1 - \frac{c}{2}$),

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 $\Pi^P_{AA} = \frac{1}{6}$, 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. For instance, consider the following strategy[10]: $w_A = 1/2$ and $w_B = 1 - \frac{c}{4} - \frac{4-c^2}{2}\sqrt{F + \frac{1}{36}}$ such that the prices are on the upper frontier of the zone of existence of downstream equilibrium (A, B). This strategy always dominates the absence of innovation for fixed costs 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 axis in $\overline{F}^{A,B} \geq \frac{1-c}{4(1+c)}$ for any $c \geq 1/2$. Thus the area in which retailers specialize and the new product is sold is wider than the area in which the vertically integrated monopoly would innovate for such values of c.

A.6 Equilibria without commitment

In that section we study the equilibria when downstream fixed costs are paid at the time where the goods are priced and sold. In this new version, stages 2 and 3 of the previous game are thus merged. When a retailer sells good B, he has to pay the fixed cost F. In the last stage of this new game, given wholesale prices w_A and w_B, there may exist several downstream equilibria in some cases. The frontiers of downstream equilibria are different than in the previous case where the investment decisions in stage 2 had a commitment value, because a new type of deviations can now occur: a retailer can sell the new product B whenever it is profitable, and no limitation comes from a previous investment decision. We summarize here the zones in which the equilibria exist, and figure 5 illustrates their repartition.

1) Equilibrium (AB, AB): both retailers sell both goods in quantities $q_K^i = \frac{(1-w_K)-c(1-w_L)}{3(1-c^2)}$ (where $\{K, L\} = \{A, B\}$ and $i \in \{1, 2\}$). This equilibrium exists if $1 - \frac{1-w_A}{c} \leq w_B \leq 1 - c(1 - w_A)$, and $F \leq \frac{(c(1-w_A)-(1-w_B))^2}{9(1-c^2)}$.

[10]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.

2) Equilibrium (AB, A): one retailer (say 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 $q_A^2 = \frac{1-w_A}{3}$. This equilibrium exists if $1 - \frac{(1-w_A)(2+c^2)}{3c} \leq w_B \leq 1 - c(1-w_A)$, and $\frac{(c(1-w_A)-(1-w_B))^2}{16(1-c^2)} \leq F \leq \frac{(c(1-w_A)-(1-w_B))^2}{4(1-c^2)}$.

3) Equilibrium (A, B): one retailer (say 1) sells only good A in quantity $q_A^1 = \frac{2(1-w_A)-c(1-w_B)}{4-c^2}$ and his competitor sells only good B in quantity $q_B^2 = \frac{2(1-w_B)-c(1-w_A)}{4-c^2}$. This equilibrium exists if $1-\frac{1-w_A}{c} \leq w_B \leq 1-\frac{(1-w_A)(2+c^2)}{3c}$ and $\frac{(3c(1-w_A)-(2+c^2)(1-w_B))^2}{4(4-c^2)^2(1-c^2)} \leq F \leq \frac{(c(1-w_A)-2(1-w_B))^2}{(4-c^2)^2} - \frac{((2+c^2)(1-w_A)-c(1-w_B))^2}{4(4-c^2)^2}$, or if $1 - 2\frac{1-w_A}{c} \leq w_B \leq 1 - \frac{1-w_A}{c}$ and $\frac{((2-c^2)(1-w_B)+c(1-w_A))^2}{4(4-c^2)^2} - \frac{(2(1-w_A)-c(1-w_B))^2}{(4-c^2)^2} \leq F \leq \frac{(c(1-w_A)-2(1-w_B))^2}{(4-c^2)^2} - \frac{((2+c^2)(1-w_A)-c(1-w_B))^2}{4(4-c^2)^2}$.

4) Equilibrium (B, B): both retailers sell only the new product, each in quantity $q_B^i = \frac{1-w_B}{3}$. This equilibrium exists if $1 - 3\frac{1-w_A}{c} \leq w_B \leq 1 - \frac{1-w_A}{c}$ and $F \leq \frac{(1-w_B)^2}{9} - \frac{(3(1-w_A)-c(1-w_B))^2}{36}$, or if $w_B \leq 1 - 3\frac{1-w_A}{c}$ and $F \leq \frac{(1-w_B)^2}{9}$.

5) Equilibrium $(B, \varnothing)$: one retailer, say 1, sells only good B and his competitor exits the market. Retailer 1 is then a monopolist on the market and he sells good B in quantity $q_{B,\varnothing}^{1M} = \frac{1-w_B}{2}$. This equilibrium exists if $w_B \leq 1 - 2\frac{1-w_A}{c}$ and $\frac{(1-w_B)^2}{16} \leq F \leq \frac{(1-w_B)^2}{4}$.

6) Equilibrium (A, A): both retailers sell only the old product A, each in quantity $q_A^i = \frac{1-w_A}{3}$. This equilibrium exists if $w_B \geq 1 - c(1-w_A)$, or $1 - \frac{(1-w_A)(2+c^2)}{3c} \leq w_B \leq 1 - c(1-w_A)$ and $F \geq \frac{(c(1-w_A)-(1-w_B))^2}{4(1-c^2)}$, or $w_B \leq 1 - \frac{(1-w_A)(2+c^2)}{3c}$ and $F \geq \frac{(c(1-w_A)-3(1-w_B))^2}{36} - \frac{(1-w_A)^2}{9}$.

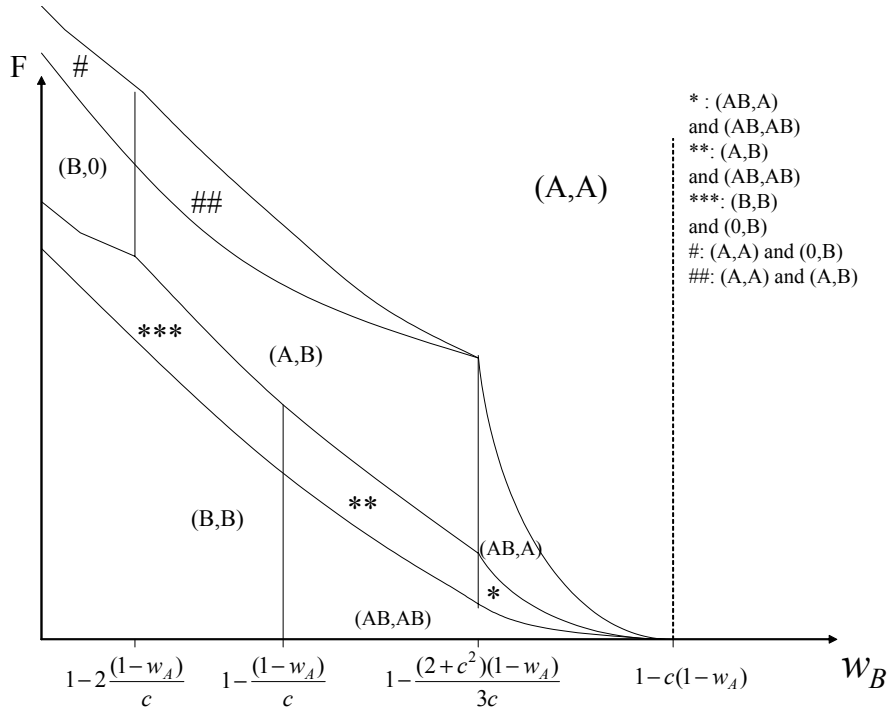

Figure 5 : Downstream equilibria without commitment

When the listing strategy do not have a commitment value, there are values of w_A, w_B, and F for which there are multiple downstream equilibria, leading to two possible market configurations. We focus on the pivotal zone where both equilibria (A, A) and (A, B) exist, for $1 - 2\frac{1-w_A}{c} \leq w_B \leq 1 - \frac{(1-w_A)(2+c^2)}{3c}$ and $\frac{(c(1-w_A)-2(1-w_B))^2}{(4-c^2)^2} - \frac{((2+c^2)(1-w_A)-c(1-w_B))^2}{4(4-c^2)^2} \leq F \leq \frac{(c(1-w_A)-3(1-w_B))^2}{36} - \frac{(1-w_A)^2}{9}$. However, in the subzone where $\frac{(c(1-w_A)-2(1-w_B))^2}{(4-c^2)^2} - \frac{(1-w_A)^2}{9} \leq F$, we can select equilibrium (A, A) using the classical Pareto-dominance criterium: both retailers receive higher profits in equilibrium (A, A) than in (A, B), so that (A, A) Pareto-dominates (A, B). Under this threshold, the retailer who sells A in equilibrium (A, B) receives a lower profit than in equilibrium (A, A), whereas on the contrary the retailer who sells B receives a higher profit than in equilibrium (A, A), so that the Pareto-dominance criterium does not allow to select one of these two equilibria.

We now turn to the producer's strategy in the first stage of the game. For each listing configuration, the downstream equilibrium quantities are the same than with commitment, so that the profits of all firms are the same: the only difference is the seperation of the areas of existence of the equilibria.

For $F \leq \frac{1-c}{16(1+c)}$, the producer's choices are similar to the case with commitment, and the equilibria are the same, with the two retailers selling both goods.

If $F \geq \frac{1-c}{16(1+c)}$, as previously, both retailers are no longer able to sell both products at the same time. The producer thus has to use a limit-pricing strategy inducing one retailer to sell a positive quantity of good B if she wants to launch the new product. The upper frontier of the area of existence of downstream equilibrium (AB, A) is the same than in the case with commitment, so that if $c \leq 1/2$, the producer chooses the limit-pricing $\widetilde{AB, A}$, such that one only of the two retailers 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 still corresponds exactly to the frontier of innovation in the chain of monopolies case.

However if $F \geq \frac{1-c}{16(1+c)}$ and $c \geq 1/2$, this strategy is no longer possible for $F \geq \frac{1-c^2}{36c^2}$, and the best the producer can do is to set prices that force the retailers to specialize in order to implement equilibrium (A, B). Now, the problem of equilibrium selection may arise: if the producer set the limit prices $w_A = 1/2$ and $w_B = 1 - \frac{c}{4} - \frac{4-c^2}{2}\sqrt{F + \frac{1}{36}}$ chosen in appendix A4, there would be two possible downstream equilibria, (A, A) and (A, B), one player being indifferent between the two, and the other strictly better off under equilibrium (A, A). To avoid this selection problem, we look at prices located on the lower frontier of existence of equilibrium (A, A) and in the area of existence of equilibrium (A, B), for instance $w_A = 1/2$ and

$$w_B = \frac{-c(6 + (2-c)c) + 32 - 2\sqrt{(4+c^2)^2 + 4(16-c^2)(4-c^2)^2 F}}{2(16-c^2)}$$

Computing the producer's profit with this strategy and comparing it to the maximum profit she can receive without innovation, that is $1/6$, shows that this limit-pricing strategy gives her a higher profit for larger values of the upstream fixed cost of innovation Ω for $c \in [0.5, 0.8]$ at least. This is sufficient to show that for a quite large range of values of c, this stategy of downstream specialization still exists without commitment of the investment strategy, and that it leads to more innovation than in the integrated monopoly case.