

ESSAYS ON THE EFFECTS OF DIGITIZATION ON MEDIA ECONOMICS

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To Prof. Gilles Le Blanc - *Studere, studere, post mortem quid valere?*

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Introduction

Publishing Brands and Digitization: Strategic Issues and Key Variables.

Abstract

This paper analyses the economic issues raised by digitization and by the roll-out of an innovative support such as Reading Tablets on Press Magazine's market. The switch from a "physical analog model" to a "digitized model", by separating the concepts of meaningful expression from the support allowing for publishing, imposes a rethinking of media industries' business models. Tablets may accelerate the switch, allowing for new version and bundling possibilities and increasing the willingness to pay for digitized media expressions. Starting from this context, this paper analyzes the key economic issues emerging for magazine publishers facing digitization, both at the firm level and at the industry level, where new strategic interactions may occur, changing the traditional dynamics in the value chain. Coping with digitization involves establishing new vertical relations and dealing with the multiplication of coordination issues on the distribution side. This paper identifies the economic issues emerging in this context for different types of brands with different business models. The objective is to show that efficiently exploiting the enhanced discrimination opportunities and emerging network externalities is a very complex issue for a publisher, especially during the start-up phase of a new distribution channel.

Keywords: media economics, digitized media, publishing, pricing, copyright, two-sided markets, multi-channel distribution.

Résumé

Ce papier analyse les questions économiques soulevées par la numérisation et par la parution des nouveaux réseaux et supports innovant comme les Tablettes numériques dans le marché de la Presse Magazine. Le passage d'un «modèle analogique physique» à un «modèle numérique", en séparant les concepts d'expression signifiante et le support qui permet sa circulation auprès d'un large publique, impose de repenser les procédés de création et production dans plusieurs domaines de l'industrie des Media. Les tablettes peuvent accélérer ce passage, puisqu'elles multiplient les opportunités de versionnage et de vente groupée et permettent d'accroître la propension à payer pour les contenus médias numérisés. A partir de cette constat, l'article analyse les principales questions économiques qui émergent pour les éditeurs de magazines face à la numérisation, tant au niveau de l'entreprise qu'au niveau de l'industrie, où de nouvelles interactions stratégiques peuvent se produire, en changeant la dynamique traditionnels de la chaîne de la valeur. Faire face à la numérisation consiste à établir de nouvelles relations verticales et trouver les meilleures solutions à la multiplication des problèmes de coordination du côté de la distribution. Le document identifie les questions économiques émergentes dans ce contexte pour différents types de marque avec des modèles d'affaires différents. L'objectif est de montrer que trouver une stratégie qui permet l'exploitation efficace des possibilités de discrimination et des externalités de réseau émergentes n'est pas simple pour un éditeur, notamment dans la phase de démarrage d'un nouveau canal de distribution.

Mots clés: édition numérique, Economie des Media, accords verticaux, tarification, marchés biface, distribution réseaux multiples

Introduction

What would be the optimal bundling and pricing strategy for a magazine publisher if the digitized market keeps growing in double digits? Under what product-market conditions (market share, “switching” and marketing costs) would it be more profitable to offer a specific digital version of a magazine? Would digitization “kill” the traditional distribution channels (through cannibalization, piracy, etc.)? After a decade during which magazines brands have gone on-line with free or *freemium*¹ models, new versions are emerging for smartphones and tablet devices. These versions can be offered as paying models, which might be more beneficial to publishers. At the same time, the introduction on the market of a substitute media, with the same content but with different economic characteristics and distribution channels, raises important strategic questions for publishers. The objective of this paper is to discuss these questions, exploring the key economic issues and trade-offs faced by a magazine Publisher under different digital scenarios. The motivation for new contributions in the field, allowing for a better understanding of the digital market for contents, its implications and future scenarios, is provided by the difficulties faced by the publishing industry and specifically by the magazine sector in the last years. These difficulties are the result of the shift of consumers and advertising revenues to digital consumption of contents, which has been steadily increasing in the last five years. According to Pew Research data, in 2012 total traffic to the top 25 news sites increased by 7.2%, while 39% of consumers declare to read news online or on a mobile device, up from 34% in 2010. The digital share of advertising revenues is increasing accordingly: eMarketer has registered an overall surge of digital advertising of around 17% in 2012 to \$37.3 billion. Digital advertising makes up around 23% of the total U.S. advertising market, up from 20% in 2011. While the digital media industry drives growth and represents an opportunity for publishers, increasing digitization raises concerns in the traditional business, which faces a downturn both in audiences and in advertising expenditure. On the one side, according to the Alliance for Audited Media, sales of newsstand copies,

¹ Freemium is a business model by which a proprietary product or service (typically a digital offering such as software, media, games or web services) is provided free of charge, while a positive price (premium) is charged for advanced features or functionality related to the good .

the measure most accepted by the industry, suffered an 8.2% decline in newsstand sales, while subscriptions have been substantially stable in the last years. On the other hand, the print advertising environment for magazines in the last years has become grim. In 2012 the analysis performed by Publishers Information Bureau on combined ad pages for six major magazines found that they went down by 10%, about twice the rate of decline in 2011. Moreover, if we consider the rate of diffusion of digital devices such as smartphone and tablets as a proxy for the development of the digital market for contents, we may expect that these trends will be confirmed and maybe increased in the following years. In fact, according to preliminary data from the International Data Corporation (IDC), worldwide tablet shipments continue to surge, growing 142.4% year over year in the first quarter of 2013 for a total of 49.2 million shipments in the quarter. Consequently, the penetration rate of Tablets has increased significantly, in particular in the U.S., where 44% of the population from 8 to 64 declared owning a tablet in their household - up from 30% in 2012 which is a 47% growth rate in one year, accordingly to a survey from Frank N. Magid Associates. If we add the data on Smartphone, whose penetration rate has 61% of online Americans as of May 2013, we understand that the potential of the digital market is really significant. As for the brand penetration, the study found out that 59% of all tablet owners in the U.S. have Apple's devices, while Amazon's Kindle Fire has risen to 31% of tablet owners vs. 28% in 2012. Finally Samsung tablets now account for 19% of tablet owners vs. 13% in 2012, while a third (32%) of tablet owners have declared having multiple brands of tablet devices in their household.

As for the other side of the market, data are much harder to interpreter. Certainly spending for digital contents was up considerably in both the tablet and smartphone markets over the last 12 months. The aggregate data, what is commonly called Application spending, has reported impressive statistics. For example, according to a study from ABI Research from March 2013, apps will be able to generate revenues of \$25 billion in 2013, \$16.4 billion will come from smartphone apps and \$8.8 billion from tablet apps. Of this \$25 billion, 65 percent will come from Apple's iOS ecosystem, 27 percent from Google's Android, and the remaining 8 percent from the other mobile platforms. According to another analysis from Canalys (April 2013), in the first quarter of 2013 there were 13.4 billion downloads, up 11 percent from the last quarter of 2012,

creating revenue of US\$ 2.2 billion from paid-for apps, in-app purchases and subscriptions, up 9 percent from Q4 2012. However, the largest share of the revenues in this promising market are actually generated by Games, which largely dominate top apps. As an example, Games account for 145/300 of top paid apps on Apple App Store and 116/300 on Google Play. The question is thus how Media brands can exploit this emerging market to outweigh the decline of their traditional sources of revenues.

The economic issues raised by digitization of information goods have been largely studied by economists. Digitization (Shapiro 1998) of copyrighted goods have had a growing impact on Media industries since it allows for a much cheaper and faster circulation of contents, the drawback being the increase of transaction's costs, cannibalization of traditional industries and the creation of new challenges for legal institutions such as massive piracy and Creative Commons. Varian, H. (1995) introduces the problem of pricing goods with heterogeneous evaluations and a cost structure with high fixed costs – or costs of the first copy – and negligible variable costs. He shows how engaging in price discrimination and bundling techniques in these cases lead to a situation in which both the industry and consumers are better off. By differentiating the product the market can be segmented and revenues can be recovered also from users with a low willingness-to-pay without destroying the value for segments of consumers with a high willingness-to-pay. Deneckere and McAfee (1994) show that even the conscious use of product degradation can make all parties strictly better off under specific circumstances. In addition to differentiation, bundling is a price discrimination technique which is particularly important when dealing with information goods and experience goods (Nelson 1970), since an evaluation of their utility can be made only after the consumption of the good, and heterogeneity in evaluations can be important. Bundling consist in offering distinct products for sale as one package. Nalebuff, B. (1999) shows how this tool is effective in auto-sorting consumers into different groups according to their willingness to pay. Bundling is effective, under specific circumstances, even if products are partial substitutes, as it is in the case of thematic channels in pay TV, or as it is likely to be with different versions of the same media² content. The effectiveness of multi-form bundling (a package composed of the same product in physical and digitized versions) has been studied by Koukova, N.,

² See Gentzkow, M. (2005) on complementarities between physical and online newspapers

Kannan, P.K. and Ratchford, B. (2008). They show that complementarities exist between different formats and consumers tend to value them positively, proportionally to the awareness they have about the differences between formats. Bakos and Brynjolfsson (2000) show that the optimal strategy for information goods (with low marginal cost) is pure bundling, while Venkatesh, R. and Chatterjee (2006) have analyzed the magazine market finding that it is always profit-enhancing for publishers to offer digitized versions although the domain of optimality of pure bundling is more limited.

However, despite all these contributions, Media companies have been struggling to define their optimal marketing mixes in a context of increasing digitization. In the case of magazine publishing, the complexity of the profit maximization problem is increasing proportionally to the uncertainty in digital scenario and the multiplication of versions and distribution channels. Each magazine has a characteristic utility function, embedding a number of characteristics and strategic choices, which needs to be adapted to each new version and to consumers' revealed preferences. The paper thus reconsiders the strategic decision-making process in the context of multi-form products under the current technological developments. We outline the economic implication of the basic available digital strategies, and we analyze which type of publishing firm could benefit more from a given digital strategy, through the identification of some common characteristics and key variables. Moreover, we show that no general differentiation or bundling strategy can be defined as optimal for the whole industry under current market conditions.

The remainder of this paper is structured as follows: the economics of a magazine publisher producing both paper and digitized versions is presented in the next section. The third section introduces the available strategies and the related economic issues. Section four concludes outlining the results of the analysis and tackling some emerging policy issues.

Digital Publishing: Market and Strategies

Magazines are publishing (and distribution) platforms, bundling collections of articles subject to copyright, which are selected, edited and published on a regular schedule under a publishing brand. They are generally financed by advertising, by a purchase price and by pre-paid subscriptions. The utility of this product is composed by expressions of various kinds (texts, photos, covered by copyrights) gathered within articles under a publishing brand and coupled with a support allowing for its diffusion.

Although generally included in the same industry, magazines press differs from news press for at least two crucial aspects: first of all, the life-cycle, although short in both cases, is not the same for the two media. Magazines provide a different kind of information, enriched with in-depth elaboration. Moreover, magazines allow for more differentiation in term of formats, topics and prices, just to name a few. On the demand side, when the exploitation of digitized information was limited to PCs, the magazine market was affected slightly more superficially than the newspaper market, due to the lower compatibility of digital supports with the exploitation of a magazine's utility. Innovations such as smartphones and tablets have accelerated digitization of written expression creating a new, fast-growing market, with higher compatibility with magazine utility. Notably reading tablets, which are conceived as a dedicated support for written or generally visual contents, have raised consumers' utility for digital version of written contents and allowed for more versioning and bundling opportunities for publishers.

On the supply side, digitization relaxes traditional constraints of the industry such as space, copying and logistic issues. This additional flexibility provides more strategic options to publishers. This may enhance discrimination opportunities but complicates the strategic decision-making process. The model focuses on two strategic decisions for publishers, which are particularly relevant:

1. Multiform marketing mix: digitization allows for the multiplication of version and bundling opportunities, complicating the strategic choice of the optimal marketing mix.
2. Organization of the retailing network: digitization opens the possibility of directly distributing contents and extending direct interaction with consumers. This implies a rethinking of the distribution channels and the retailing network, considering cannibalization issues among alternative choices.

1. Multiform marketing mix

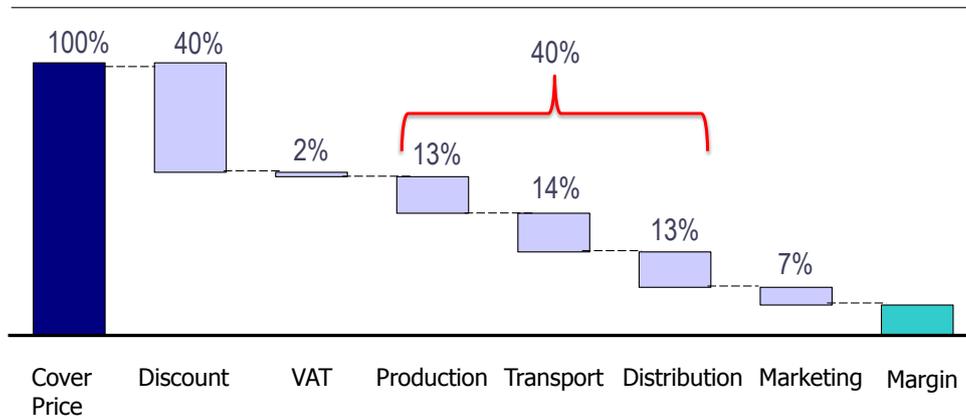
As shown in the graph below, digitized versions of magazines allow for the saving of marginal costs, which accounts for around 40% of cover price, following the data provided by a French top player of the industry. The tradeoff which needs to be calculated is whether these savings are sufficient to outweigh a number of emerging costs with digitization. In order to exploit the opportunities offered by the digital market, a publisher needs to produce an investment effort (production and marketing of digital versions) that varies depending on the selected version and distributing strategy. Moreover, externalities must be carefully evaluated since each digital strategy may have a different impact on the traditional business model. An evaluation of the possible effect of cannibalization³ among supports is particularly critical: not only may it reduce sales but it may also deprive the physical channel from economies of scale which are crucial for the business model. The fewer copies are sold, the higher becomes the production and distribution costs, as well as the fixed costs allocated to each copy. Finally, digitized distribution fees needs to be paid to online retailers as well, unless a publisher set up his own digital retailing network. Estimations of the rate of technology adoption (potential market) and magazine-specific digitized market share are crucial to determine the optimal digital strategy for a publisher. The above reasoning may explain why in many cases, the free or *freemium*⁴ models, which are the strategies more commonly

³ Cannibalization is the decreased demand for an existing product that occurs when its vendor releases a new and similar product.

⁴ A business model which allows a consumer to receive basic services for free, but requires them to pay for any service deemed to be premium.

used by publishers to approach the digital market, have often revealed themselves not to be sufficiently profitable.

Magazine Cost Structure – Paper vs Digital Model*



* Weekly magazine subscription, France

Fig.1: Impact of dematerialization on a magazine’s cost function

Another difficulty encountered by many publishers who initially adopted a free model are the insufficient advertising revenues that they were able to collect on the digital market, despite the promising data that we have shown in the previous section. A reason that may explain this issue is the different competitive environment that publishers face in the new media. Digital devices such as tablets and smartphone allows for the exploitation of different content on the same platform, enlarging the potential competition for the leisure time of each consumer.

This implies a reconsideration of the magazines’ market. In fact, in its traditional print form, publishing is often referred to in literature as an example of monopolistic competition (Dayl 2002, Albarran 2002), in which each title has a share of the market including a base of loyal readers and a share of consumption by impulsion. This may not be the case in the digital market. The cost structure of a paper magazine includes important fixed costs – or costs of the first copy - related to editing and marketing. Variable costs, related to quantity include mainly: cost of reproduction, logistics and distribution. We have seen that these latter costs do not apply to the digital market, but the fixed costs may even potentially increase in the digital market. On the revenue side,

publishing is a two-sided market in which both consumers and advertisers contribute to the global revenues. As said above, the introduction of digitized versions allows for more version and bundling opportunities, which can increase the price discrimination opportunities for a publisher. However, digitized versions could be considered as substitute products of a paper magazine, since they share the same creative contents. Moreover, different versions may have different degrees of substitutability, due to their characteristics and the shape of consumer preferences. The table below summarizes the characteristics, in terms of substitutability and revenue opportunities of the most common digitized versions.

Version	Revenues	Substitutability
Free website	Only advertising	Low due to format compatibility
Premium website	Subscription and advertising	Low due to format compatibility
PDF version on PC	Cover price and advertising	Medium
PDF version on tablets	Cover price and advertising	High
Smartphone app	Cover price, dynamic advertising	Medium due to low comfort
Tablet app	Cover price, dynamic advertising	High

Fig 2: Characteristics of Digitized Versions

Finally, different versions can be combined, thanks to bundling techniques, to offer a marketing mix capable of discriminating efficiently or in reducing the negative externalities. The most commonly offered bundles in publishing are:

1. **Bundle of editions (subscription):** consumer pays ex-ante for a certain number of editions of the same magazine at a discounted price. This reduces the risk for the publisher and allows for a better planning of capital investments.
2. **Bundles of titles:** one or more magazines are sold together with the main media as annexes.

Digitization increases the bundling possibilities eliminating physical constraints to the dimensions of the bundles. Moreover, it introduces a new bundling option:

3. **Bundle of versions,** allowing for multi-support consumption, basically unlimited access to magazine content in time and space. This may include access to content on up to “four screens” (namely TV, PC, Tablet and Smartphone) plus the printed version.

As in the case of versioning, each bundling strategy has different characteristics in term of profitability and emerging costs, such as cannibalization.

2. Organization of the retailing network

Once a Publisher has decided to develop digital versions, he will have to establish a digital distribution strategy. He may decide to outsource distribution, in which case he will have to bargain with an independent agent to set a fee for this service. On the other hand he may choose to distribute directly through his own platform. A digital distributor develops a digital offer and maximizes his profits. These profits are positively correlated with the quantity and quality (in terms of market share) of media available on his platform. Furthermore, a digital distributor may exploit the available bundling strategies, to create attractive offers and capture consumers' surplus, or even to prevent entry of new competitors in the market. In fact, digital distribution is characterized by barriers to entry, due to high fixed costs to set up the platform and to exclusive licensing contracts with publishers. Moreover, the objective of the digital distributors may be different from the objective of the publishers, introducing an agency problem if the distributor is not directly controlled. To analyze the trade-off between setting up a

digital retailing network and outsourcing digital distribution providing licenses to third parties, a number of economic effects need to be observed. Consider a Publisher facing a strategic decision for the distribution of digitized versions: if we exclude, for simplicity, hybrid strategies, the publisher is left with two options:

1. **Licensing.** This strategy is undertaken by establishing one or more contracts with digital distributors which are in charge of selling the digital versions of a product. This option implies lower investments (the only additional cost being eventually the implementation of specific reading applications for the different OS). On the other hand, revenues from sales must be shared with the distributor, which is usually entitled with a distribution fee, calculated as a percentage of the cover price.
2. **Direct retailing.** A publisher may decide to sell independently the digital version of his paper magazine on his own distribution platform. This strategy implies a higher investment but it guarantees a complete control of the marketing mix and on the pricing strategy.

3. Advertising

Profitability of press, both paper and digital, depends also on advertising revenues. The observed advertising revenues for publishers in the digital markets are slightly lower than the equivalent in the physical market. This gap between online and offline advertising does not seem to be justifiable on the basis of technical reasoning. On the contrary, online advertising presents a number of advantages with respect to traditional advertising, such as allowing for sophisticated targeting of the audience and increased traceability and measurability. Despite these enhanced features and the steadily increasing share of the global advertising investment that is moving through the Internet, the per-copy revenues that traditional publishers make online, are considerably lower, according to the data provided by a French Media group. This gap can be a consequence of two factors: on the one side, as we introduced above, the multiplication of the offer of contents on the same support, typical of the digital market, which is

diluting both the market shares and the time spent on the single content by consumers. On the other side, there may be a distortion in the market due to piracy and freeriding on brand investments by digital intermediaries such as ISPs, search engines, social networks, etc. These agents convey the traffic on their website using copyrighted contents or proprietary brands potentially creating a transfer of surplus from the owners of these rights to the owners of the infrastructures. This trend, which has not been considered as potentially harmful during the development phase of digital networks, is now under serious scrutiny and the recent agreements signed by Google in France and Germany are trend indicators that we will observe new regulatory interventions in the near future. The evolution of the regulatory framework and the gap in advertising revenues between the digital and the physical markets will be crucial in determining the strategic decisions and the sustainability of the different business models in the publishing industry. It deserves an in depth analysis that we will further develop in a later paper.

Bundling and Pricing Digitized Contents

This section analyses what marketing mix would be optimal for a given magazine as a growing share of consumers gets access to the new *medium*, in the literary sense of the supports allowing for the exploitation of digitized contents. We also try to identify the implications of different pricing strategies of digitized versions for publishing firms operating in both markets.

In the case of magazine publishing, the firm's asset can be represented as a portfolio of brands, identifying different magazines. Each paper magazine is associated with a share of the global market, which is the result of the utility of the single content and the immaterial investment in the brand. The physical market is traditionally characterized by a few big players with relevant shares of the market (above 1%) and a multitude of niche players with lower shares. For each brand included in the Portfolio, the Publisher may have to select a digital strategy.

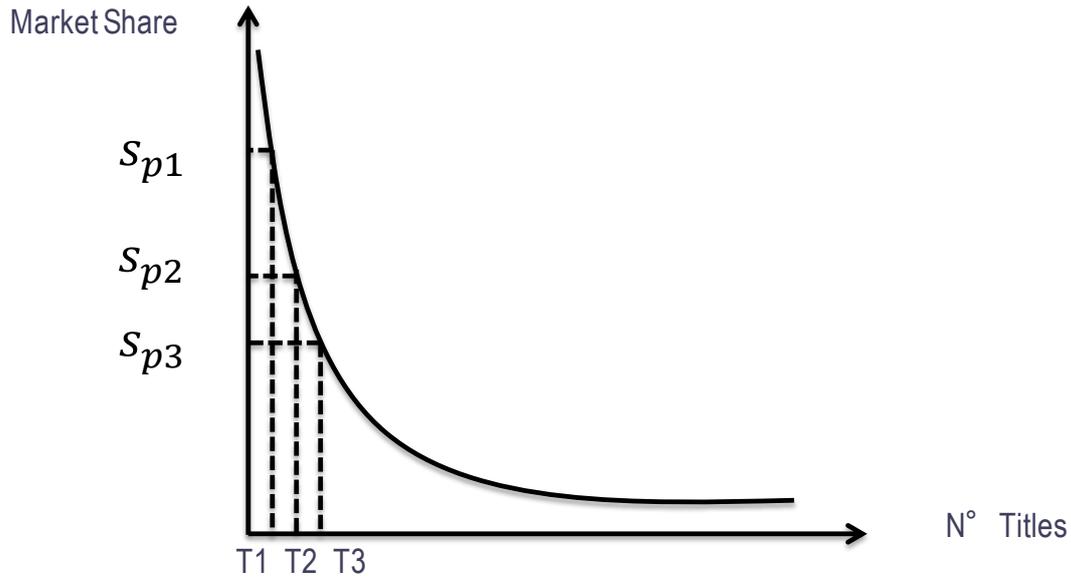


Fig 3: Representation of paper market and identification of publisher's portfolio

1. Definition of new agents, variables and strategic decisions

Excluding authors, we can simplify the emerging digital value chain to two rational agents:

- A Publishing Brand p
- A Digital Media Retailer r

Assume that the publishing Brand produces and owns the property rights of a magazine which is available in two versions: Paper or Digital. p is the only possible producer of the magazine but there exist substitutable (although not perfectly) products in the market. On the other hand r is a retailer that owns a platform allowing for the distribution of magazines in digital versions. If p chooses to distribute through r , it has to pay a distribution fee on each copy sold. The problem for p is to maximize his profit function π_p , choosing the most suitable digital strategy and the appropriate pricing strategy for the different version of his magazine. Disregarding all the hybrid strategies, we can simplify the decision space of the publisher as follow:

1. At the first stage p decides, given his strategy in the traditional market,

whether to enter the digital market.

2. At the second stage, if he enters the digital market, the firm decides whether to distribute the digital versions directly or to outsource distribution to the retailer.
3. At the last stage, if p distributes directly, he chooses the marketing strategy and prices. To simplify, we will assume that the available marketing mixes are limited to three pure strategies:
 - a. To sell the paper version and the digital version independently.
 - b. To sell exclusively a bundle including both the paper and the digital versions.
 - c. To sell both the print version, the digital version and a bundle composed of the two.

To resume, the model produces five possible outcomes, as outlined in the graph below:

- **Strategy1** (π_{ne}): *Not entering* digital market and keeping doing business as usual in the traditional market.
- **Strategy2** (π_l): Outsourcing distribution of digital magazines through *licensing* to digital distributors.
- **Strategy3** (π_{dr}): Setting up a direct distribution platform to sell the digital version of the proprietary magazine, as *direct digital retailer*.
- **Strategy4** (π_{pb}): Setting up a direct distribution platform, through which only the bundle composed of the paper and the digital versions of the magazine is sold, as a *pure bundling* strategy.
- **Strategy5** (π_{mb}): Setting up a direct distribution platform, through which both the bundle, the paper and the digital version are sold independently, in a *mixed bundling* strategy.

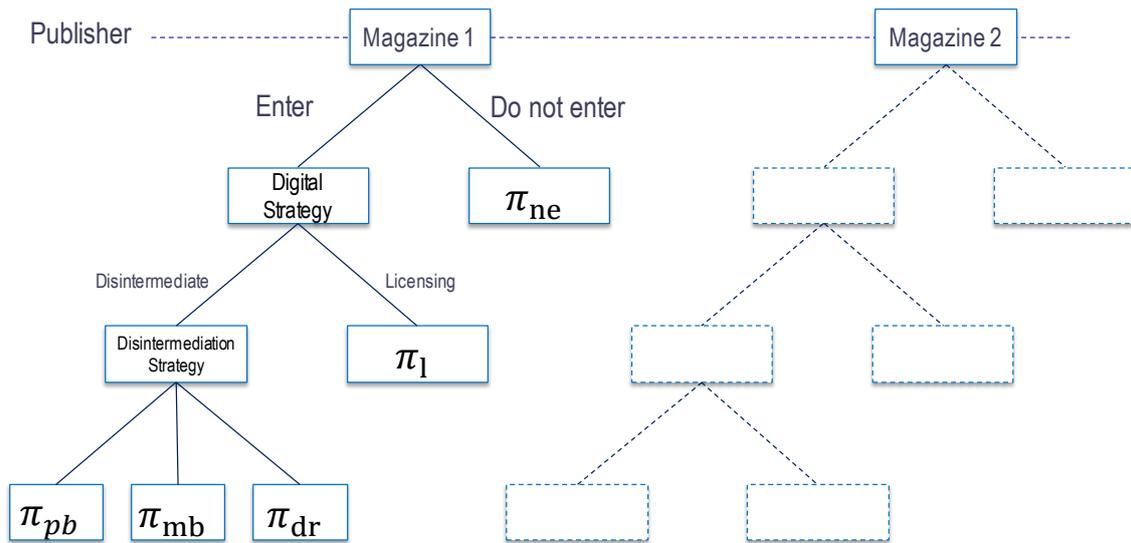


Fig 4: Sketch of the strategic decisions faced by a publisher

The above-mentioned strategies are likely to have different impacts on paper sales and on costs structure. In fact, introducing a digital version of the same paper magazine is equivalent to introducing a substitute product in the market and may generate a cannibalization effect. Moreover, producing a digital version and setting up a digital distribution may generate additional costs. A possible argument would then arise on whether every strategy introduces externalities in the business model. This could be counter-intuitively at least for the non-entering strategy. However, we can think of at least three reasons to support this hypothesis. First of all, in order to access the digital version, consumers need to be equipped with a specific, costly device. These consumers may have their preferences shaped in such a way that they will be willing to change their valuation of a magazine if it is not available in digitized format, thus changing their preferred selection. The second reason is that, as the diffusion of digital devices increases the share of contents sold in digital formats, keeping a print-only strategy market is likely to result in a decrease in competitiveness for a brand, due to increased transaction cost for those consumers who have a high willingness to consume digital versions. The third reason is the possibility of a cost increase in the traditional channel as the sector declines. As for the other strategies, licensing is likely to generate strong externalities on paper sales, since we are both introducing a substitutable product and a new agent in the market, with a possible principal-agent problem, since the distributor's

maximization problem is likely to disregard the effects of his strategy on the sales of a publisher on the traditional market. On the other hand, a pure bundling strategy would allow publishers to decrease eventual negative externalities among versions, since the print version can be always included in the bundle. The debate on the effects generated by the introduction of a digital distribution channel has been very high in the last decade. While many economists agree on a strong cannibalization between digital and traditional sales (Simon & Kadiyali, 2007), some other have found evidence of milder negative externalities, mitigated by the positive externalities that can emerge among different Media contents and brands. For example, in their recent study Koukova et al. have shown that the substitutability between print and digital versions is not perfect and can be further reduced increasing the awareness of different usage functions among different versions.

As we said before, another issue can be represented by the fact that a publisher wishing to enter the digital market needs to invest in order to produce and promote his digital offers. Digital versions are commonly assumed to have zero marginal costs, but each strategy may imply additional costs for the firm. In this case we can assume that these costs are null if a firm does not enter the market or provides licenses to sell digital editions, while they become important if the publisher chooses to distribute his digital contents independently.

2. Demand and maximization problem with multi-channel distribution

We assume that the potential market consists of surplus-maximizing consumers who have heterogeneous preferences for the magazine produced by p . The utility of the good for the consumer is revealed only after the purchase is made and the magazine has been examined. Moreover, consumers may have heterogeneous preferences for a particular format. Some of them may have a higher evaluation for the hardcopy for many reasons: for example, they may value positively the marginal cost of the paper or the traditional reading experience for different reason. On the other hand, a group of consumers may

have a preference for the digitized versions, for example because they have invested in a specific digital reader. In such a context, defining the maximization problem becomes more complex for publishers than in the traditional market. In addition, as we introduced before, the competitive environment and the regulatory framework of the two distributive channels may differ slightly. In the paper market, publishers have a very good grasp of the dynamics of demand and of their competitors, due to their past experience; moreover, they suffer limited piracy and free-riding, they often benefit from special fiscal regimes and from public subsidies. On the other hand, the demand in the digital market depends on new variables, which have not been previously observed. Moreover, the risk of piracy and free-riding is higher and tax benefits are not granted for digitized versions in many countries, even if the product shares the exact same content of the traditional one. A digitized magazine often loses its status of a cultural good and becomes an electronic good or a digital service.

Among the various issues stated above, we will focus in the following chapters of this thesis on those that seems to be the key variables for the analysis of demand in the emerging market: on the one side the correlation within the diffusion of digital devices and the market for contents, on the other side the possible pricing strategy for publishers. In the remainder of this paper, we will examine the third key issue for publishers facing digitization, that is: if he decides to enter the digital market, how should the publisher distribute the new version of his products. In terms of costs there are two variables that need to be considered, both in the short and in the long term: on one side, the emerging fixed costs to produce and advertise the digital version; on the other side, an effective control on the pace and amplitude of the shift to the digital market is crucial to manage the externalities in a context of multi-channel distribution. Investing more today to keep the total control of the distribution through the set-up of a direct digital retail network can protect the firm from cannibalization and free-riding, but the competition with large digital retailers can become unsustainable in the long run. On the other hand, outsourcing distribution to a large retailer may increase the exposure of the brand and its diffusion in the short run, but in the long run, as the digital retailer increases his market power, may result in a transfer of surplus from the contents producers to the owners of the distribution network.

3. Strategic guidelines for publishers facing digitization

From the above discussion, it seems complicated to establish a general optimal strategy for publishers facing digitization. The optimal strategy is likely to depend on the characteristics of the publisher, such as his market power in the traditional market and his capability of investing in the new market. In addition, it all will depend on the evolution of the digital market in term of size and regulatory framework.

In this section we outline in detail the key economic implication of each of the digital strategies that we have previously defined above. Each strategy provides different discrimination opportunities and risks for a publisher. The problem for the publisher is to select the strategy that generates the highest profit for the firm, considering the specific characteristics of his business model, between the available strategies:

$$\max_i \pi_i: [\pi_{ne}, \pi_l, \pi_{dr}, \pi_{pb}, \pi_{mb}]$$

Let's analyze these outputs. We start from the bottom of the graph in Fig. 4 and we proceed backward analyzing all the decisions.

Strategy 3(π_{dr}) – Setting up a direct digital retailer

If the publisher decides to directly distribute digital versions, he needs to calibrate his investments and select a pricing strategy for the two versions. Beside the investment needed to set up and manage the digital retailer, the firm needs to establish a plan to advertise his own distribution platform at the same time taking in consideration the negative impacts of cannibalization on the traditional retailing channel. One strategy could be to focus the strategy and the advertising campaign on enlightening different usage functions and complementariness within versions. Digitized versions allow for more personalization, interactivity and for the addition of extra contents. Nevertheless, the introduction in the market of a digitized version sharing large chunks of the same content is likely to produce a cannibalization of the print sales proportional to the diffusion of digital supports. As the digital market grows, the only variable that can drive this process is price. A common strategy in the industry has been to offer digitized contents at marginal cost (i.e. for free) on direct platforms. Offering digital versions for

free, especially when the price of the hardcopy is positive, is likely to increase the shift of consumers to the digital market. If the business model of the publisher is based on advertising revenues, to test the sustainability of the model, the emerging advertising revenues should compensate not only for the investment made, but also for the direct and indirect losses in the traditional channel. Direct losses includes, among others, marketing investments and the eventual losses on the traditional market if negative externalities emerge. Indirect costs could be for instance caused by a shift of the marginal cost of production and distribution if the industry is subject to economies of scale. The profit function of a firm offering the digital version for free can be represented with this extremely simplified expression:

$$\pi_{dr} = [(p_p + \gamma_p - c_p) \times (q_p - \alpha q_d) - FC_p] + [\gamma_d q_d - FC_{dr}]$$

Where the index p or d represent the paper or the digital version, p is the cover price, γ is the per-copy advertising revenue, c is the marginal cost of production, $\alpha \in [0; 1]$ is the coefficient of cannibalization and FC is the fixed cost. In order for the pricing strategy to be sustainable, we must have:

$$\gamma_d \geq \frac{FC_{dr}}{q_d} + (p_p + \gamma_p - c_p)\alpha$$

Considering the condition for the digital market only, can lead to profit losses for the firm.

$$\gamma_d \geq \frac{FC_{dr}}{q_d}$$

Notice that if cannibalization is high, $\alpha \geq 1$, the per copy advertising revenues of the digital version should be higher than the total net margin per copy in the paper market $(p_p + \gamma_p - c_p)$.

Strategy 4 (π_{pb}) – pure bundling strategy

A good option to mitigate the eventual negative externalities could be the use of bundling. Economists such as Bakos and Brynjolfsson (1999), Jeon and Menicucci (2006) and Nalebuff (2004), have analyzed the beneficial effects of this option for firms as a discrimination tool and as an entry barrier. The originality here is that we are not

bundling different products or components, but rather different accesses to the same set of information. We call this multiform bundling. Bundling may help reduce cannibalization and consumers' heterogeneity in evaluations. On the other hand, the choice of a pure bundling strategy, which means selling only a bundle composed of both the paper and the digital version of a magazine at a price which is lower than the sum of the two prices and is usually equal or higher than the higher of the two single prices, may imply an increase of marketing expenses in order to increase consumers' awareness of the added value (different usage functions) of a multi-support offer, as outlined in Koukova, et al. (2008).

An example of a pure bundling option that has been used frequently in publishing is to offer the digital versions for free to paper subscribers. This strategy allows for the total control of cannibalization and is a way of developing brand loyalty on the digital market. In order to describe the profit associated to this strategy, we can write:

$$\pi_{pb} = [(p_p + \gamma_b - c_p) \times q_b - FC_p - FC_{dr}]$$

Where the index b denotes the bundle. With respect to the previous strategy, the cost for the company can be written as:

$$\Delta\pi_{pb} = (q_b - q_p)(p_p + \gamma_b - c_p) + (\gamma_b - \gamma_p)q_b - FC_{dr}$$

Where $(q_b - q_p)$ represent the increase in sales implied by the enhanced offer and $\gamma_b - \gamma_p$ represents the eventual increase in advertising revenues as a consequence of increased diffusion. If $\Delta\pi_{pb} \leq 0$, the strategy is profit enhancing for the publisher; otherwise it may still represent a possible initial digital strategy, since it allows a total control on the shift towards digital market. In addition, bundling reduces variance of consumers' evaluations for the different versions and allows for auto selection, allowing for testing of digital pricing strategies with a lower risk.

Strategy 5(π_{mb}) – mixed bundling strategy

The mixed bundling case is an intermediate strategy between strategy dr and strategy pb . The firm offers the paper and digital versions of the magazine as well as the bundle composed of both the versions. This strategy provides the publisher with a tool that can regulate the tradeoff between cannibalization and digital profits, better discriminating

consumers with a high willingness to pay for a specific version of the product. Since the optimal price of the paper version is already known when the digital strategy starts, by setting the price of the digital version and the bundle, the publisher can decide which objectives to pursue. Setting a higher price for the digital version or a lower price for the bundle is likely to decrease cannibalization while increasing the price of the bundle and reducing the price of digital version will encourage the shift towards digital consumption. Increasing both the price of the bundle and the price of the digital version is likely to reduce the quantity and profits in the digital market, thus this strategy can be used, as an example, to slow down the switch to the digital market by consumers with a high appreciation for both the physical and the digital versions. This solution can be particularly effective if the organizational switching costs are high. On the other hand, reducing both the price of the bundle and of the digital version will increase the demand in the digital market and the cannibalization of paper sales. This strategy is effective either to promote digital offers, or when the firm expects a growing profitability for digital versions, for example an increase in γ_d or a favorable policy set by the government.

For a given p_p^*	Increasing $p_d > p_d^*$	Decreasing $p_d < p_d^*$
Increasing $p_b > p_b^*$	Economic impact: reducing total sales, slowing down digitization, reduced cannibalization	Economic impact: Increase digital sales and cannibalization
Decreasing $p_b < p_b^*$	Economic impact: increases digital sales and reduces cannibalization	Economic impact: increases digital sales, accelerates digitization

Fig 5: The effects of pricing in a mixed bundling strategy

Having analyzed the output for the direct retailing strategies, we can move back one step on our decision space and analyze the tradeoffs that a publisher should consider

before deciding whether to distribute digital versions or provide licenses to an external digital distribution.

Strategy 2(π_1) – Outsourcing distribution through licensing

As we said at the beginning of this chapter, we call r a retailer selling digital versions of magazines. We assume that the retailer is already active in the digital market selling other magazines (or bundles of magazines). If r is given a license to distribute the good produced by p , his decisions will affect the publisher's marketing mix. As an example, the retailer will decide whether to offer the good in a given bundle or as a single product or both options. Moreover, in order to distribute the digital content, a licensee fee is required, usually calculated as a percentage on the cover price of each copy sold. The key differences between this model and the direct retailing thus are:

1. Firm p does not need an initial investment to enter the digital market $FC_d = 0$, but his margin on the digital good is reduced to $(1 - x)_{dr}$
2. The publisher loses the direct control on the distribution of his content. This has different economic implications:
 - a. On the one side the distributor gets contact with the final consumer and canalizes the traffic on his platform. Exploiting the brands in his portfolio, r becomes the recipient of a share of advertising revenues in the digital market which is hardly quantifiable for the publishers.
 - b. On the other side, the retailer's objective function does not take in account the traditional channel and the retailer may try to put pressure on the publisher to lower the prices of his digital versions

Moreover, if allowed to do so, the digital distributor will always have an interest in bundling the contents on his platform since this strategy would be profit enhancing for him. In fact, as shown in the bundling literature such as Nalebuff (1999), Venkatesh & Chatterjee, (2006), by bundling non substitutable products with null marginal costs, the firm is always capable of increasing its profits, exploiting auto-selection of consumers and introducing barriers to entry by leveraging the exclusiveness of its offer. While this strategy is certainly beneficial for the distributor, it may impact negatively on publisher's profits. In fact, as seen in the previous section, lowering p_d increases digital

sales but also the cannibalization effect on the traditional channel, with uncertain effects on the total profit of the firm.

Intuitively, being included in a bundle can be more beneficial for small publishers, which will be able to leverage their digital sales by free-riding on the strong brands within the bundle. On the other hand, to participate in these types of bundle is likely to be less beneficial for products with a high share of the traditional market, since they will be used as flagships in the bundle and will generate positive externalities on niche magazines that they are hardly able to internalize.

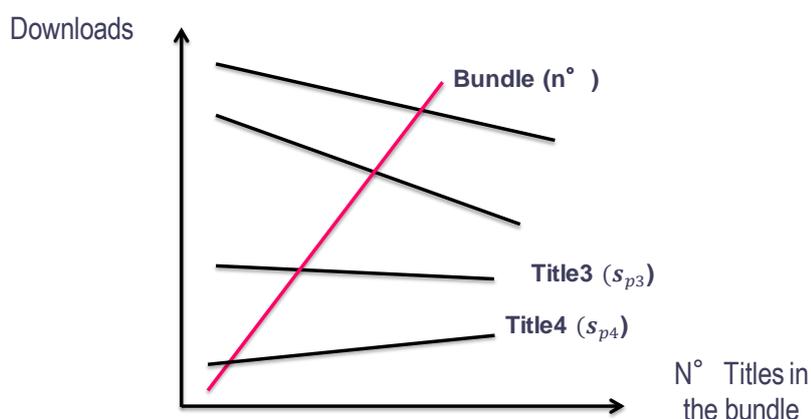


Fig 6: Externalities in an “all you can eat” type of offer

A recent survey by Cmmetrix supports this intuition on consumer behavior towards digital offers of the type known as “all you can eat” or “flat”: 75% of consumers’ will download magazines they would have never bought in paper version. Among this, 42% have discovered titles they didn’t know and are likely to keep downloading these new magazines in the future. Finally, about 18% of consumers who discovered new titles have then bought a paper copy in the following period.

In order to mitigate this effect, if a licensing strategy is selected, strong publishing brands should establish very specific contracts with digital distributors, limiting their control on the marketing mix.

Strategy 1(π_{ne}) – Non entering the digital market

Having analyzed the economic issues behind every possible digital strategy, we can now look at the first strategic decision faced by a publisher; whether to set up a digital

offer or to keep doing business as usual in the traditional market. The issue here is to model the effect of the growth of digital media markets on the traditional markets. The observation of previous cases and the economic literature seems to show a negative impact of the growing diffusion of bit-encoding techniques on traditional media markets. In the last decade, digital media are attracting higher shares of advertising revenues, while consumers are increasingly shifting the allocation of their leisure time from traditional to digital media. Moreover, innovations such as smartphones and tablets have increased these trends, raising the share of consumers with a high degree of preference for the new versions. Summing up, publishers who decide to keep doing business as usual renounce an uncertain result on the digital market but are still likely to suffer increasing negative externalities from not operating in the new market, including a possible reduction of global demand in their traditional business. However, the strategy of limiting losses by not entering the digital market can be optimal for a number of publishers with specific characteristics. A few examples:

1. Local free press, which relies on local advertisers which may find it more convenient to invest in a limited area than to use sophisticated Internet techniques to reach their target audience.
2. Magazines that target audiences with a very low preference for digital versions (i.e. third age press)
3. Luxury magazines, using special types of paper and pictures that cannot be reproduced digitally.

4. Regulatory framework and competitive environment

The last element that we need to analyze is the regulatory framework of the new market. As shown in the economic literature on multi-channel distribution and in this paper, when a new avenue of conducting business is set in parallel with the traditional distributive channel, two negative externalities are introduced in the business model: cannibalization and freeriding on immaterial investment. Non-homogeneous regulatory

frameworks or different competitive environments among the retailing channels can further increase the distortions in the market. In the case of digital publishing, we can identify two critical aspects related to heterogeneous or incomplete legislation

1. Taxation issues (or the different taxation for the same content).

The differential in gross profitability of physical and digitized versions, as we have seen, depends mainly on their different cost structures, on eventual distributor's fees, on consumer preferences for formats and on differential in per copy advertising revenues. In order to calculate the net differential, we should add the differences in taxation, which can be observed in many countries. In fact, counter intuitively, the same content proposed in different versions can be subject to different regulations. In Italy and France, for example, a physical magazine benefits from the status of cultural good while a digitized copy of the same magazine is an electronic good, subject to regular taxation. We can write the net margin on paper copy as:

$$(p_p + \gamma_p - c_p) * (1 - VAT_p)$$

While the margin on a digitized copy reads:

$$(p_d(1 - x) + \gamma_d) * (1 - VAT_d)$$

We can use the differential in cover prices $\delta = \frac{p_p - p_d}{p_p}$ and substitute in the above expression to obtain:

$$\left((1 - \delta)p_p(1 - x) + \gamma_d \right) * (1 - VAT_d)$$

Setting the condition:

$$(p_p + \gamma_p - c_p) * (1 - VAT_p) = \left((1 - \delta)p_p(1 - x) + \gamma_d \right) * (1 - VAT_d)$$

We can calculate the differential in cover price that equalizes the profitability of the two versions:

$$\delta = 1 - \frac{(p_p + \gamma_p - c_p) * \frac{(1 - VAT_p)}{(1 - VAT_d)} - \gamma_d}{(1 - x)p_p}$$

This way we can appreciate the effect of non-homogeneous taxation on the price differential that equalizes profitability. In the case of homogeneous taxation we have that:

$$\delta = 1 - \frac{(p_p + \gamma_p - c_p) - \gamma_d}{(1-x)p_p}$$

While in the extreme case of $VAT_d \rightarrow 1$, or $VAT_p \rightarrow 1$ we have respectively that:

$$\delta \rightarrow -\infty \text{ and } \delta \rightarrow \frac{\gamma_d}{(1-x)p_p}$$

This differential is a strategic variable that needs to be considered while setting a digital strategy. The table below shows the economic impact of setting a certain price for a version. The choice of a given differential should be done accordingly with the strategic objective of the firm. Setting an incoherent differential could otherwise worsen the negative externalities or reduce the effectiveness of a digital strategy.

Premium for paper version	Difference in marginality per copy
$\delta > 1 - \frac{(p_p + \gamma_p - c_p) * \frac{(1 - VAT_p)}{(1 - VAT_d)} - \gamma_d}{(1-x)p_p}$	Paper copy has higher net margin
$\delta = 1 - \frac{(p_p + \gamma_p - c_p) * \frac{(1 - VAT_p)}{(1 - VAT_d)} - \gamma_d}{(1-x)p_p}$	Equal margin for paper and digitized version
$\delta < 1 - \frac{(p_p + \gamma_p - c_p) * \frac{(1 - VAT_p)}{(1 - VAT_d)} - \gamma_d}{(1-x)p_p}$	Digitized copy has higher net margin

Fig 7: The impact of taxation on net marginality of different versions

2. Policy issues (or the different regulation for the same content).

Taxation is not the only distortion introduced by regulation in the publishing industry. There are two other policy aspects which need attention in order to create a level playing field for digital media content. The first aspect is the regulation about vertical agreements. The recent cases in the U.S. and E.U., where publishers have been

investigated for the establishment of tacit vertical agreements with a major digital retailer have outlined the different treatment that physical and digital media goods are subject to. While the physical books market historically benefited from exemptions on vertical agreement regulations in various forms, regulation of the e-books market has been more favorable to digital retailers in the last decade. Still immaterial investments are common for books in both physical and digital forms. While some countries have tried to homogenize regulation extending special provisions from the physical to the digital segment of the same industry (i.e. the law PULN on minimum retailing price for e-book), some others do not, generating more distortion between the two distributive systems.

The second policy issue is the revision of Copyright law, which does not seem able to protect intellectual property under current market conditions and to cope with the separation of meaningful content from a physical support allowing for its distribution. This aspect is crucial for any cultural industry and a more in-depth analysis of the economic effects of possible emerging regulation is left to a following paper. Nevertheless, we observe that the difficulty of harmonizing the regulation with the new emerging business models has not permitted the creation of a definitive new framework yet. On the contrary, digitized copyrighted works are suffering more and more since the uncertainty on property rights is coupled with confusing interpretations of the exhaustion principle (digitized copyrighted works are often sold as licenses, while their physical homologous are exchanged as goods). The only strategy available for publishers is thus to team-up with the providers of access to digital media catalogs. In fact, distributors of digitized media and manufacturer of reading devices found that a way to protect and reward IPs is the creation of non-compatibles, proprietary standards and environments such as Kindle from Amazon.com or iPad from Apple. They are thus promoting “walled gardens” as an efficient way for protecting and valuing copyrighted goods. This solution is suboptimal with respect to an efficient copyright law and presents intrinsic risks for the preservation of diversity in the cultural industries since it leaves the authority on the intellectual property rights in the hands of private firms.

Conclusions

In this paper we have analyzed the economic issues raised by the development of digitized versions of magazines and then we have discussed the main available digital strategies for a publisher facing the emergence of this new market. After a decade in which almost every publisher has created a free website offering exclusive copyrighted contents, the appearance of tablets has increased the utility of digital magazines and stirred up the offer and the consumption of digitized versions. The originality of the problem is that digitization introduces a new way of conducting business reformatting the same meaningful contents through bit encoding techniques. While the products share the same set of information and should thus be regarded as substitutes, the cost structures, the distribution dynamics, the competitive environments and even the regulatory frameworks differ slightly in the traditional and the digital market. Finding the optimal strategy to exploit this new market, exploiting the potential of a multiform marketing mix without devaluing the traditional value chain is not an easy task for publisher. We have tried to provide the reader with all the elements that are needed to take strategic decisions while dealing with growing digitization, starting with the assumption that there exist no optimal strategy that can be adapted to all publishers and strategic objectives. As an example, the relevant investments needed to implement a direct digital retailing strategy may not be compatible with a niche publisher, while a well renown publisher may be reluctant to outsource distribution, since a digital distributor may then have an incentive to free-ride on the brand value of his licensors to maximize profits. We have also discussed the strategic use of multiform bundling techniques to mitigate the negative externalities of multi-channel distribution with substitute products. By bundling different versions of a single brand and adjusting relative prices, a publisher can control the cannibalization effect on the traditional value chain and control the pace of growth of his digital sales. Nevertheless, entering the digital market will not necessarily be profitable for every publisher. In particular for some categories of magazines with specific local or social targets, the optimal strategy may as well be not to enter the digital market at all, at least until the digital market will

not be sufficiently developed. Furthermore, we have proposed a synthetic measure that allows calculating the price differentials that are compatible with the selected strategies with respect to objective parameters. Finally, we have discussed the main policy issues at stake and the effects they may have on a publisher's choice on his optimal digital strategy. The heterogeneity of the regulatory frameworks and the difficult adaptation of traditional copyright law to digital media seem to be the key factors in this respect. Distributors of digitized media found that a way to protect and reward intellectual property under current conditions is the creation of non-compatibles, proprietary standards. This business model may be effective in the short run but poses new questions for publishers about the competitive structure of the digital market for media content in the near future.

Bibliography

Adams, William James and Janet L. Yellen. 1976. "Commodity Bundling and the Burden of Monopoly." *The Quarterly Journal of Economics*, 90(3), 475-98.

Bakos, Y. and E. Brynjolfsson. 1999. "Bundling Information Goods: Pricing, Profits, and Efficiency." *Management Science*, 45(12), 1613-30.

Baumol, William J.; John C. Panzar and Robert D. Willig. 1983. "Contestable Markets: An Uprising in the Theory of Industry Structure: Reply." *The American Economic Review*, 73(3), 491-96.

Bomsel, Olivier, 2013. "Copyright and brands in the digital age: Internalizing the Externalities of Meaning", *Contemporary Economic Policy*, Vol. 31, Issue 1, pp. 126-134, 2013.

Bomsel, Olivier, 2011. "Do you speak European ? Media Economics, Multilingualism and the Digital Single Market, *Communications and Strategies*, n°82, 2nd Q.

Buxmann, Peter; Jochen Strube and Gerrit Pohl. 2007. "Cooperative Pricing in Digital Value Chains : The Case of Online Music." *Journal of Electronic Commerce Research* 1 . 8 (2007) : pp. 32-40.

Chen, Yeh-ning and Ivan Png. 2003. "Information Goods Pricing and Copyright Enforcement: Welfare Analysis." *Information Systems Research*, 14(1), 107-23.

Chu, C.S.; P. Leslie and A Sorensen. 2011. "Bundle-Size Pricing as an Approximation to Mixed Bundling," *American Economic Review* 101(1), February 2011.

Chuang, J. C. I. and M. A. Sirbu. 2000. "Network Delivery of Information Goods: Optimal Pricing of Articles and Subscriptions". Cambridge, *MIT Press*, August 2000.

Deleersnyder, Barbara; Inge Geyskens; Katrijn Gielens and Marnik G. Dekimpe. 2002. "How Cannibalistic Is the Internet Channel? A Study of the Newspaper Industry

in the United Kingdom and the Netherlands." *International Journal of Research in Marketing*, 19(4), 337-48.

Epstein, Jay. 2005. "The Big Picture: The New Logic of Money and Power in Hollywood," *Random House Publishing Group*, 2006

Hogendorn, Christiaan and Stephen Ka Yat Yuen. "Platform Competition with Must-Have Components." *The Journal of Industrial Economics*, Vol. 57, Issue 2, pp. 294-318, June 2009.

Jeon, D. S. and D. Menicucci. 2006. "Bundling Electronic Journals and Competition among Publishers." *Journal of the European Economic Association*, 4(5), 1038-83.

Joseph, Farrell and Klemperer Paul. 2007. "Co-Ordination and Lock-In: Competition with Switching Costs and Network Effects." *Handbook of Industrial Organization*, Elsevier, edition 1, volume 3, number 1, 00.

Katz, Michael L. and Carl Shapiro. 1985. "Network Externalities, Competition, and Compatibility." *The American Economic Review*, 75(3), 424-40.

Koukova, Nevena T.; P. K. Kannan and Brian T. Ratchford. 2008. "Product Form Bundling: Implications for Marketing Digital Products." *Journal of Retailing*, 84(2), 181-94.

Liebowitz, Stan J. and Stephen E. Margolis. 2001. "Network Effects and the Microsoft Case." *Dynamic Competition and Public Policy: Technology, Innovation and Antitrust Issues*. Cambridge: Cambridge University Press.

Matthew, Gentzkow. 2007. "Valuing New Goods in a Model with Complementarities: Online Newspapers." *American Economic Review*, *American Economic Association*, vol. 97(3), pages 713-744, June

Nalebuff, Barry. 2004. "Bundling as an Entry Barrier" *Quarterly Journal of Economics*, 2004

Nelson, Phillip. 1970. "Information and Consumer Behavior." *Journal of Political Economy*, 78(2), 311-29.

- Olivier, Bomsel and Ranaivoson Heritiana.** 2009. "Decreasing Copyright Enforcement Costs: The Scope of a Gradual Response." *Review of Economic Research on Copyright Issues* 6, 2 (2009) 13-29
- Rochet, Jean-Charles.** 2003. "Platform Competition in Two-Sided Markets." *Journal of the European Economic Association, MIT Press*, 1(4).
- Rohlf, Jeffrey.** 1974. "A Theory of Interdependent Demand for a Communications Service." *The Bell Journal of Economics and Management Science*, 5(1), 16-37.
- Shankar, V. and Bayus, B.** 2002. "Network Effects and Competition: An Empirical Analysis of the Home Video Game Industry." *Strategic Management Journal*, 24 (2003), 375-384.
- Simon, Daniel H. and Vrinda Kadiyali.** 2007. "The Effect of a Magazine's Free Digital Content on Its Print Circulation: Cannibalization or Complementarity?" *Information Economics and Policy*, 19(3-4), 344-61.
- Venkatesh, R. and Chatterjee, R.** 2006. "Bundling, Unbuilding, and Pricing of Multiform Products: The Case Magazine Content." *Journal of Interactive Marketing*, 20(2), 21-40.

Chapter 1

Digital Media Economics: How bit-encoding techniques have changed the business?

Abstract

Media economics is undergoing a process of rethinking due to radical technology innovation on the support side. The originality of the problem is that digitization is quite not just a technological innovation, improving efficiency through the value chain (search costs, copy costs, logistic costs, enhanced differentiation, etc.); it is also a new written language. Bit encoding affects the meaning of copyrighted contents and their publishing protocols in many ways: unveiling model, creation of demand and resonance, timeliness, appropriation and distribution of property rights, just to name a few. The study of these aspects is essential in order to fully understand the emerging economic models in media industries. In this paper we will explore some of the recent research efforts focusing on the effects of digitization and regulation on Media economics and in particular on the publishing industry. The main contribution of this analysis is that it tries to combine the economic literature that analyses technology related issues generated by digitization with contributions analysing the impacts of new publishing protocols. The references analysed in this chapter are gathered by the main economic issues they treat, these include: versioning, price discrimination, bundling, vertical relations, printed press economics, piracy and regulation issues in the media sector. Economists will find in this article not only many important contributions on pricing and bundling in digital two-sided markets or multi-channel distribution models, but also interesting contributions from other specialists, analysing questions related to regulatory framework and even epistemological issues. The objective is to combine these contributions to provide researchers with a broader set of intuitions and a fresh approach to explore topical questions such as: is an e-book a book or an electronic good? What will be the future competitive environment for a digital publisher?

Résumé

L'Économie des médias est en train d'être repensée à cause des innovations technologiques radicales du côté des supports. L'originalité du problème est que la numérisation n'est pas seulement une innovation technologique, qui permet d'améliorer l'efficacité et la productivité de l'industrie en impactant les procédés dans la chaîne de valeur (coûts de recherche, coût marginal de la copie, coûts logistiques, possibilités améliorées de versionnage, etc.). La numérisation est aussi un nouveau langage, une nouvelle écriture. En effet, le codage binaire affecte le sens des contenus protégés par le droit d'auteur et de même leurs protocoles d'édition en modifiant plusieurs phases de l'industrie: modèle de dévoilement, la création de la demande et de la résonance, la temporalité, l'appropriation et la répartition des droits de propriété, etc. L'étude de ces aspects est donc essentielle pour comprendre les modèles économiques émergents dans l'industrie des médias. Dans cet article, nous allons explorer les récents efforts des chercheurs qui concernent les effets de la numérisation et de la réglementation sur l'économie des médias, en particulier dans le secteur de l'édition. L'apport principal de ce travail est qu'il essaie de conjuguer la littérature économique qui analyse les enjeux liés aux changements technologiques générés par la numérisation avec des contributions analysant les impacts des nouveaux protocoles d'édition. Les articles sont traités selon l'enjeu économique principal qu'ils analysent, notamment : discrimination des prix, vente groupée, versionnage, piratage, problématiques de la presse imprimée et relations verticales dans la filière des médias. Les économistes trouveront dans cet article non seulement les contributions les plus importantes sur la tarification et les offres numériques groupées, dans des marchés bifaces où les modèles de distribution avec réseaux de distribution multiples, mais aussi des contributions intéressantes par d'autres spécialistes, comme l'analyse des questions liées au cadre réglementaire et même certains aspects épistémologiques de la numérisation des Médias. L'objectif est de conjuguer ces contributions pour fournir au lecteur un éventail plus large d'intuitions et une nouvelle approche à la problématique pour explorer des questions d'actualité comme : un e-book est-il un livre ou un bien électronique? Ou bien, quel sera le futur environnement concurrentiel pour un éditeur numérique?

1. Introduction

Bit encoding techniques represent an unrivalled opportunity to promote a wider diffusion of cultural goods. They allow for diffusing messages, images, music and videos with negligible copying and transport costs, both for correspondence or for publishing purpose. In order to deploy the social benefits (positive externalities) of digitalization, access to this technology needs to be provided to consumers. The support allowing for exploitation of digitized media is composed by a device capable of decoding strings of bits and a network connecting sources and receivers of these strings. Given these characteristics, digitization cannot be regarded just as a technical innovation. It is a new avenue for communication composed of a new support or “medium” (the Internet) and a new language (the 0, 1 alphabet). The advent of this innovation has permanently changed the traditional paradigms of the Media industry. Moreover, the impact of these changes on the media value-chain is growing exponentially with the deployment of enhanced networks (such as ADSL) and the penetration of the market by new digital supports (smartphones, e-readers, etc.).

This article synthesizes key contributions in different fields, related to the economic effects of digitization on media firm business models. The focus of the research is on the issues emerging for publishing firms that are active in the traditional media industries, and approach the new avenues of conducting business offered by the Internet channels. The originality of this problem is that it combines many fields of economics research: publishing is an example of a two-sided market and the introduction of digitized versions configures a multi-channel distribution of substitutable products. Moreover, the originality of the information goods cost structure and distribution allows for profit enhancing bundling strategies but threatens the immaterial investment that are critical in the context of experience goods subject to copyright. In order to organize all these important aspect, we identify a number of key issues from a business point of view and we analyse recent and relevant contributions focusing on each of them. Moreover, we consider two categories of effects introduced by digitization: on the one side we have technological effects, defined as the changes generated by bit encoding

techniques in the supply chain or in the industrial context. This includes for example: gains in efficiency, reduction of transportation and production cost, new opportunities for price discrimination such as unlimited bundling or some drawbacks of online distribution such as increases in piracy and freeriding or cannibalization among competing distribution channels. On the other side, we address the effects of digitization which are related to the content of media goods, such as the creation of content, their nature, their meaning, their publishing protocols and the distribution of property rights. These effects are slightly harder to analyse and to evaluate, since they affect the utility of media goods as well as customer preferences and willingness to pay both for the new goods and for the traditional ones.

1.1. Overview of Research

To provide a visual mapping of this research, we can build a two-dimension matrix in which on one axis we have the main economic issues raised by the development of a digital market for content while on the other axis we set the two categories identified in the previous section. Following a previous work on Strategic Issues and Key Variables for Publishers facing Digitization, we can identify the main economic issues affecting the strategic space of a Publisher. The first effect of bit-encoding techniques is to provide new differentiation opportunities, from which a publisher has to create his new marketing mix. After this step, the publisher needs to select a price that maximizes her profit under the new offer. While choosing the price for each version the publisher needs to consider the differences in the cost functions among versions and the possibly different shape of consumer preferences. A price discrimination tool which is typically used in the media sector is the practice of selling more than one product in a single offer, also known as bundling. Digitization enhances the reach of this tool, both by eliminating the traditional physical constraints and reducing the cost of assembling new bundles. Moreover, once the publisher has created his digital offer, he needs to choose how to distribute the new products. The main available choices are to distribute digital versions directly through proprietary platforms or licensing distribution to digital distributors. In a context of multi-channel distribution, vertical relations in the value

chain become crucial and each distribution model determines not only a direct impact on a publisher's digital activities, but also an indirect effect on printed press economics. Finally, digitization raises new concerns about intellectual property rights regulation. These concerns are twofold: on the one side, the characteristics of the new digital media contents may increase the diffusion of illegal copies, on the other hand, in many countries the regulation concerning media contents is heterogeneous with respect to the support on which contents are exchanged. As an example, in many European countries printed books benefit from a lower VAT, while digital versions better known as e-books are subject to the regular taxation.

Regarding the columns of the matrix, we can label the categories of effects as technological, if it does not affect the intrinsic characteristics of the goods or as related to the publishing protocol if it does. We define publishing protocol as the set of transformations which are necessary in order to transform some meaningful expression in a media product. It is composed of different steps, the most important of which are: creation (transposition on an exploitable format), selection, edition (refining), risk evaluation, contextualisation, signalling, exhibition and critical evaluation. All of these steps generate complex economic transactions and contribute to bridge building between consumer and the evaluation of a media good.

Categories	Technologic	Publishing Protocol
Economic Issue		
Versioning	Simon & Kadiyali (2007) Gentzkow (2007)	Schweizer (2002) Bomsel (2011)
Pricing and Bundling	Parker & Alstyne (2000) Bakos and Brynjolfsson (2000) Sundararajan (2003) Jeon & Menicucci (2006) Venkatesh & Chatterjee (2006)	Koukova & al. (2008)
Vertical Relations	Cattani et al. (2005) Bernstein & al. (2005) de' Grassi (2012)	
Printed Press Economics	Travis (2006) Kirchhoff (2009) Evans (2009)	Cope & Kalantzis (2010) Bomsel & al. (2012)
Piracy And Regulation	Landes & Lichtman (2003) Lian & Chen & Wang (2010)	Zimmerman (2003) Darling (2012)

Figure 1: Map of research

In this paper, we identify and discuss research that has been conducted in each area of the conceptual map above. Figure 1 also indicates all of the references that are discussed in detail in the following sections. Since the amount of research produced in these areas is quite voluminous, we choose to focus in particular on those papers which analyse the publishing sector.

1.2. Digital publishing economics

In its most parsimonious form, a supply chain in the Media industry consists of authors, editors, retailers and customers (consumers of media or advertisers) who manage the bi-directional flows of goods, information and money. Digitization affects each interface in many ways. First of all, digitization changes the relationship between authors and publisher. In the traditional model, each work had to go through a number of costly steps before being published, including reviews by experts from publishing firms. Thanks to the new technologies, a work can now be literally “published”, or given to public, at very low cost and made available to the whole developed world through the Internet, with barely any need of a traditional publishing firm. Moreover, authors may start growing or cultivate their audience by setting up a blog or a twitter account before even having physically published or produced a relevant work. Authors have the opportunity to manage their “brand” through these direct channels and to by-pass the bargaining process with traditional publishers by negotiating directly with emerging digital distributor (Amazon, iBookstore, etc...). On the other hand, the remuneration of published works is threatened by the ease with which works can be multiplied digitally. Copyright seems less capable of mediating between the interests of producers of works in getting paid for them and of their consumers in gaining access at a reasonable cost to what is produced. Moreover, digitized copyrighted works suffer from a lack of recognition and heterogeneous legislation.

Moving to the distribution side, the deployment of network technologies based on bit encoding has opened new retailing avenues for media contents. Online distribution has a number of competitive advantages with respect to traditional retailing networks: for example, digital distributors incur in lower costs for real estate, personnel and logistics. Moreover, they are able to reach a global market with just one interface. In addition to these general features, in media industries online distributors represent an opportunity for differentiation, since they allow selling digitized versions of the same copyrighted products. The use of the Internet as an alternative distribution channel thus provides several opportunities to affect the interactions and performances of media industry

supply chains. In order to efficiently integrate digital distribution in the supply chain of media industries, a number of strategic decisions and key variables need to be analysed. The main strategic decision at the publisher level is whether to integrate digital distribution vertically or horizontally. This will determine the range of opportunities they have to coordinate different facets of the supply chain. This decision is affected by firm specific characteristics but also by a number of variables related to the digital market (i.e. concentration, consumer preferences) and regulation (i.e. copyright, network access and product group).

Assuming a simplified supply chain structure with a media editor selling products to a physical retailer, who in turns sells products to a customer through a traditional channel, such as a retail store or an industrial products distributorship, the basic options that are available for a Media brand to include digital distribution are the following:

1. Independent digital distribution: the firm can establish cooperation with an independent digital distributor, such as Amazon, AppleStore or Google. (e.g. Gallimard)
2. Vertical integration on digital market: the firm can open a proprietary Internet channel to directly reach the customers of his products, to provide an alternative channel that is under his direct control (e.g. New York Times and many other news brands)
3. Horizontal integration: a physical retailer can use the capabilities of the Internet to provide customers with multiple options for purchasing their products (e.g. relay kiosks network and its digital distributor relay.com)
4. Mixed competition on digital market: the firm owns an integrated digital distributor but also provide its products to independent digital distributors (e.g. Feltrinelli).

The last fundamental issue for the economics of a publisher facing digitization is the determination of the pricing structure and the marketing mix. Pricing in a supply chain that involves the Internet is affected by several issues. First of all, the Internet channel provides an alternative retailing channel, so pricing must be made in the context of a multi-channel distribution, which means that risks such as cannibalization and free-riding must be embedded in the pricing structure. Moreover, digitization causes an expansion of the marketing tools available as well as an enlargement of the product

array of an editor. In particular, since the Internet allows for a relaxation of space, copying and distribution constraints, this results in the multiplication of versions and bundling opportunities available for a firm in the media industry. As for the demand side, the main issue is to understand the shape of consumer preferences towards the new media, and particularly whether they perceive the Internet channel and digitized media contents as imperfect substitutes for the traditional products or potentially as complementary products.

2. Economic issues for Publishers in the digital Era

One of the main benefits of bit encoding techniques is, as anticipated earlier in the article, the reduction of traditional costs in production and transactions. In the media industry, these effects are even stronger since additional economic constraints such as space limitation (on the support), copying capacity and logistic are relaxed in a digitized supply chain. Relaxation of constraints determines enhanced version and discrimination opportunities for publishers and authors. However, the introduction of new versions, which can be marketed through different distribution and retailing network, complicates the business model of media content producers, raising a number of issues which needs to be analysed in order to efficiently exploit the opportunities introduced by digitization. The first question is which marketing mix should be offered and how each new version affects the firm's business model. In the following section we review a number of interesting references focusing on these aspects.

2.1. Multi-media versioning

The analysis of multi-media versioning includes technology related analysis and issues related to publishing protocols and future scenarios. We start with the well-known paper from Simon & Kadiyali (2007), in which the authors examine how offering digital content affects demand for print magazines and introduce the problem of substitutability among different versions of the same content. In fact, following their model the authors

find strong evidence that digital content cannibalizes print sales. However, the effect varies with the type of digital content offered. Offering digital access to the entire contents of the current print magazine slightly reduces print sales. On the other hand, even if there is no evidence that digital content complements print magazines, offering limited access mitigates the cannibalization effect. The hypothesis from which the authors start is that a physical magazine and its websites are seemingly perfect substitutes for their print counterparts. On the other hand, a magazine's website may complement its print version by increasing diffusion of a publishing brand. Moreover, the Web's interactive features are likely to increase loyalty of clients pushing more readers towards subscriptions. The key element of this paper is that it analyses the type and the amount of digital contents that are made available through the new distribution channel. The results indicate that digital content is a substitute for print content no matter the type or amount of free content that is released online, while providing no evidence of being complementary. However, the authors also emphasize that, for most consumers, digital content is not a perfect substitute for print media. More than 90% of readers continue to buy the print magazine when the identical content is available online, for free. However, the new supports which are conceived in order to read articles and book more comfortably, will inevitably affect this trend. Anticipating this further increase in cannibalization, many brands have started to set paying offers on these supports, leaving the free accessibility only on less comfortable devices. If consumer willingness to pay for digitized versions will increase with the increased comfort of digital reading, firms will be able to mitigate cannibalisation by adjusting the price of the digital version, while if the free model keeps dominating the digitized market, the pressure on margins is likely to continue to take a heavy toll on publishing firms.

Another author that has analysed the issues of versioning media content is Gentzkow. In his 2007 paper, the author develops a model to study empirically the competition between hardcopies sold through traditional distribution channels and online versions sold through a direct digital distributor. Drawing on data from the newspaper market, he estimates the relationship between the print and online papers in demand, the welfare impact of the online paper's introduction and the expected impact of charging positive online prices. With respect to Simon & Kadiyali, the author extends on the techniques for estimating the impact of new products, allowing for goods to be either substitutes or

complements. The discrete demand model that he develops permits consumers to choose multiple goods simultaneously and allows the demand-side relationship between each pair of products to be freely estimated from the data. The results show that properly accounting for consumer heterogeneity both the reduced-form OLS regressions and a structural model without heterogeneity suggest that print and online editions of a newspaper are strong complements. In contrast, estimating the full model with both observed and unobserved heterogeneity, the author finds that the print and online editions are significant substitutes. Moreover, the author develops two approaches to estimate the effects of charging a positive price for online contents which are usually provided free of charge. The first approach assumes that the firm may be setting the price of the online edition sub optimally, and asks whether profits could be increased by charging positive prices. The result is that, for the period under study, the optimal price is indeed positive, so the firm experiences some losses from charging the suboptimal price of zero. The second approach supposes that the zero pricing is optimal, and ask how large transactions costs would have to be to rationalize it. The result in this case is that a zero price would be optimal for any transaction cost higher than a threshold. Moreover, the author shows that because of growth in online advertising demand, the gain obtainable raising online prices was eliminated by 2004. This suggests that the zero pricing strategy may have been part of a rational forward-looking strategy and is approximately optimal today. To sum up, the author finds that print and online versions are substitutes; however, he finds that the magnitude of the crowding out of print readership is relatively smaller in his sample. His conclusion is thus that the advent of online newspapers does not appear to threaten the survival of print media. Moreover, he finds that welfare benefits of the online newspaper appear to outweigh its costs since consumers gain from the free provision of the online paper, and although the firm appeared to suffer a net loss during the 2000–2003 periods, an improved advertising market could outweigh the calculated annual effect on firm profits. Finally, the authors find that in the period under study, the firm could have increased profits by charging a positive price for online content. We will analyse more in depth the pricing of different versions of the media content in the next section of this chapter. On the other hand, we move now to the analyses of issues related to publishing protocols, since the increase of version possibilities introduced by the development of bit-encoding techniques imposes a reflection also on the long term effects of the digital revolution. In fact, technology

innovations may generate also stylistic innovations, permanently changing the way contents are produced and marketed in the long term. In his paper from 2002, Schweizer introduces these issues, explaining how the quality certification processes for technological and stylistic innovations differ and how they may interact in the media industries. Stylistic and technological innovation may take place in the content or in the form of media products. The author argues that the interaction between these types of innovation depends on their location within the product and on the characteristics of the certification schemes faced by the producing firms. Innovation in the media industry has been discussed by economists mainly in the context of technological innovations. On the other hand, artistic innovation and the interaction of technological innovation with such other types of innovation have been neglected. According to the author, a media product can be separated into three parts. First, there is the core of the product, which for a media product will represent the thematic part or message of the product. This core together with the inner form represents the content of a product, in turn surrounded by the outer form of the product. The inner form in the case of a book would be the 'literary form', while the outer form includes in a wider sense the way in which the content is transmitted and presented to the consumers. In the case of a book this would include design characteristics of the cover, but also new technologies in the mode and means of producing and transmitting content to the consumer. Technological innovation, however, may not only figure in the form, but also in the content of a product. In the content, technology may open up new stylistic opportunities in the 'inner form'. Vice versa, stylistic innovation may not only occur in the content, but also in the outer form, where it is usually referred to as design innovation. Content innovations in the media industries, such as stylistic innovations in the inner form of the content or innovations in its core tend to be highly certifier-dependent. This is mainly due to the experience and credence qualities of such innovations, which means that belief in the quality experienced by others forms a central part in the perception of such products, a belief, which the certifiers have the power to create. In the media content industries these certifiers are professional critics or experts who work independently or within publishing firms. The better the firm's or critic's reputation, the more it will act as a certifier of quality in its own right. Building on these considerations the author proposes a definition of stylistic innovation applicable to management analysis. In his view, stylistic innovation is the sum of the features in a product or the process of its

production, which differentiate a producer from other producers, based on differences in their cognitive structures underlying the realization of new means and ends in a product and its production process, which do not match the collective expectations in a particular certification environment, but are recognized as novel. This concept, coupled with the concepts of reputation, identity and the certification scheme are then used by the author to try and explain variations in the interaction between the different innovation types. Drawing on two case studies the author indicates that, although the representatives of the media technology industry do not seem to be conscious of these interactions, some of their statements do refer to the tension between style and technology. In contrast, in the media content industry the awareness of the techno-stylistic interactions seems stronger. Finally, the author sets a number of hypotheses as potential departure points for future research in this area. (1) The interaction between different types of innovation in the content and the form of media products depends on the characteristics of the certification schemes typically faced by the producing firms in particular industries. (2) In the certification scheme governing sectors of the publishing industry in which the importance of stylistic innovation as a quality indicator is higher, technological innovation visible in the form of a product is more likely to unfavourably influence the certifiers' perception of the product's content quality. (3) Publishers who have built-up either very strong or very weak reputation resources with respect to stylistic content innovation within a technological innovation-averse certification scheme are more likely than those with average reputations to be receptive to technological innovations. (4) The more resources firms operating within a technological innovation-averse certification scheme have built up with respect to direct customer contact, the less dependent they are on certifiers, and therefore the more receptive they are for technological innovations affecting their production and distribution channel. (5) The introduction of a technological innovation visible in the form of a media product is more likely to be successful if it is presented with content which is already well-established in the media content industry, rather than with innovative content.

In his 2011 article, Bomsel outlines another interesting aspect concerning the relation between technological innovation, versioning and content innovation. The characteristics of the new Media affect content production and the competitive

environment in Media industries in many ways, and some issues can result in permanent competitive advantages for certain media goods with respect to others, independently of the meaningfulness of the content. Among these issues the author focuses on fragmentation along linguistic and cultural lines. The level of fragmentation varies slightly among countries. For instance, the European media industry is highly fragmented both from a language and a cultural point of view. Moreover, the patchwork of different media markets in Europe is the result of diverging consumer preferences and varying technological, economic and regulatory circumstances across the EU. The thesis of the article is that this high fragmentation may result in a permanent competitive disadvantage in a context of expanding digitization of media distribution, unless specific regulation policies are implemented. To support this reasoning, the author shows that multilingualism not only adds specific costs to all media distribution systems, but it also prevents economies of scale in producing or marketing media contents across Europe. Such fundamentals explain why multi-territory licensing is counter-productive for media creation. The organisation of media industries in Europe is specific to the national regulation of each Member State, but is now being challenged by the rollout of new media markets. Digital networks do not capture all the value of the media, but have to get inserted in their complex and path-dependent multi-version discrimination schemes. Consequently each member state has built up specific media regulations aiming at shaping discrimination schemes compatible with its national goals of media creation and diversity. The problem is that these regulations are complicated to harmonize, especially because of multi-linguism. In fact, media goods provide meaningful experiences that generate cultural paths affecting their relative value within the different cultural communities. Therefore, both creation and distribution are highly sensitive to linguistic and cultural parameters. Moreover, media industries are capital intensive both for production and marketing. This means that large linguistic markets, such as the United States, have a structural competitive advantage. On the other hand, European media industries carry high discrimination costs: the investments required for shaping consumer utility of a product or service, are comparably higher and riskier than in larger linguistic markets. This penalises creation, diversity, and curtail potential economies of scope. In the author's view, the key factors are thus discrimination costs. Having them low allows efficient media distribution, which increases returns on creation of new products and new brands. The problem of the European media industry

is that linguistic segmentation increases these costs incrementing the protection of national media sectors with idiosyncratic rules. In conclusion Europe suffers a lack of competitiveness compared to monolingual markets such as the United States or even China, both at the production, marketing and distribution level. The multiplicity of languages and cultures creates a wide distribution of individual preferences that requires expensive differentiation that adds to the high discrimination costs created by the path-dependency of each individual member state. On the other hand in big linguistic communities digitization can be exploited to improve discrimination efficiency in media distribution. As a consequence, digital distributor strategy focuses on benefiting from scale economies of a large monolingual markets on which the media discrimination systems are homogeneous. The problem faced by the European media industries is thus to avoid an excessive concentration in digitized distributions and harmonize media regulations in order to mitigate the competitive disadvantages deriving from multilingualism.

2.2. Pricing and Bundling

Having analysed the economic implications of multi-media versioning, in this section we review the contributions related to the pricing schemes for a content which is available in different versions and through different media. The selected papers focus on the pricing strategies in a context of multi-channel distribution and possible substitutability among versions. As introduced above, digitization relaxes many constraints of the traditional publishing business model, enhancing price discrimination opportunities. We analyse in particular the effects of bundling, the practice of offering several products for sale as one combined product. This price discrimination tool becomes more flexible and effective thanks to the relaxation of physical constraint, thus many economists have studied the effects of enhanced bundling on media firms pricing strategies. The optimal pricing structure should reflect as well the additional costs and risks introduced by the new media, such as cannibalization, distribution fees and freeriding problems, which will be treated more in depth in the next section, or even regulation and taxation issues, which will be treated later in the article. Finally, firms

need to evaluate that consumers may not have the same preference structure for the same work consumed on different supports. As an example, despite new supports, such as tablets, are specifically designed to read text, most consumers still seem to have a higher willingness to pay for a physical book rather than a digital one.

Venkatesh & Chatterjee (2006) analyse the product market conditions under which a publisher should start offering online contents. Moreover, they discuss optimal online marketing mixes (bundle, unbundled contents, or both). Finally, they address pricing implications and they find that going online is profit enhancing even when the market strongly prefers the traditional medium and there are no advertising revenues. They find that under specific market conditions, the online modules, rather than the bundle, better complements the print bundle. The authors start their set up building on these three considerations. First of all, in the case of multiform products, consumer reservation prices depend not only on their evaluation of the content but also on their preferences for the different supports (i.e. tablets, smartphone, PC, hardcopy). Moreover, with multiform products the range of options is expanded beyond pure components, pure bundling, and mixed bundling. For example, the print magazine and its bit-encoded version are two distinct bundles and offering them both is arguably neither pure bundling nor mixed bundling. Finally, subscription and advertising revenues gaps related to the support (when applicable) must be included in the decision concerning digital strategies. The authors find that it is profitable for publishers to go online even when consumers strongly prefer the traditional support. Moreover, in their view the optimal strategy is to offer initially only online modules in addition to the print version; the bundle should be added to the product line only when the market is more accepting of the digital versions. Moreover, they found that low priced versions should be targeted at consumers with a low valuation for the content. Finally, the optimum price of the hardcopy is influenced by the presence of the online offerings. It decreases initially as the market's acceptance of digital versions grows, but increases subsequently.

Another interesting study is the work of Parker & Alstyne (2000). In their article, the authors examine the possible benefits arising for firms in the digital market if they have to concede content for free. The intuition is that free strategic complements can raise a firm's own profits while free strategic substitutes can lower profits for competitors. The author uses a model of cross-market externalities based on network effects, price

discrimination and product differentiation that shows how the characteristics of digital media market may lead to novel strategies such as eagerness to enter into Bertrand price competition. The three main results are: (1) a firm can rationally invest in a product it intends to give away in perpetuity even in the absence of competition. (2) Markets for content-providers and end-consumers can both be a candidate for free good. (3) A firm can use strategic product design to penetrate a market that becomes competitive post-entry.

The 2003, a paper of Sundarajan adds an important issue, since he analyses optimal pricing strategies for copyrighted goods and technological deterrence levels in a market with digital piracy. The firm's optimal pricing schedule is characterized as a combination of the zero-piracy pricing schedule and a piracy-indifferent pricing schedule, which makes all customers indifferent between legal consumption and piracy. Other results of the paper include the fact that while increases in piracy reduce prices and profits, on the other hand may improve welfare by expanding the ratio and volume of legal uses. Moreover, the author shows that in the absence of price-discrimination, the optimal level of technology-based protection against piracy is shown to be the technologically-maximal level, which maximizes the difference between the quality of the legal and pirated goods. However, when a seller can price-discriminate, it is always optimal to choose a strictly lower level of technology-based protection. Moreover, if a DRM system weakens over time, due to its technology being progressively hacked, the optimal strategic response may involve either increasing or decreasing the level of technology-based protection and the corresponding prices. This direction of change is related to whether the technology implementing each marginal reduction in piracy is increasingly less or more vulnerable to hacking. The model used by the author to analyse technological protection of copyright builds on the commonly used notion of pirated good as an inferior (vertically differentiated) substitute for the legal good. The model generalizes the pricing analysis significantly, deriving a continuous pricing schedule which explicitly takes into account the differing value of pirated products to different customers. The model involves an information good which may be used by consumers in continuously varying quantities. The firm selling this legal good is monopolist, by virtue of owning the copyright. Fixed costs of production or IP protection are assumed to be sunk while variable costs of production are zero. In

addition to the legal product, there is a pirated good, which is a lower-quality substitute and is free. Customers are heterogeneous, indexed by type. The preferences of a customer of a given type, for the legal good, are represented by a utility function depending on the quantity of the legal good used by the customer, and on a measure of the quality of the legal good. However, this study does not consider the negative externalities that may occur by reducing the price of a good, when a substitute distributive channel with higher margins exists. Moreover, the hypothesis that the illegal good is lower in quality is questionable. In particular, this hypothesis may not to apply to publishing in general (particularly for segments such as news or academic articles).

One of the best-known references on the pricing issues of digitized products is Bakos and Brynjolfsson (2000). In their paper, the authors show that, when the marginal costs are very low, bundling can create economies of aggregation for information goods even in the absence of network externalities or economies of scale or scope. These economies have important competitive implications for the digital market. The first is that when competing for upstream content, larger bundlers are able to outbid smaller ones. On the other hand, when competing for consumers, bundling practices may be used to discourage entry even when potential entrants have a superior cost structure or quality. Conversely, by adding contents to a bundle, a firm may be able to profitably enter a new market and even dislodge incumbents who do not bundle. Finally, since large bundlers are able to capture larger shares of the market, single brand firms may have lower incentives to innovate and create such markets. This implies that the largest bundler in the market will tend to grow further relatively to other firms that compete in the upstream market. Thus distributors with enough initial funding can get a competitive advantage by adding a large number of content on their platform. Finally, if there exist substitutes products in the market, bundling is a dominant strategy since it allows to gain a competitive advantage both on producers of single good and to firms selling substitute goods separately. Another consequence of these results is that a large bundler obtain relevant market power and can use bundling to strategically deter small potential entrants from entering the market or to force single-product firms out of the market, even if it would not be able to do so offering a substitute product.

Jeon and Menicucci (2006), on the other hand, analyse publishers' incentives to practice bundling, the ensuing effects on social welfare as well as implications for merger

analysis, through the case of academic publishing. They consider a mature stage of e-journals in which publishers practice price discrimination based on usage, assuming heterogeneity among libraries and building a model in which each publisher offers a set of journals to a library which wants to build a portfolio of journals and monographs. Their model analyses how bundling affects journal pricing through its impact on the library's allocation of budget between journals and books under a budget constraint. Considering independent pricing (i.e. no-bundling), the authors find that industry concentration does not affect prices. In the general case of heterogeneous journals, they show that there is a unique equilibrium candidate regardless of the level of industry concentration and that the equilibrium always exists both under the maximum concentration (i.e. the monopoly case) and under the minimum concentration in which each publisher sells only one journal. Moreover they find that when bundling is allowed each publisher has an incentive to bundle all his journals. They identify two effects of bundling:

1. Bundling has the direct effect of softening competition from books.
2. Bundling has the indirect effect of generating negative pecuniary externalities for all other publishers.

Therefore, bundling is a profitable and credible strategy: it increases the publisher's profit and decreases the profits of rivals. The direct and indirect effects of bundling suggest that any merger increases the merging publishers' profits because of the direct effect while reducing rivals' profits because of the indirect effect. Moreover, bundling (or any merger) increases industry profits. However, the authors conclude that bundling decreases social welfare and that any merger among active publishers reduces social welfare as well. Moreover, they examine publishers' incentive to acquire a journal from a third-party, finding that in the absence of bundling each publisher has the same willingness to pay for the journal, while under bundling the largest publisher has the highest willingness to pay. This suggests that bundling might affect industry dynamics increasing the market power of the largest publishers and forcing small publishers out of the market. The paper suggest that there is a strong conflict between private and social incentives in the bundling of e-journals; each publisher wants to bundle his journals and bundling in-creases industry profits but reduces social welfare. Moreover, they found

that bundling creates incentives for mergers, but this again reduces social welfare by reducing book and journal consumption. However, mergers among publishers who would not be able to sell their journals because of their lack of size might increase social welfare. Finally, in the authors' view, bundling can have a serious impact on the evolution of industry concentration by affecting the incentives to acquire other journals. While in the absence of bundling each publisher has the same willingness to pay for a journal, under bundling the largest publisher has always the highest willingness to pay. Hence, bundling might create a vicious cycle through which big publishers induce the exit of small publishers and become even bigger by purchasing their titles. Nevertheless, because of the specific characteristic of the academic publishing industry, the authors have been able to disregard two elements that are crucial for the analysis of the publishing industry and may affect some of the results when you consider the industry as a whole, namely the effects of multi-channel distribution on the value chain and the effects of digitization on the advertising dynamics in the industry.

Finally, the contribution of Koukova, Kannan & Ratchford (2008) investigates the problem of product form bundling, defined as marketing two or more versions of the same product, available on different supports, as a bundle. The media inherent substitutability may consistently limit the attractiveness for consumers of acquiring more than one version. On the other hand, the author outline that digital and physical formats may provide different type of utilities connected with specific usage situations. Using experimental manipulation by providing consumers with communications that emphasize differentiation in usage functions, the authors find that for book and newspaper subscription categories, this manipulation does significantly increase intent to purchase more than one version of the content, as long as the bundle is discounted. The authors start from the intuition that bundles of information goods differ from bundles of physical goods. Information bundles tend to have very low marginal cost of producing digital versions in addition to print and the individual versions may be redundant, since after experiencing a content, such as an online book, consumers do not benefit in the same way from reading the hardcopy. On the other hand, conventional bundles generally have positive marginal costs and are not redundant. In their experiment they test four hypotheses: (1) when presented with advertising messages emphasizing different usage situations, consumers will be more likely to choose the

bundle as compared to when presented with stimuli emphasizing the same usage situations for the product form. (2) The likelihood of buying the information product bundle is low if there is no bundle discount. If there is a bundle discount, then the likelihood of buying the bundle will be significantly higher if awareness of different usage utilities is high than if it is low. (3) Consumers of information goods will be less likely to purchase a bundle consisting of different versions than consumers of conventional goods for all discount levels and usage situations. (4) Consumers will be more likely to choose the product form bundle when the hardcopy is priced at a premium and the electronic product is discounted as compared to when both forms are equally priced. These results seem to suggest that when different versions are not perceived as having a relative advantage in different situations, the cannibalization among versions is large and it cannot be mitigated by discounting the additional version. On the other hand, when different versions are perceived to have an advantage in different situations, a mixed bundling strategy with a discount for buying the second item can be profit enhancing compared to offering only the individual items.

2.3. Vertical relations and multi-channel distribution issues

Digitization provides an alternative distribution channel, which can be added or substituted to the existing, and which allows for selling products directly to customers. The Internet is a viable option for selling traditional goods and, in the case of the media industry, for the distribution of digitized works, which are substitutable products, although arguably not perfectly, for their physical homologues. This innovation thus affects in many ways the interactions and performances of the media industries supply chain, further complicating a firms' strategic decision. The new problem to solve is how to maximize profits, efficiently distributing an array of substitutable versions in a multi-channel scenario. On the demand side, customers may view the Internet channel as an imperfect substitute for a traditional channel and thus have different willingness to pay not only for different versions but also for different delivery modes. Moreover the costs associated with distribution through the Internet are likely to vary from those of the

existing channel, further complicating the analysis required to determine the optimal retailing structure for each product.

Cattani et al. (2005) analyse a scenario where a firm with a traditional retailer adds a direct Internet channel that is in competition with the traditional channel. Initially, the firm chooses wholesale prices as a Stackelberg leader and commits to setting a direct channel retail price that matches the retailer's price in the traditional channel, in order to mitigate cannibalization. Under this general equal-pricing strategy, the authors study the effects of different pricing strategies on profits. The strategies are: (1) keep wholesale prices as they were before, (2) keep retail prices as they were before, or (3) select wholesale and retail prices that optimize profits for the manufacturer. They found out that the latter may also be preferred by the retailer and customers. Another result is that the equal-pricing strategy is appropriate as long as the Internet channel is significantly less convenient than the traditional channel. If the Internet channel is of comparable convenience to the traditional channel, then the manufacturer has a strong incentive to abandon the equal-pricing policy, which results in a severe cannibalization of the traditional channel. By introducing an Internet channel with equal pricing, the firm places the traditional retailer in a mildly competitive position where the retailer may even benefit if the Internet is more costly and less convenient on average to the population of customers. However, when the costs and average convenience of the Internet channel become more favourable, then the manufacturer will be in a position to use the direct channel to undercut the prices in the traditional channel – and “boil” the traditional retailer. To sum up, the introduction of a direct channel can harm or benefit the retailer. Surprisingly, the retailer prefers the scenario where the firm acts optimally in terms of her own objectives. While average retailer profits decrease notably under fixed wholesale prices, they increase slightly under fixed retail prices and grow substantially when the firm maximizes her profits. The objectives of the manufacturer and the retailer are connected through the manufacturer's commitment to matching the retail price set by the retailer. In this model, if free to set a different price on the web channel, the manufacturer would almost always want to price much lower on the web channel. Finally, if the web channel becomes more convenient over time, the firm has more incentives to undercut the retailer. However, the authors consider only the case in which the new channel is under direct control of the firm and has no competition, unlike

what is observable in the market. Moreover, they disregard possible externalities caused by the introduction of the new channel or by the undercutting of traditional retailers.

Bernstein, Sheng Song & Zheng (2005) examine how free riding affects a firm's decision for running a direct distribution channel (online or offline), when there are fixed plus incremental variable costs for operating the direct store. Free riding in a multi-channel supply chain occurs when one retail channel engages in the customer service activities necessary to sell a product, while another channel benefits from those activities by making the final sale. The authors suggest that, although free riding generally has a negative impact on supply chain performance, certain recent practices seem to suggest an opposite view. For example a firm could choose to set up an Internet direct channel just to offer information to consumers, limiting product offerings online. The Internet increases exponentially consumers' ability to access a wide range of information sources at low costs and consequently increase the possibility of free riding, introducing negative externalities in multi-channel supply chains. Common approaches that firms use to mitigate free riding among retailers include, for example, exclusive territory provisions or limits in the number of firms selling a product in one area, sharing sales effort expenses with retailers, and engaging in resale price maintenance. In the digital market, however, most of these practices are unfeasible or illegal. On the other hand, free riding can sometimes induce positive effects: it is the case when manufacturers knowingly allow retailers to free ride on the customer service efforts of their direct stores in order to increase global sales. However, even if potentially beneficial, this strategy embeds emerging risks. First of all, stores are costly to operate and incur high fixed costs. Secondly, consumers may use the stores to educate themselves about the product, but then buy a rival product at a lower price.

The authors consider a setting with a firm selling its product through an independent retailer and, at the same time, contemplating offering the product through its own direct store. They investigate the manufacturer's and the retailer's pricing decisions with and without a direct store and find that when the firm operates a direct store it sets the price higher than that at the retail store. Moreover, the retailer benefits with the presence of a direct channel only when the inconvenience experienced by consumers to buy the product at the retail store after visiting the direct store is not too high and not too low and with the existence of a closely substitutable product, the value of the direct channel

for the firm decreases as the consumers' valuation for the competing product increases, while the retailer is always better off by distributing two products, regardless of the presence of a direct channel. Finally, as the proportion of consumers in need of sales service increases, all firms' prices first decrease and then increase due to the combined effects of increased consumer valuation for the products and intensified competition between the two channels. The analysis conducted in the paper suggests that, in some contexts, the direct channel may merely be a service provider and make no sales. For example, when the variable costs incurred for sales at the direct store are high, no sales occur at the direct channel. In contrast, the firm may be better off by selling its product through the direct store, avoiding sales through retail channels when the direct channel's variable operational costs are not too high. Interestingly, the authors find that, even if adding a direct channel generally favours the firm, the supply chain as a whole may not benefit, meaning that the incentives of the firm and the supply chain may not be aligned regarding the decision to open a direct store.

In the following chapter of this thesis, I myself analyse myself the problem of multichannel distribution in a context of a two sided market depending on the adoption of a new technology embedding network externalities. The article shows that under given conditions subsidies from content producers are pivotal in order to reach a positive development of the new technology. Moreover, this type of subsidies can lead to a more efficient adoption, increasing social welfare. However, assuming a monopolist platform manufacturer of the technology, complete contracts are needed to reach the Pareto optimal equilibrium, otherwise the platform manufacturer has an incentive to internalize the whole surplus while the content producer, anticipating this behaviour, will try to protect his traditional retailing channel by not subsidizing the new market.

2.4. Printed press economics in the digital age

The development of a market for digitized contents affects the economics of the printed press in many ways, since it introduces new substitutable products exploiting the same original contents on different formats. This paragraph analyses contributions from the

literature which focus on these aspects, which includes technology related issues such as cannibalization and free-riding or the evolution of advertising business models as well as issues related to publishing protocols, such as the evolution of the role of editing or the economies of cultural and epistemic scale. Media content, when published, is an edited object, adapted to a certain type of consumption, connoted with brands and labels, which provide it with a defined social usage. The dematerialization of books, sounds, images, movies, music, coupled with their real-time circulation on digital networks, obscure progressively the traditional supports of publishing. Following Cope and Kalantzis, what is truly new about the emerging regime of digitized text are the economies of cultural and epistemic scale. Whilst something like one thousand copies needs to be sold to make a print run viable, there is no difference in the cost of one person or a thousand reading a web page, or a print-on-demand book. The consequence is that the amount of published and accessible content is rapidly growing and the average number of copies accessed of each academic work is declining (Waters 2004). These are ideal conditions for the development of more finely grained areas of knowledge, cultural perspectives and localized applications of knowledge. Moreover, there is what Cope and Kalantzis call a shift in the balance of textual agency between the author and reader, namely a blurring of the boundaries between authors and readers. If print limited the scope for dialogue, the electronic communications web opens up that scope. Digitization has also changed the social relations of representation. Audiences have become users. The division of labour between the creators of culture or knowledge and their consumers has been blurred. The direction knowledge flows is changing because consumers are also creators, and creators, consumers.

These evolutions affect the role of intermediaries in the Media sector as well as the sustainability of their business models. In his 2006 work, Travis discusses the role of intermediaries and the legislation of fair use in the digital era, based on the case of Google Books Search. It concludes that not only does this service makes a fair use of copyrighted contents, but it has a positive effect both for publishers and authors by providing a solution to the paradox of experience good marketing experience. The arguments adopted are that Google service provides enhanced sampling possibilities for consumers, thus reducing the information asymmetry due to the characteristics of experience goods. Moreover, the author evaluates substitutability and finds out that it

can be kept under control establishing limits on sampling and considering that the physical supports are not perfectly substitutable. In the authors opinion a digital sampling service does not have a negative impact on the sales of a book, like i-tunes 30 second sampling of songs. On the contrary, it has a positive effect for authors and publishers since it is a powerful marketing tool. This service is undoubtedly beneficial for consumers in the short term since it has reduced the transaction costs to find information or books as well as providing an invaluable tool for the conservation of the cultural heritage of human beings. However, some concerns may be raised on whether the latter objective should be left in the hand of a private company which, by following her objective of maximizing profits, may in certain cases have incentives to distort the access to this worldwide bibliography.

In his essay (2009), Evans treats another crucial aspect for printed press economics. The author presents the characteristics and evolution of the advertising business as well as future scenarios. Traditional advertising sustains a complex ecosystem of businesses. A wide range of media entities earn significant portions of their revenues from the sale of advertising inventory. In turn, these businesses support a variety of content generation businesses. Moreover, diverse other businesses or agencies work around advertisers. Online advertising methods pose a serious threat to traditional methods; they increase the efficiency of matching buyers and sellers and delivering advertising messages to the buyers, this way reducing the economic importance of traditional intermediaries in the long term. Moreover, they increase the supply of advertising inventory significantly, putting pressure on margins. Finally, online advertising increases the supply of online content which provides a substitute for traditional content. In the author's view, the industrial structure of the online advertising industry could evolve either with a highly concentrated set of intermediaries at its centre, with many content providers around this core or with many intermediaries at its centre, with some intermediaries focusing on mass advertising and others focusing on niches. The ultimate structure depends on the relative importance of several factors: the strength of indirect network effects and scale economies on one side, the possible benefits of specialization of knowledge in certain areas on the other side. The most controversial issue about online advertising is the use of personal data for targeted advertising. If people had ownership over information about themselves, and there was a competitive market for it, they could decide whether

to sell it to an online advertising business. However, consumers have limited control over their private information on the digitized networks. For example a user can choose not to use websites that insert “cookies” that collect data on its machine, but most of Internet users are not sufficiently web-savvy to discern among websites. Web browsers have increasingly provided mechanisms for consumers to control the retention of information on their browsing history and manage their cookies, but even the most sophisticated one is still largely insufficient to protect a user’s privacy effectively. Another crucial issue is that consumers may agree to provide private information without anticipating that this information would be sold to other vendors who might combine it with other information about them. Solving the privacy problem should be one of the priorities of policy makers to set up a level playground for advertisers and consumers in the digital era. In order to do that, the complex social issues associated should be analysed thoroughly.

Another interesting perspective on this subject is provided by Kirchoff in his 2009 article, in which he presents the issues emerging for policymakers as the advertising industry faces structural shifts, caused by consumers relying on the Internet and other digital platforms for news, entertainment, and socializing. Regulation in advertising follows the principles of ensuring fair competition, shielding consumers from unfair or misleading messages, limiting the exposure of children, and restricting promotion of products such as tobacco and liquor deemed morally or physically harmful. Federal oversight of the advertising industry is intensifying as regulators and lawmakers try to keep pace with shifting technology and consumer habits, but recently the key issue has been the state of the newspaper industry, which is in financial distress due to eroding ad revenues. The search market is dominated by Google and Yahoo. At the same time, the proliferation of ad-supported websites, online videos, blogs, and other offerings has created more supply, lowering advertising rates in both online and in conventional media markets. Media companies are struggling to craft new business strategies; they are investing in developing extensive online operations as customers move to the web. Some media firms have created online properties that pull in millions of consumers each month, but revenues have not grown in proportion to the digital audience, reducing the margins. One of the reasons is that many publishers chose to offer content for free online, under the theory they would generate higher advertising revenues by increasing

their consumer base. Another factor is proliferation of websites, which has pushed down the price for some types of ads. On the other hand, media companies are taking on some of the functions of marketing and advertising firms as they reposition themselves. In this scenario, regulators and lawmakers are trying to keep up with an emerging world in which advertising is becoming both more pervasive and more difficult to distinguish from other content. Moreover, the advertising industry is trying to ward off new regulation, saying it has moved aggressively with self-regulation, including its recent guidelines on behavioural advertising and that digital commerce is vital to the nation's overall well-being. Whatever the outcome of the current initiatives, dramatic changes in the delivery of news, entertainment, and advertising are likely to continue, creating complex questions for lawmakers and regulators regarding consumer privacy, competition, and free speech. Media and cultural critic Marshall McLuhan in the 1960s argued that each new medium has its own intrinsic effect, changing the nature of society and commerce. Four decades later, technological advances are forcing media companies and advertisers to refine and reshape their messages to reach consumers in new venues, from mobile phones to handheld readers to online gaming networks. The developing forms of communication are, in turn, influencing the content of advertising as companies attempt to become part of the conversation on social networks or part of the landscape by embedding products in news and entertainment programming. Consumers must figure out how to determine the value and veracity of advertising and media, as regulators determine how to craft a workable oversight system that stretches beyond advertising on traditional media, to the rapidly expanding digital world.

Cope & Kalantzis, in their article of 2010 explore the wider issue of these contemporary transformations, not just in the textual forms of digital representation, but also the emerging social forms that digitization reflects, affords and supports. They evaluate the impacts and potentials of these changes on the processes of formation of new knowledge. The conclusion of the authors is that to make the most of the new digital communications media, we need to move beyond the question of business models and the binaries of the commercial publishing/open access debate. The resolution will probably be found in hybrid models and a genuine pluralism of different solutions for different domains of knowledge creation. Open access publishing is likely to grow, and develop sustainability models based on explicit subsidies by institutions and research

funders, and possibly also low cost author publication fees. Commercial publishing needs to reduce its cost structures, and if the big publishers can't, innovative new entrants will. And then there will be hybrid solutions in which some knowledge is made available at no cost, and other knowledge at a price, all in the same space instead of today's bifurcated commercial/non-commercial spaces. Whatever the models of sustainability that emerge, in the author's view knowledge systems of the near future could and should be very different from those of our recent past. The sites of formal knowledge validation and documentation will be more dispersed. They will be more global, mainly using the lingua franca of English. The knowledge processes they use will be more reflexive and so more thorough and reliable. Knowledge will be published more quickly, and through semantic publishing it will be more discoverable and open to aggregation and reinterpretation. There will be much more of it, but it will be much easier to navigate. In conclusion, the author believes that it would be the responsibility of knowledge workers to realize the promise of the Internet and to create more responsive, equitable and powerful knowledge ecologies.

To conclude this section, we review the recently published book by Bomsel & al. (2012), which analyses the evolution of the publishing industry starting from the objective of defining what the intrinsic meaning of the verb to publish is in the digital era. The central hypothesis of the author is that digitization is a written language, a communication system based on a visual and spatial support capable of translating the meaning of language in a string of discrete signs that can be recognized and reused. The meaning transmitted by a media, however, is the result of accrued expressions, which take form only after its edition, when the « rotary press » starts working. It is the firm that transform natural expression in a work and the transition, which includes an effect on the meaning of the expression, is what the author calls the publishing protocol. The editor is the authority which gives a symbolic status to authors' expressions. The industrial transformation behind this institution is composed of different steps: selection, risk evaluation, contextualization, marketing mix elaboration, signalling, exhibition, critical evaluation, distribution, etc. Each step embeds complex economic transactions which contribute to create the utility of editing for consumers, the effect on the meaning. The economic impact of edition is thus significant in publishing, thus the author suggest that digitization may not abolish all kinds of publishing protocols, on the

other hand it will create more protocols, because media never had such an important economic and institutional impact in history. The complexity of editing comes from the distance (in terms of time lag, physical distance, accumulation of meaning, etc.) between creation and public demonstration. This distance changes substantially among different publishing protocols. The distance generates a number of interactions, which need to be coordinated and organized with contracts, among agents in the publishing protocol. The two key phases of each different protocol are: (1) accumulation, in which the architecture of meaning is established. (2) Display, is the phase in which expression is accrued and published. Editors are responsible for this phase, they validate the publishing protocol. Only once the work is published, the commercial results come into play. The latter will be determined by the resonance of the work and its chronotope. Digitization has reduced the business cycle of media industries by increasing infinitely the frequency at which publishing can occur online. Real-time information has reduced the attention and the utility of narrative chronotopes, which are constantly set on a time-lag with respect to present. In the author's opinion, the biggest revolution of digitization is thus not dematerialization of support but this reduction to real-time of the display phase of media contents. As an example, in the press industry this continuous need for "refresh" is producing negative externalities for it pollutes editorials articles and reduces publishers' profits eliminating the possibility of synchronized display of journals. The future of the industry will thus depend on the capacity of reconciliation, through bundle pricing, of the display phases and chronotopes of real-time information and editorials.

2.5. Piracy and regulation issues

The separation of contents from their traditional support (book, cd, etc...) has increased the potential circulation of contents but also the possibilities of eluding copyright and the complexity of Media content regulation. The latter factors have further increased the risk of publishing for both authors and editors. In this section we present several papers that address important issues related to copyright in the digital era and regulation of digital media goods. The problem in economic terms is how to provide the right incentives, in the emerging market conditions, for artists to produce an optimal level of

new works in terms of quality, diversity and quantity. Technology itself provides tools that can help excludability, such as indexing, encryption and watermarking. However, these tools alone do not seem sufficient to solve the problem and researchers are thus examining the necessities of finding new business models or adapting legislation to the digital era. Key aspects in this domain are, among others, the responsibility of intermediaries, accessibility of information and the new definitions of ownership and exhaustion principle.

Lian & Chen & Wang (2010) try to solve the problem of copyright in multimedia networks using technologic tools; more specifically, they set up a content distribution and copyright authentication system based on media index and watermarking techniques. Watermarking technique is commonly used to protect multimedia content's ownership. It consists in imperceptibly modifying the media good embedding the ownership information directly in the file. Once a media is watermarked, the ownership information can be extracted and used for authentication at a later point in time. In order to simplify the authentication process, the authors suggest that after the process, the robust features and content emendation are extracted from the watermarked media and registered in a feature database that constitute a database for copy detection so that it provides a filter for the file to be checked. Authentication of suspicious files becomes a smooth and immediate second step of the process. This system has the advantage that it is capable of detecting copyright infringements even if the file has been modified, for example through compression, rotation, shearing, scaling or translation. The system proposed by Lian, Chen & Wang gives great results in terms of identification of authentic copies, but it does not seem sufficient to solve the problem of authors' remuneration unless coupled with a regulation preventing users who have an authentic copy to share it as they would do with a physical book or video or compact disk. Moreover, regulation would need to provide the right incentives to digital distributors in order for them to apply these tools.

On the other hand, Zimmerman (2003) focuses on possible alternative business models and analyses the so called "Street Performer Protocol", one of the most interesting models based on voluntary compensation of artists, first introduced by Kelsey & Schneier in 1999. In this model, the author set a release price for a work, and commits to make it available in digital form, without copyright restrictions, once members of the

public voluntarily contribute sufficient funds to meet the asking price. The releaser can of course be a publisher, which could be responsible, as in the traditional model, for selecting and signalling the quality of the future work and for internalizing transaction costs. The success of the expectations on the work would then become the key variable determining whether the work is actually released or not. Once the work is released, since it has already been paid for, it will then reside in the public domain. The point of view of the author is that a public license for digital free use and distribution would solve the problem of authors' remuneration without the need of intrusive measures to police and prevent unmetered distribution. Furthermore, this limited license leaves open the opportunity for authors to exploit the most successful digitally published work in the traditional way with the advantage of knowing more about consumers' preferences. However, the future exploitation on the traditional channel of a content which is already public raises again questions on whether a digital version should be treated equally, from a legal point of view, to the same content published on a different support.

Under current law, copyright vests automatically upon the fixation of a work in tangible (including digital) form; on the other hand, digital works are sold through licenses and are often regarded as "electronic goods" in many markets, while physical works are usually subject to ad hoc legislation regarding "cultural goods". Beside the complex general application of this model as a substitute of the traditional publishing protocols, this example show that new way of producing media are available in the market. The Street Performer Protocol could apply, for example, to new publishing protocols in which ownership itself is under questioning such as blogs or tweets. With this protocol, consumers could reward authors through a sort of renewable subscription, which allow them to produce new contents and grow the number of readers as well as their loyalty.

In his recent work (2012), Darling analyses the approaches undertaken by the United States, Germany and France towards copyright law in order to deal with the problems of bargaining asymmetry and predicting the future success of creative works. While the former has instated author termination rights, some legal systems prevent authors from licensing the rights to unknown uses of their work. The perspective of the paper is a mix of law and economics. The conclusion is that surplus redistribution is likely to be unfavourable to authors if no action is taken to adapt copyright to the digital market. However, the author finds also that restricting what he defines as "new-use-right grants"

may not redress effectively this distortion in surplus reallocation. Since the prediction of the financial success of an experience good is rather complicate and subject to sudden changes during the timeframe of a contract, United States copyright law allows authors to grant publishers the rights to all known or unknown uses of a work. New media developments have prompted litigation and raised the issue of which exclusive rights should be implicitly licensed has never been resolved with consistency. In most European countries, granting rights to uses unknown at the time of the contract is prohibited. The objective of this approach is to ensure that authors are not excluded from unforeseen future returns because of incautiousness, inexperience, or lack of bargaining power in dealing with publishers. The author argues that this solution may have effects that counteract the legislative goals in the digital era. Restricting the grant of rights to unknown uses means that a new contract negotiation is necessary between author and publisher whenever a new distribution method or a new version of the product emerge. This renegotiation may resolve in consistent emerging transaction costs, especially if the number of negotiations is high or the emergence of new uses is frequent, as it seems to be the case in digital publishing in the last decade. This situation may put pressure on publishers' margins without any benefit for authors or it may as well harm authors by decreasing the total number of rights transfers. In light of these results, restrictions on granting the rights to new uses in the digital era should be considered with caution, as they might not be suitable instruments for distributing wealth to creators.

The complexity of the problem of adapting current regulation to a growingly digitized market for contents is not a new discover for researchers. Already in 2003, Landes & Lichtman stated that the exponential increase of piracy in the digital media industry is partially caused by the uncertainty in responsibility for copyright infringement. When individuals infringe copyright on the Internet, they often do that using tools, services, and venues provided by other agents. Thus before punishing infringements, regulation should establish to what extent private users and other parties such as distributors, ISP or others should be held liable for the resulting infringement. In this paper the authors introduce and evaluate from an economic perspective the main common law doctrines and statutory provisions in modern copyright law. The starting line is that unlike the Patent Act, the Copyright Act of 1976 does not explicitly recognize the possibility of

indirect liability. Nevertheless courts have held third parties liable for copyright infringement under two long-standing common law doctrines: contributory infringement and vicarious liability.

A provision that has significantly expanded indirect liability is the Digital Millennium Copyright Act, which stated that it is illegal for a firm to manufacture, import, or provide to consumers a device primarily designed “to descramble a scrambled work, to decrypt an encrypted work, or to avoid technological measures used to protect copyrighted work. This provision is controversial since it holds a party liable for undermining technological protections even if no resulting act of infringement occurs. On the other hand, it is a clear recognition of the fact that traditional forms of copyright protection are not adapted to a digital market. The intuition on which it is based is, in fact, that many copyright owners use technology to protect their work since this sort of self-help is less costly and more effective than copyright enforcement. In the authors’ view, an efficient approach to indirect liability applied to a digital environment might start by applying a negligence rule to any activity that can lead to copyright infringement. Another critical aspect of regulation is the safe harbour provision. Thanks to this provision, Internet service providers and digital distributors have been immune from indirect liability until recent judgments against Ebay and Google. That has eliminated the risk created by an otherwise uncertain legal standard and has favoured the development of a few large digital distributors in the digital market. Another authors’ proposal for an efficient indirect liability regime, which is being discussed also in Europe recently, is to include a tailored tax applicable to particular tools, services, or venues associated with copyright infringement. The tax can be then used to compensate those agents which have been harmed excessively by the infringements. Indirect liability is not the only instrument to improve the efficiency of copyright in the digital era. A possible mechanism is to make adjustments to the scope and duration of copyright protection or even to the criminal penalties now applicable to certain types of infringement. Another hypothesis is to set cash incentives put forward by the National Endowment for the Arts.

3. Conclusions

From the analysis of this selection of academic references, the first conclusion that we can draw is that the continuous and rapid evolution of technologies, competitive scenarios and digital strategies, which characterize the development of the digital market for media, require more research to provide solutions for the various complex issues that are still under discussion. However, it seems clear that the efforts from media content producers could be more effective if a clear regulation, creating a level playground for the digital media market, could be implemented. In order to contribute to this important objective, research should focus on providing solid economic evidence in support of the many policy initiatives which are emerging in the field, with particular attention to copyright regulation for digitized versions of media contents and to the structure of the digital distribution and advertising markets. Moreover, research should focus not only on economic effects which are related to technological innovations. On the other hand, it should systematically include socio-economic questions that are rising since digitization affects also the core of media works, such as their meaning and their publishing protocols. As an example, an important question that needs to be addressed as a starting point for the modelling of digital publishing issues is the nature of digitized media contents. As today, in Europe, an e-book is comparable to an electronic license for software; it is not considered a cultural good. This poses different economic problems, such as whether the exhaustion principle applies or which level of VAT should be applied to them. A second relevant question is how to reengineer the mechanisms of remuneration for content creators. Despite lawmakers' efforts, copyright by definition is not adapted to a market in which copies cannot be physically accounted for. This question cannot be properly answered without an in depth analysis of how digitization affect and will affect the creation and distribution of intellectual property rights. For example, who is the right's owner of a Tweet? Is it the author or the platform or is it just common knowledge? How do we trace the new line dividing correspondence from publishing? A third fundamental issue is the organization of digital distribution, the extent of the responsibility of intermediaries and their interaction with the physical

distribution of the same contents. Finally, an issue that is emerging as a consequence of the unclear structure of the digital market is how to coordinate efficiently the policy objectives in the area of digital agenda and culture. In the last decade, the objective of developing digital infrastructures has prevailed and the availability of a large amount of copyrighted goods for free has resulted in an indirect subsidy that has favoured this deployment. On the drawbacks, a number of cultural industries have been suffering from this development, especially those that have benefited less from the new media specific competitive advantages. In particular, the language basins have been critical. As an example, while digitized media in English have benefited immediately from the increased circulation possibilities and from the globalisation of the market, smaller cultural industries haven't, since their potential market was capped by the dimension of their linguistic basin. In some cases, the unwilling subsidies provided by the cultural industries for the development of the digital networks can thus hardly be compensated by an expansion of demand. Moreover, media companies have concentrated their efforts on the most profitable digitized products, but this may further increase the negative impact on cultural development and diversity. Summing-up, it seems that Digital Agenda objectives have gone in contrast with Cultural objectives in the digital market. Positive externalities created by the deployment of new networks have compensated for this cultural slow-down until now but they are quickly reaching saturation and the negative impact on welfare of cultural pauperisation can becoming predominant in the future.

Bibliography

Bakos, Y. and E. Brynjolfsson. 1999. "Bundling Information Goods: Pricing, Profits, and Efficiency." *Management Science*, 45(12), 1613-30.

Bernstein, F., Song, J.S. and Zheng X. 2005. "Free Riding in a Multi-Channel Supply Chain". *The Naval Research Logistics*. 2009;56(8):745-765.

Bomsel, O. 2011. "Do you speak European ? Media Economics, Multilingualism and the Digital Single Market", *Communications and Strategies*, n°82, 2nd Q, 2011.

Bomsel, O. and al. 2012 "Protocoles éditoriaux: Qu'est-ce, au fond, que publier ?". *Armand Colin*, 2013.

Carlton, D. and Chevalier, J. 2001. "Free Riding and Sales Strategies for the Internet". *Journal of Industrial Economics*, Wiley Blackwell, vol. 49(4), pages 441-61, December.

Cattani, K., Gilland, W., Heese, H.S. and Swaminathan, J. 2006. "Boiling Frogs: Pricing Strategies for a Manufacturer Adding a Direct Channel that Competes with the Traditional Channel". *Production and Operations Management*, Vol. 15, No. 1, pp. 40-56.

Cattani, K., Gilland, W. and Swaminathan, J. 2004. "Coordinating traditional and internet supply chains", invited contribution to Simchi-Levi, D., Wu, D. and Shen, Z. 2004. "Handbook of Quantitative Supply Chain Analysis Modeling in the E-Business Era, *International Series in Operations Research and Management Science*, Kluwer Academic Publishers.

Chen, Y.N. and Ivan P. 2003. "Information Goods Pricing and Copyright Enforcement: Welfare Analysis." *Information Systems Research*, 14(1), 107-23.

- Cope, B. and Kalantzis, M.** 2009. "The Role of the Internet in Changing Knowledge Ecologies", *ARBOR Ciencia, Pensamiento y Cultura* (Madrid, Spain), Vol. CLXXXV, No. 737, 2009, pp.521-530.
- Darling, K.** 2012. "Contracting about the Future: Copyright and New Media", 2012. *10 Nw. J. Tech. & Intell. Prop.* 485.
- de'Grassi, M.** 2012. "Digitized Magazines: Strategic Guidelines for Efficient Discrimination", ParisTech Chair for Media and Brands Economics, Cerna Working Paper, MINES ParisTech.
- Deleersnyder, B., Geyskens, I., Gielens, K. and Dekimpe, M.** 2002. "How Cannibalistic Is the Internet Channel? A Study of the Newspaper Industry in the United Kingdom and the Netherlands." *International Journal of Research in Marketing*, 19(4), 337-48.
- Evans, D.** 2009. "The Online Advertising Industry: Economics, Evolution, and Privacy", *Journal of Economic Perspectives*, American Economic Association, vol. 23(3), pages 37-60, Summer.
- Gentzkow, M.** 2007. "Valuing New Goods in a Model with Complementarity: Online Newspapers," *American Economic Review*, American Economic Association, vol. 97(3), pages 713-744, June.
- Jeon, D. S. and Menicucci, D.** 2006. "Bundling Electronic Journals and Competition among Publishers." *Journal of the European Economic Association*, 4(5), 1038-83.
- Kirchhoff, S.** 2009. "Advertising Industry in the Digital Age", *Congressional Research Service* 2009.
- Koukova, N., Kannan P. and Ratchford, B.** 2008. "Product Form Bundling: Implications for Marketing Digital Products." *Journal of Retailing*, 84(2), 181-94.
- Landes, W. and Lichtman, D.** 2003. "Indirect Liability for Copyright Infringement: An Economic Perspective", *Harvard Journal of Law & Tehnology*, 16, 395-410.

- Lian, S., Chen, X. and Wang, J.** 2012. "Content distribution and copyright authentication based on combined indexing and watermarking", *Multimedia Tools Appl* (2012) 57:49–66.
- Lierouw, L.** 2004. "What's changed about new media? Introduction to the fifth anniversary issue of new media & society", *New Media & Society* Vol6(1):9–15, SAGE Publications.
- Parker, G. and Alstyne, M.** 2000. "Information Complements, Substitutes and Strategic Product Design". *ICIS 2000 Proceedings*. Paper 2.
- Schweizer, T.** 2002. "Managing Interactions between Technological and Stylistic Innovation in the Media Industries: Insights from the Introduction of eBook Technology in the Publishing Industry". *ERIM Report Series Reference* No. ERS-2002-16-ORG
- Simon, D. and Kadiyali, V.** 2007. "The Effect of a Magazine's Free Digital Content on Its Print Circulation: Cannibalization or Complementarity?" *Information Economics and Policy*, 19(3-4), 344-61.
- Sundararajan, A.** 2004. "Managing Digital Piracy: Pricing and Protection and Welfare", *Information Systems Research*, 15 (3), 287-308
- Travis, H.** 2006. "Google Book Search and Fair Use: iTunes for Authors, or Napster for Books?", *University Of Miami Law Review*, 2006.
- Shankar, V. and Chatterjee, R.** 2006. "Bundling, Unbuilding, and Pricing of Multiform Products: The Case Magazine Content." *Journal of Interactive Marketing*, 20(2), 21-40.
- Smith, M. and Telan, R.** 2012. "Assessing The Academic Literature Regarding the Impact of Media Piracy on Sales." *Carnegie Mellon University*.
- Zimmerman, D.** 2003. "Authorship Without Ownership: Reconsidering Incentives in a Digital Age", *DePaul Law Review*. 2003.

Chapter 2

Subsidizing Network Technology Adoption. The Case of Publishers and E-readers: is there a Need for Vertical Agreements?

Abstract

To market a new network technology effectively, manufacturers need to understand the structure and size of network effects associated with the product. If consumer surplus from adoption depends positively on the number of interconnections in the network, early adopters may need to be subsidized until a critical mass is reached. Moreover, in a two-sided market where platforms and complementary content are constrained by non-negative prices, subsidies can be provided both by platform manufacturers and by producers of complementary contents. The article presents a model to analyze adoption dynamics with different subsidies and different stand-alone values for technology. The model shows that if the stand-alone value of technology is limited, subsidies from complementary contents producers may be pivotal to reach the critical mass. Moreover, under given conditions, this type of subsidies can lead to a more efficient adoption, increasing social welfare. In this case, assuming a monopolist platform manufacturer of the technology, complete contracts are needed to reach the Pareto optimal equilibrium.

Keywords: two-sided markets, network effects, technology adoption, copyright, vertical relations, media economics, publishing, e-books.

Résumé

Pour déployer efficacement une nouvelle technologie de réseau, les fabricants ont besoin de comprendre la structure et l'amplitude des effets de réseau associés au produit. Si le surplus des consommateurs qui dérive de l'adoption dépend positivement du nombre d'interconnexions dans le réseau associé, les premiers utilisateurs peuvent avoir besoin d'être subventionnés jusqu'à ce qu'une certaine masse critique soit atteinte. En outre, dans un marché biface où les plates-formes et les contenus complémentaires sont contraints à des prix non négatifs, les subsides à l'adoption peuvent être fournis à la fois par les fabricants de plates-formes et les producteurs de contenus complémentaires. L'article présente un modèle qui analyse les dynamiques d'adoption avec différents types de subsides et avec différentes valeurs intrinsèques de la technologie innovante. Le modèle montre que si la valeur intrinsèque de la technologie est limitée, les subsides des producteurs des contenus complémentaires peuvent être déterminants pour atteindre la masse critique. Par ailleurs, dans certaines conditions données, ce type de subventions peut conduire à un niveau d'adoption plus élevé, en augmentant au même temps le bien-être social. Dans ce dernier cas, sous hypothèse d'un fabricant de plates-formes monopoliste, il est impératif de pouvoir établir des contrats complets pour atteindre l'équilibre optimal.

Mots clés: édition numérique, Economie des Media, accords verticaux, tarification, marchés biface, distribution réseaux multiples

Introduction

A network technology can be defined as a platform (of tools, machines, techniques, crafts, systems, methods of organization or environmental rearrangements) giving access to a number of interconnections embedding externalities (usually positive). Starting with the initial work of Rohlfs (1974), the literature has emphasized the role of externalities and the value of network interaction as determinants of technology adoption. Rohlfs' model of interdependent demand defines consistent equilibrium user sets and finds multiple equilibria at any given price. He concludes that, if the initial disequilibrium is the null user set, early adopters need to be subsidized in order to reach a critical mass compatible with the start-up problem of the technology. Katz and Shapiro (1986) analyze the case of a new technology competing with an incumbent technology, they find that the determinant for adoption is the willingness from the manufacturer to make investments and promote the new technology. In the absence of subsidies, the incumbent technology has a competitive advantage due to its installed base of users. Many markets deriving from network technologies are two-sided; platforms court two or more sides that use the technology to interact with each other. The value of the network technology depends on the two (or more) user sets, in a dynamic of indirect network externalities: it is the case of industries such as Media, software or credit cards. In these cases, as studied by Rochet and Tirole (2003), since demand in the two sides is interdependent, platforms can cross-subsidize between agents which take part in the transactions and producers of complementary contents can provide subsidies for technology adoption.

Moreover, network technologies can slightly differ in their stand-alone value, which is defined here as the utility they bring to a given consumer when the set of interconnections available in the network is the null set. For example, a single telephone cannot provide any utility to any user without an associated set of interconnections. On the other hand, a technology such as PC started providing utility to many users before the associated network (the Internet) was deployed. The recent introduction on the market of e-readers, the most known of which being the I-Pad from Apple and Kindle

from Amazon, is a case of particular interest. These devices are specially conceived to exploit digitized written and visual media, increasing comfort, accessibility and portability of e-books, magazines and other media contents. Many users may thus be interested in e-readers only if they can have access to their favourite contents through this platform. Nevertheless, other users may allocate a positive stand-alone value to the technology: it is the case of what we call technology “geeks”, which by definition have a high willingness to pay for every new information technology. It can be also the case for specific segments of the population which can be interested in some of the particular characteristics of these technological devices (light weight, possibility of editing texts, touch screen, design, brand, etc.).

The paper develops a theoretical model to investigate the dynamics of technology adoption with different stand-alone values. While there exists a wealth of literature that examine the role of stand-alone value and network value in technology adoption⁵, this paper focuses on efficient subsidy schemes and coordination problems arising from different type of network technologies and different installed bases. The model examines the start-up problem described by Rohlfs (1974) in which a unit mass of consumers with interdependent demand needs to choose whether to adopt a new technology, marketed by a monopolistic manufacturer. In the next session, we thus formulate a simple model in which the incremental utility of the service to an individual depends only on the number of adopters on the two sides of the market and not on who these adopters are. While the above mentioned model does not consider stand-alone value, following Tucker (2008) we consider that a group of user may adopt the technology because of utility arising from local usage of the new technology. In her paper, as an example, she estimates the weight of the stand-alone value in the adoption decision for a service of video messaging. Nevertheless, different technologies may lead do very different estimations. In our example, we may assume for instance that the I-Pad, providing a much broader range of utility, may have a positive stand-alone value for a larger share of the population while the Kindle, which is conceived almost exclusively for reading books, will have a lower one.

In the paper, we thus consider the general case in which a given share of the population has a positive valuation for stand-alone technology, while the residual part of the

⁵ See for example Farrel and Saloner (1985) or Tucker (2008)

population has a null valuation. Given this assumption, there exists a non-negative demand right after the introduction of the technology, before the network is deployed. This demand determines an installed base for a given technology and modifies the start-up problem for a network technology. In some cases, the installed base can be sufficient to solve the start-up problem, leading to a high level of adoption equilibrium without any subsidy. Nevertheless, in many cases the installed base is limited and a subsidy scheme is needed to reach a more efficient equilibrium. In the model, two types of subsidies are considered: a penetration pricing scheme and an investment boosting the awareness or characteristics of the product. Moreover, both the manufacturer and the producers of complementary contents can provide these subsidies. The case of publishers and e-readers is again a good example. A manufacturer such as Apple or Amazon can provide subsidies by reducing the price of the platform or by investing to enhance product characteristics. While the first is a non-discriminatory subsidy, the second one may push more technophiles or brand fans towards adoption but it is not likely to impact the decision process of a consumer which is only interested in exploiting Media contents through his e-reader. On the other hand, a subsidy from a publishing company is likely to impact those consumers that are interested in the network of Medias connected to the platform.

Finally, the model shows that when the stand-alone value is small, subsidies from complementary contents can be more efficient to solve the start-up problem. In these cases, a coordination problem emerges in the market. Assuming that a platform manufacturer has a market power and that other firms do not, the manufacturer can adopt an opportunistic behaviour to free-ride on complementary contents subsidies and internalize all positive externalities. Anticipating this behaviour, companies will not invest in subsidies. Their optimal strategy is to wait until the technology is adopted by a sufficiently large share of the population, eventually free-riding on other firms' investment. However, if the subsidies are pivotal to a successful start-up, the network technology may reach a suboptimal equilibrium due to underinvestment: not only consumers will obtain a lower surplus, since their utility increases with the size of the network, but they will pay a higher price for the technology. In such cases, vertical agreements leading to a complete contract between manufacturers and complementary contents producer can increase total welfare.

As an example, subsidies to broadband diffusion have been provided to telecom operators and Internet service providers, which were in charge of the deployment of the network, both with financial aid and with a favourable regulation (ex. safe harbour regulation, Digital Agenda, etc.). These distortions, which are now under discussion for their potential long-term negative effects, introduced the problem of piracy and free-riding on media brands, but they did increase the value of broadband networks for consumers, accelerating the adoption of the technology. The video game and DVD markets are further examples of successful start-ups of network technologies subsidized by publishers of complementary contents. Economists have shown that the availability of titles on this type of platform is crucial in determining the adopted standard among competitive platforms (Inceoglu, Park, 2009).

The case of digital publishing has surged to the attention of public opinion in the last years, in the light of recent developments in the anti-trust investigation opened by the European Commission in 2011, against five publishers and Apple Inc. The case was opened to determine whether international publishers Hachette Livre (Lagardère Publishing, France), Harper Collins (News Corp., USA), Simon & Schuster (CBS Corp., USA), Penguin (Pearson Group, United Kingdom) and Verlagsgruppe Georg von Holzbrinck (owner of inter alia Macmillan, Germany) had engaged in anti-competitive practices affecting the sale of e-books in the European Economic Area, with the help of the leading manufacturer of digital readers. The suspicious behaviour, in possible infringement of Article 101 of the Treaty on the Functioning of the European Union (TFEU) that prohibits cartels and restrictive business practices, was the joint switch by the five companies from a wholesale model, where the retail price of e-books was determined by the retailer, to agency contracts that contained the same key terms for retail prices, including an unusual retail price Most Favoured Nation clause, maximum retail price grids and the same 30% commission payable to Apple. The Commission was concerned that the switch to these agency contracts may have been coordinated between the publishers and Apple, as part of a common strategy aimed at raising retail prices for e-books or preventing the introduction of lower retail prices for e-books on a global scale. To address these concerns, in December 2012 the Commission has adopted a decision that renders legally binding commitments offered by Apple and four of the publishers included in the investigation (except Penguin). The companies offered in

particular to terminate on-going agency agreements and to exclude certain clauses in their agency agreements during the next five years. The publishers have also offered to give retailers freedom to discount e-books, subject to certain conditions, during a two-year period. After a market test the Commission declared to be satisfied by these commitments.

Drawing on this recent case, the objective of our model is to provide a general framework to analyse the start-up phase of a two-sided market with network externalities and to outline the dynamics that can lead to these types of agreements. In particular we try to show that network technologies are different, and in some cases we could end up in equilibrium were the market cannot develop successfully without subsidies or cooperation between manufacturers and producers of complementary contents. The paper is structured as follows: in Section 2 we set up a monopolistic network technology adoption framework. We then study the equilibrium users set with different stand-alone values. Section 3 introduces the subsidy schemes outlining the trade-off effects of different types of subsidies and the coordination problem. Section 4 concludes discussing results of the model and eventual policy insights.

A Model for Network Technology Start-up Dynamics

1. Interdependent Demand for a Network Technology

Consider a population consisting of n individuals. As in Artle and Averous' and Rohlfs' work, we define a set of binary variables:

$$(1) \left\{ \begin{array}{l} q_j = 0 \text{ if individual } j \text{ does not adopt the network technology} \\ q_j = 1 \text{ if the individual } j \text{ does adopt the network technology} \end{array} \right\} \text{ for } = 1, \dots, N$$

We assume there are M potential goods accessible in the network and P other goods in the economy, where good P is the platform giving access to the network. Since we are in a two sided market, we establish a linear relation between the fraction $f = \frac{\sum_j q_j}{N}$ of

users adopting the network technology and the share m of network goods available through adoption:

$$(2) \quad m(f) = af$$

Where:

$$(3) \quad \left\{ \begin{array}{l} m_i = 0 \text{ if good } i \text{ is not available through the network} \\ m_i = 1 \text{ if the good } i \text{ is available through the network} \end{array} \right\} \text{ for } i = 1, \dots, M$$

$$(4) \quad m = \frac{\sum_i m_i}{M}$$

To model interdependent demand, we specify a pair of additive utility functions for each individual:

$$(5) \quad U_j^0 = f(r_{j1}, \dots, r_{jP-1})$$

$$(6) \quad U_j^1 = f(r_{j1}, \dots, r_{jP-1}) + r_{jP} + \sum_{h \neq j} v_{jh}(m)q_j$$

Where:

- U_j^0 is the utility of individual j if he does not subscribe to the network technology,
- U_j^1 is the Utility of individual j if he does subscribe to network technology,
- r_{jp} represents the consumption of good p by individual j ,
- $v_{jh} \quad h \neq j$ is the incremental utility to individual j of the additional user j , which is dependent on the effect of the new user on the number of goods available in the network.

Equations (5) and (6) implicitly assume independent utilities with respect to all goods in the economy other than:

1. The platform,
2. The goods accessible through the network.

In addition, we make the usual monotonicity assumptions:

$$(7) \frac{\partial U_j^k}{\partial r_{jp}} \geq 0 \quad \forall p \text{ and } > 0$$

$$(8) U_j^0 \leq U_j^1 \quad \forall j, k, q_1, \dots, q_{j-1}, q_{j+1}, \dots, q_n, r_{j1}, \dots, r_{jP-1}, r_{jP}$$

We also make two specialized assumptions, the first applicable to network technologies and the second applicable to two-sided markets:

$$(9) \frac{\partial U_j^1}{\partial m_i} \geq 0 \quad \forall i$$

$$(10) \frac{\partial m_i}{\partial q_j} \geq 0 \quad \forall j, q_1, \dots, q_{j-1}, q_{j+1}, \dots, q_n, r_{j1}, \dots, r_{jP-1}, r_{jP}$$

That is, a subscriber's utility never decreases as additional media goods become available in the network (and none drop out). In the same way, the number of media goods never decreases as additional users adopt technology (and none drop out). This is the logic usually defined as indirect network effect and seems like a sustainable assumption. In fact, it is hard to find an example of a network whose value would decrease if additional goods or services become available through it, or a market in which a higher demand leads to a reduction in the number of firms. It is maybe easier to think of a network technology becoming less valuable for a consumer as more users join it: it is the case for example of premium credit cards or exclusive clubs, in which the quality of service cannot be guaranteed beyond the optimal size of the set of users. However, as a rule, the increase of interconnections (user to goods or good to users) in a network technology is not detrimental to any party involved in the transactions.

Since we have assumed (9) and (10), the adoption of technology from user j will not be detrimental for any user $h \neq j$ thus $v_{jh} \geq 0 \quad \forall j, h$. The additive model assumes that these incremental utilities do not depend on consumption of other goods outside the network. This is a reasonable assumption for the purposes of this article, although the deployment of a new network may certainly have an impact both on social and individual behaviour. To go back to our example, the adoption of e-readers has an effect on the consumption of books or other Medias through other distribution networks. This effect, which is of particular interest for the publishing industry, is not discussed in this article for the sake of simplicity but most of all because it is so complex that it needs a specific article on the subject.

Every user is a rational consumer aiming at the maximization of his utility. The maxima U_j^0 are defined by the *ceteris paribus* conditions and do not depend on the adoption of network technology. Maximizing equation (6) with respect to $r_{j1}, \dots, r_{jP-1}, r_{jP}$, subject to individual i 's budget constraint, we have:

$$(11) \widehat{U}_j^1 = \widehat{U}_j^0 + r_{jP} + \sum_{h \neq j} v_{jh} q_j - c_j(p)$$

Where $c_j(p)$ is the generic cost function for user j and $c_j(0) = 0$, $c_j(p) > 0 \forall j$. The condition for adoption will thus be:

$$(12) q_j = \begin{cases} 1 & \text{if } r_{jP} + \sum_{h \neq j} v_{jh} q_j \geq c_j(p) \\ 0 & \text{if } r_{jP} + \sum_{h \neq j} v_{jh} q_j < c_j(p) \end{cases}$$

Assuming a linear cost function $c_j(p) = b_j p$, we can reformulate (12) as:

$$(13) q_j = \begin{cases} 1 & \text{if } \theta_{jP} + \sum_{h \neq j} \theta_{jhN} q_j \geq p \\ 0 & \text{if } \theta_{jP} + \sum_{h \neq j} \theta_{jhN} q_j < p \end{cases}$$

Where $\theta_{jP} = \frac{r_{jP}}{b_j}$ and $\theta_{jhN} = \frac{v_{jh}}{b_j} \forall h \neq j$. To solve the model we need two more assumptions. The first one is that only a part of the population has a positive evaluation for the platform itself, what we defined in the introduction as the stand alone-value. The rest of the population derives utility only from the network accessible through the technology. We can write:

$$(14) \theta_{jP} = \begin{cases} \theta_{jP} \sim [0, \widehat{\theta}_{jP}] & \text{if } j \in g \\ 0 & \text{if } j \notin g \end{cases}$$

Where $g = \beta f$ with $\beta \in [0,1]$, and represents the share of “geeks” in the population. This assumption is reasonable in the light of the discussion developed in the introduction and allows us to extend Rohlfs investigations by modelling different network technologies. Following this assumption, we can define different adoption conditions for the two types of consumer.

$$(15) q_j \forall j \in g = \begin{cases} 1 & \text{if } \widehat{\theta}_{jP} \geq p_d \text{ or } \sum_{h \neq j} \theta_{jhN} q_j \geq p \\ 0 & \text{if } \widehat{\theta}_{jP} < p_d \text{ and } \sum_{h \neq j} \theta_{jhN} q_j < p \end{cases}$$

Where p_d is the price of the platform and p_m is the price of goods in the network, thus p_d is given by $p_d = p - p_m$. For all the other users, the adoption condition is:

$$(16) q_j \forall j \notin g = \begin{cases} 1 & \text{if } \sum_{h \neq j} \theta_{jhN} q_j \geq p \\ 0 & \text{if } \sum_{h \neq j} \theta_{jhN} q_j < p \end{cases}$$

The second assumption, following Artle and Averous and Rohlfs, is that only the size of the network, in term of users and goods, affects an individual's demand. This is a contestable approximation, since the quality of goods in the network does have an impact on demand, just like the relationships among users does affect the utility of each of them for a communication service. Nevertheless, some interesting results can be derived even considering the simple case in which all goods and all users affect the network in the same way. From now on, we thus assume uniform calling pattern, acknowledging that the relaxation of this hypothesis would be a very interesting field for further research.

Let's start analysing demand for "non-geeks" in the first place. Thanks to uniform calling assumption, we can re-write equation (16) for the unit mass representing our total population:

$$(17) q_j = \begin{cases} 1 & \text{if } f \theta_{jN} \geq p \\ 0 & \text{if } f \theta_{jN} < p \end{cases}$$

Where $\theta_{jN}(m) = \sum_{h \neq j} \theta_{jhN}$ and $f = \frac{\sum_j q_j}{N}$ is the fraction of users adopting the technology that we have introduced at the beginning of the section. This allows ordering individuals in term of their demand for the service, since if $\theta_{hN}(m) \geq \theta_{jN}$, user h will be an adopter in any equilibrium for which j is an adopter. Consider a technology where valuation θ_{jN} of the j^{th} consumer associated to the complete network is distributed uniformly over the population $\theta_{jN} \sim U[0,100]$. For the marginal consumer we have:

$$(18) \theta_{jN} = 100(1 - m(f))$$

The reserve price a "non-geek" consumer will be willing to pay to join the network when the latter is incomplete is proportional to the fraction of population which has subscribed to the network, since this determines the quantity of goods available in the

network. We have denoted this fraction f , with $f \in [0,1]$. The utility U_j of the j^{th} consumer can thus be rewritten as:

$$(19) U_j = \begin{cases} \theta_{jN}m(f) - p & \text{if he adopts technology} \\ 0 & \text{if he does not adopt} \end{cases}$$

The j^{th} consumer will buy the service if and only if his utility is higher than 0, the condition for adoption becomes:

$$(20) p \leq \theta_{jN}m(f)$$

The fraction of subscribers for a given price p will be equivalent to a scalar multiplied by the fraction f of consumers with an utility from adoption equal or higher than p . To simplify we will start assuming that in (29, coefficient $a = 1$, so that we can substitute $m(f) = f$ as in Rohlfs. If U_j is the utility of the consumer for which $p = \theta_{jN}f$ (indifferent consumer), since utility is uniformly distributed we have:

$$(21) U_j \geq 0 \rightarrow \theta_{jN} \geq \frac{p}{f}$$

Substituting we have that demand is the locus of points where:

$$(22) p = 100f(1 - f)$$

The combination of the hypothesis on uniform distribution and the proportionality between utility and the fraction of subscribers allows showing the fraction of the population that may adopt technology for any given price.

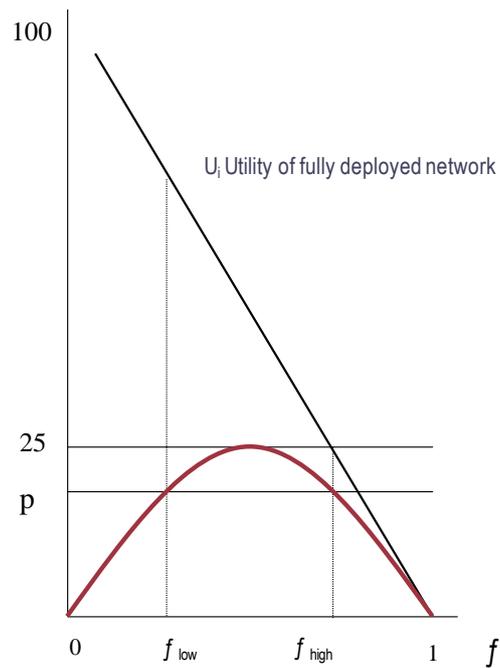


Fig.1 Demand for “non-geeks” users, as in Rohlfs’s Model (1974)

The graph above visually shows the demand of “non-geeks” consumers. The black curve represent the valuation of consumers for the complete network, namely a network in which all consumers are connected and all goods are available in the network. The red parabola represents demand for the incomplete network. The intersections (if any) of the red curve with price identifies possible equilibria. Solving for f we have:

$$(23) f \in [0.5 - \delta, 0.5 + \delta]$$

$$(24) \delta = \frac{1}{2} \sqrt{\left(1 - \frac{4p}{100}\right)}$$

We thus have three possible outputs:

- For $p > 25$, we have a single equilibrium in $f = 0$, the user set is null,
- For $p = 0$, we have multiple equilibria $f = 0, f = 1$, depending on the starting disequilibrium, we end up either with a null user set or a user set including the entire population

- For $0 < p \leq 25$ multiple equilibria, $f = 0$, $f = f_{low}$, $f = f_{high}$, with the equilibrium on the right-end side of the parabola (f_{high}) which is always pareto-superior to the ones on the left-end side.

If p is higher than the reserve price for the incomplete network, “non-geeks” consumers will not adopt technology in any case. If the price is below this threshold there will always be two possible outputs for non-geeks demand. The left-end equilibrium (f_{low}), beside behind suboptimal, is an instable equilibrium: if a single consumer chooses to drop from the network, the utility of others consumers will progressively become lower than p bringing back the equilibrium to the null user set. On the other hand, if the level of deployment is higher than f_{low} , the utility for a newcomer will be higher than p and the roll-out will proceed further and will reach the point of equilibrium defined as f_{high} .

This model shows the existence of a threshold, a critical mass of consumers which is necessary to solve the start-up problem of a network technology and generate the positive externalities.

Proposition 1: If the starting disequilibrium for a network technology is the null user set and all consumers are non-geeks, for any maximizing price $p^* > 0$, in order to reach the critical mass and solve the start-up problem, early adopters have to be subsidized.

Proof: if $p^* > 25$, $\forall j 0 \geq \theta_{jN}f - p^*$, thus nobody is interested in adopting the technology, unless subsidies are provided. If $0 < p \leq 25$, we have that $\theta_{jN}f - p^* > 0$ for $f \in [f_{low}, f_{high}]$ but $\theta_{jN}f - p^* < 0$ for $f \in [0, f_{low}] \cup [f_{high}, 1]$, thus if the starting disequilibrium is $f = 0$, nobody will be interested in adopting technology. The share of population that needs subsidies to adopt technology, which we call $\lambda = f_{low}$, while the amount of needed subsidies can be calculated as the area under the parabola:

$$(25) \Lambda(p) = \int_0^{f_{low}} p(f) df$$

2. Stand-alone Value and Geeks Demand

To learn more about adoption dynamics for network technologies we have to include in our model the demand from “geeks” users. We have assumed that a group of users has a positive valuation for the good defined as a platform or device, which is essential to access the network technology. This category of consumers has two options to adopt, as described in (15). When the network user set is null, in the moment in which the technology is launched on the market ($t = 1$), he adopts if his valuation of the device is higher than the price of the device, namely $\widehat{\theta}_{j,p} \geq p_d$. If this is not the case, he can still adopt at a later stage ($t = 2$) following the dynamics of adoption of “non-geeks” consumers. To simplify the strategic problem for “geeks” consumers, we further assume that a manufacturer cannot change the price of the device and discriminate between different groups of consumers. Moreover, we assume that demand for the device from geeks is less elastic than demand from “non-geeks” consumers. This seems a reasonable assumption since “geeks” users do not suffer any risk by adopting the technology, while for a “non-geeks” exists the risk of receiving only a local utility from the device, for which he has a null valuation, or finding only a limited number of goods in the network, if a suboptimal equilibrium is reached.

The demand curve for “geeks” (from now on referred to as f_g) is defined as function of the share of “geeks” in the population (g), the price of device d (p_d) and of a parameter (α) which models the investment which can be allocated by a manufacturer to enhance the technological characteristics or the awareness of the new device.

$$(26) f_g(g, p_d, \alpha) = f_g \in [0, g]$$

Where:

$$\frac{\partial f_g}{\partial g} \geq 0, \frac{\partial^2 f_g}{\partial g^2} = 0, \frac{\partial f_g}{\partial p_d} \leq 0,$$

And

$$(27) \frac{\partial f_g}{\partial \alpha} \geq 0, \frac{\partial^2 f_g}{\partial \alpha^2} \leq 0 \text{ if } j \in g, \quad \frac{\partial U_j}{\partial \alpha} = 0 \text{ if } j \notin g$$

An additional investment has a positive effect on the demand of geeks, but this effect decrease progressively since the share of “geek” in the population is not affected and thus the investment increases the utility to a progressively smaller share of the population. Moreover, investment in technology does not have any effect on “non-geeks” consumers. This property can be observed in most new technologies, a typical example being the PC’s market. Many manufacturers kept investing in technology to increase the performances of their devices, but only a few consumers, the more technophiles, were actually impacted in their decision to adopt a new model or not. Most people decision to adopt a new model was driven by the appearance on the market of new programs, which required more advanced technology to run. In the same way, when Apple invested to enhance the external aspect of their devices, which can be considered to be a complementary content, the evaluation of a large share of consumers was impacted, but not the one of “geeks”.

Consider as an example a demand curve for “geeks” with a linear dependence on parameter α and a logarithmic dependence on parameter p_d . The choice of the function derives from the assumed lower elasticity to price of the “geeks”:

$$(28) f_g(g, p_d, \alpha) = g - \left(\frac{1}{\alpha+1}\right) \times \log(1 + p_d)$$

With $\alpha \in R^+$. This archetypal demand has two advantages: first of all we can visually depict it on the same graph that we used for “non-geeks” demand. Moreover its particular shape is helpful to visually show the effect of additional investment α on adoption dynamics.

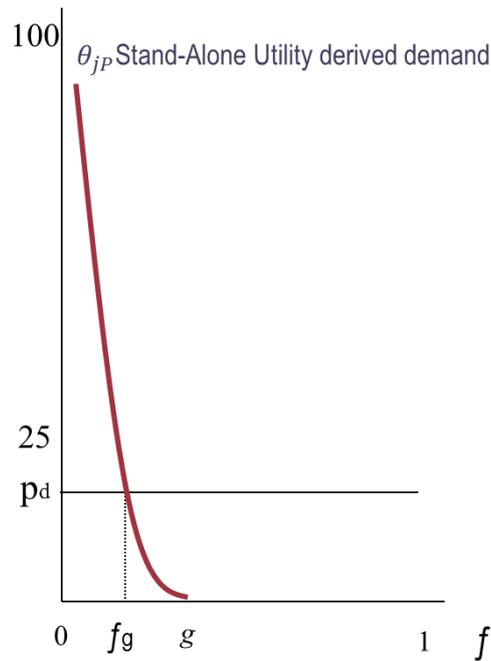


Fig.2 demand curve for “the Geeks”

Fig.2 introduces the demand function of “geeks”. If the share of “geeks” in the market increases, the curve will shift to the right, if the quantity of “geeks” decreases, it will shift to the left. An increase of parameter α , on the other hand, will change the shape of the curve, reducing elasticity to price of geeks and leading to higher demand for the technology. The existence of “geeks”, under given conditions, allow for a positive demand even starting with a null user set and with no subsidies available. To complete the definition of the problem, we need to define the dynamics of the technology adoption and to analyse the supply side.

3. Maximization Problem for a Monopolistic Manufacturer

i. Timeline with no subsidies

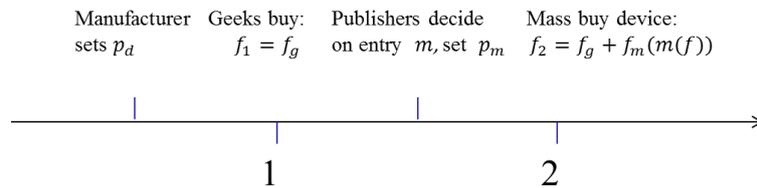


Fig.3 Timeline for network technology adoption with no subsidies

The simplest timeline of the game starts with the manufacturer setting p_d , which is fixed for the two periods. Then at time $t = 1$ the geeks for which $\widehat{\theta}_{jP} \geq p_d$ adopt the technology, creating an installed-base of early adopters of size $f_1 = f_g$. Publishers will observe f_1 and decide on entry and set their optimal price p_m , determining m . Then at $t = 2$ “non-geeks” decide on adoption. Fig.3 visually shows the timeline for adoption.

ii. Manufacturer Profit function

The manufacturer’s problem is to maximize his profits, which are given by the sum of profits in period 1 and discounted profits in period 2 which are a function of the installed base at $t = 1$. The profit function can be written as:

$$(29) \max_{p_d} \pi_d = \pi_1 + \delta \pi_2(f_1, p_d)$$

Where δ is the discount factor and profits are given by:

$$(30) \pi_1 = p_d f_1 - C(f_1)$$

$$(31) \pi_2 = p_d (f_2 - f_1) - C(f_2)$$

The associated cost functions are simply:

$$(32) C(f_1) = c(f_1) - (1 + \alpha)FC$$

$$(33) C(f_2) = c(f_2 - f_1)$$

$$(34) c = MC_d$$

Where c is the marginal cost of the device and FC represents all fixed cost of the technology, which can be increased with further investment (α) if subsidies are allowed. To complete the manufacturers market we have to set two conditions: the first one is a budget constraint, so that a manufacturer cannot keep increasing investment without a limit. We write this as $\pi_d \geq -K$, where K is the initial endowment of the firm. The second is a regularity condition:

$$(35) \max \pi_1 \leq \max (\pi_1 + \delta \pi_2(f_1, p_d))$$

This means assuming that a successful adoption of technology by “non-geeks” users is always more profitable for a manufacturer than the simple maximization of profits on the “geeks” market. This assumption is reasonable in most cases, since positive externalities increase with the size of the network, nevertheless there may be some counter-factual examples, in which raising the price to prevent “*non-geek*” users from adoption can be the optimal strategy. An example can be a premium credit card: in this case, a limited size of the network is essential to provide exclusive utilities to the adopters and thus a raise in price can lead to higher profits with respect to an increase in the number of adopters. The First Order Condition for the manufacturer is:

$$(36) 0 = \frac{\partial \pi_d}{\partial p_d} = \frac{\partial \pi_1}{\partial p_d} + \delta \frac{\partial \pi_2}{\partial f_1} + \frac{\partial f_1}{\partial p_d}$$

Therefore, if (35) holds, at $t = 1$ the manufacturer charges a lower price or sets a higher quantity than would maximize short-run profits, in order to raise its customer base and hence its future profits, whenever a successful adoption is feasible.

iii. Equilibrium User Sets with Geeks in the Market

In the absence of subsidies, the equilibrium user set at $t = 2$ is determined exclusively by the installed base of geeks obtained at $t = 1$. Equilibria for a given price p is given by:

$$(37) f_2 = \begin{cases} f_g & \text{if } f_1 \leq f_{low} \\ f_{high} & \text{if } f_1 > f_{low} \end{cases}$$

If $f_1 \leq f_{low}$ the installed base is lower than the critical mass, thus for every consumer $j \in [f_1, f_{low}]$, we have that $0 \geq \theta_{jN}f - p$, thus no more consumers are interested in adopting the technology and we end up in a stable equilibrium in which only “geeks” adopt the technology. If $f_1 > f_{low}$ the critical mass is reached and more users adopt technology until the stable equilibrium in f_{high} is reached, where $0 \geq \theta_{jN}f = p$ is as described at the beginning of this session. Fig 4 illustrates this situation. The disequilibrium point f_1 is located underneath the parabola. This implies that for some non-geek users j the network valuation is higher than their willingness to pay. User j thus adopts the technology further increasing the value of the network. Other users successively adopt technology until the stable equilibrium f_{high} is reached.

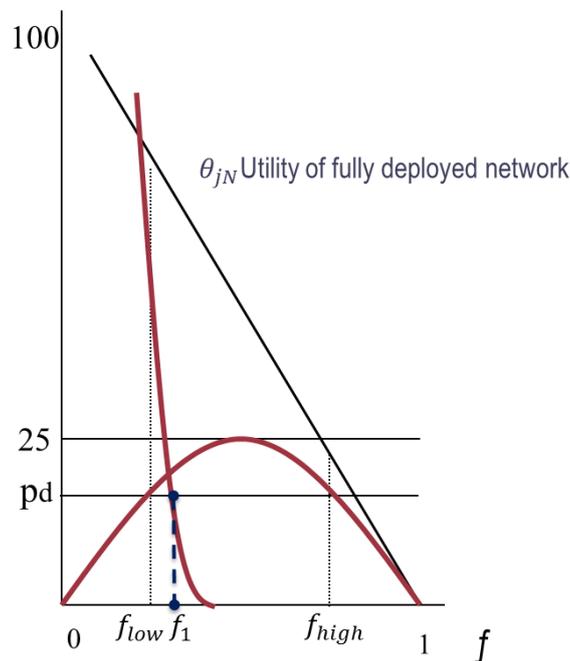


Fig.4 Technology Adoption dynamics with high Stand-Alone Value

Proposition 2: if $f_g(p_d) = f_1 > f_{low}$, for a given network technology, the start-up problem is solved and there is one and only one stable equilibrium user set at $t = 2$. Such equilibrium user set implies that a share f_{high} of the economy adopts the network technology and a share $(1 - f_{high})$ does not adopt.

Proof: if $f_1 > f_{low}$, f_1 is not a stable equilibrium. $\forall j \in [f_1, 1 - f_{high}]$ we have that: $u_j = \theta_j f_1 - p_d \geq 0$. Thus all users in this set adopt the technology at $t = 2$.

This situation captures a scenario in which the network technology has a very high Stand-Alone value and thus the population of “geeks” is predominant in the economy. This output is a first best solution both for the manufacturers, who maximize his profits and for consumers, since “geeks” will pay a lower price and “non-geeks” will obtain a larger surplus than in f_{low} or f_g .

The necessary but not sufficient condition to obtain $f_1 > f_{low}$ at $t = 2$, is to have a sufficient share of “geeks” in the economy, namely $g \geq f_{low}$. If this condition does not hold, meaning that $g < f_{low}$ and no subsidies can be provided except lowering the price, optimal strategy for manufacturer may be to choose p_d in order to maximize π_1 , since non-geeks will not adopt the technology unless the price is consistently reduced to $p_d \leq p_i$, as depicted in Fig5. The equilibrium user set will then depend on other variables such as the marginal cost of production c . If the price cannot be reduced below p_i the final equilibrium user set is in $f_1 = f_g(p_d)$. This captures the situation of a technology with low stand-alone value and underinvestment to subsidize early adopters or a technology for which the valuation of the device from “geeks” is very high while the valuation of the access to the network for “non-geeks” is low (Examples can be: Satellite phones or mini discs).

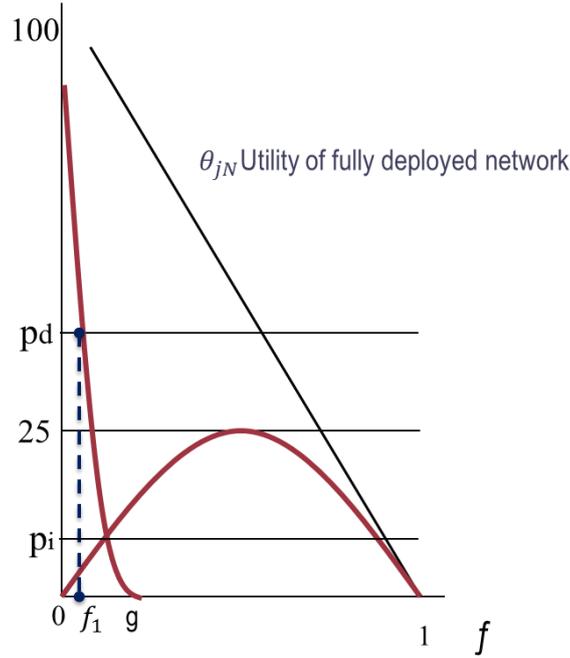


Fig.5 Technology Adoption dynamics with low Stand-Alone Value

Proposition 3: for any given g , in the absence of subsidies, the maximum price compatible with the start-up problem, is p_i , defined as the price for which $f_g(p_i) = f_{low}(p_i)$, $p_i = 100f_g(1 - f_g)$.

Proof: for any $p_d \leq p_i$, $f_1 \geq f_{low}$, thus $\forall j \in [f_1, 1 - f_{high}]$ we have that: $u_j = \theta_j f_1 - p_d \geq 0$. Thus all users in this set adopt the technology at $t = 2$. Conversely, for any $p_d > p_i$, $f_1 < f_{low}$, thus $\forall j \in [f_1, 1 - f_{low}]$, $u_j = \theta_j f_1 - p_d < 0$, non-geeks users do not adopt at $t = 2$.

Dynamics of Network Technology Adoption with subsidies

In this session we allow for additional types of subsidies from both the manufacturer and the producers of complementary contents and we analyse their effect on the adoption problem. First of all, let's formulate the general scheme of needed subsidies.

Proposition 5: Consider $p = p_d + p_m$, and assume that for “non-geeks” consumers the two good are perfect complements. For any p_d^* compatible with adoption, the share of

population needing subsidies is at most $\lambda = f_{low}(p)$, decreasing with the installed based. Moreover, for any $f_g > 0$, the quantity of needed subsidies is lower than: $\int_0^{f_{low}} f(p) - p df$ ⁶.

Proof: if $g - \left(\frac{1}{\alpha+1}\right) \times \log(1 + p_d) \leq 0$ then the share of population to subsidize is: $\lambda = f_{low}(p)$. If $g - \left(\frac{1}{\alpha+1}\right) \times \log(1 + p_d) \geq f_{low}$, $\lambda = 0$ and no subsidies are needed. If $0 < g - \left(\frac{1}{\alpha+1}\right) \times \log(1 + p_d) < f_{low}$, $0 < \lambda < f_{low}$. Quantity of subsidies needed is given by:

$$(38) \int_{f_g}^{f_{low}} f(p) - p_i df$$

For any p_i , we thus have:

$$\int_{f_g}^{f_{low}} f(p) - p_i df \leq \int_{f_g}^{f_{low}} f(p) df \leq \int_0^{f_{low}} f(p) df \quad \forall p_i, f_g$$

1. Subsidies from Manufacturer

i. Timeline with Subsidies from Manufacturer

In this section, we allow the manufacturer to provide subsidies not only by reducing price p_d but also by increasing investment α .

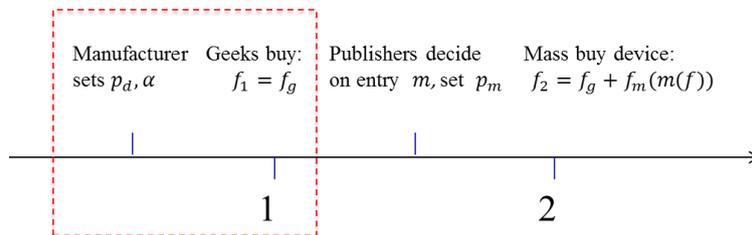


Fig.6 Timeline of Adoption dynamics with manufacturer subsidies

⁶ Quantity of subsidies calculated using Rohlfs (1974) model, starting from the null user set disequilibrium.

ii. Adoption Dynamics with Subsidies from Manufacturer

Manufacturer can invest α at $t = 1$ in order to enhance technical characteristics or awareness of their technology. We have described this subsidy in the previous session. Recall that we assumed α is “device related”, it affects $\widehat{\theta}_{JP}$, thus it does not have significant impact on “non-geeks”, since they have $\widehat{\theta}_{JP} = 0$. On the other hand, subsidies from complementary contents’ producers are “Network related”, they will impacts θ_{jN} . This working assumption reflects the actuality of the launch of e-readers, characterized by two distinct marketing channels (device, device + Media) from the very beginning. Although scope economies may exist among the two channels, we consider that they have second order effects.

Manufacturers can provide subsidies also by reducing the price of device, as introduced above. A reduction in p_d will affect the whole market; since price is fixed in the two periods, it is an indiscriminate subsidy. The intuition is that an over-investment effort in technology, by pushing more geeks towards the adoption of the new technology at $t = 1$, can be more profitable than reducing p_d , since it is a discriminated subsidy. The condition for this strategy to be effective is that subsidy α is sufficient to solve the start-up problem. The effect of an increase in investment is shown in Fig 7. Higher investment leads to an increase in the demand from geeks. f_1 grows, nevertheless the share of “geeks” g in the population is not affected, nor is the utility of “non-geeks”. Recall also that the marginal effect of an over-investment in technology of the hardware is decreasing as α increases. In our example, the problem for the manufacturer becomes:

$$(39) \max \pi_d(p_d, \alpha)$$

$$(40) \frac{\partial f}{\partial \alpha} = \frac{1}{(\alpha+1)^2} \times \log(1 + p_d), \frac{\partial^2 f}{\partial \alpha^2} = -\frac{2 \log(1+p_d)}{(\alpha+1)^3}$$

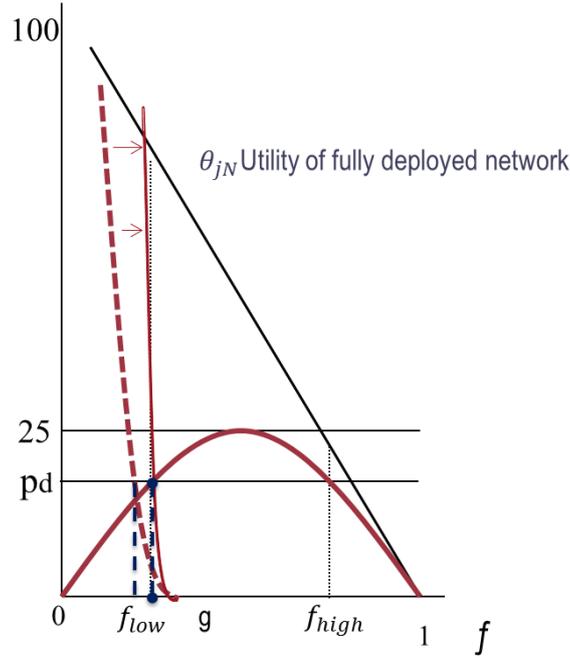


Fig.7 The effect of an increase in the investment effort

The First order condition becomes:

$$(41) \frac{\partial \pi_d}{\partial \alpha} = \frac{\partial \pi_d}{\partial p_d} = 0$$

Proposition 6: Consider a technology for which $g > f_{low}$ for the optimal price p_d^* . If manufacturer is allowed to provide infinite subsidies ($K = \infty$), then the start-up problem can always be solved without reducing optimal price p_d^* . The Pareto-superior equilibrium in f_{high} can be reached thank to subsidy α . We say that α can be “pivotal” when $g > f_{low}$.

Proof: If $g > f_{low}$, for every optimal $p_d^* < 25$, we can have either $f_g > f_{low}$ or $f_g \leq f_{low}$. If $f_g > f_{low}$ holds, the start-up problem is solved and no subsidies are needed. If $f_g \leq f_{low}$ the manufacturer can always set α^* such that $f_1(\alpha^*) > f_{low}$. This solves the start-up problem and it is always feasible if ($K = \infty$). In fact, for $\alpha \rightarrow \infty$, $f_g \rightarrow g \forall p_d^* < 25$, thus if $g > f_{low}$, the start-up problem can always be solved.

This choice may also be Pareto-superior for the economy if from the maximization problem we have that $\pi(f_{high}(p_a^*)) - \alpha^* \geq \pi(f_g(p^*))$. Otherwise, the manufacturer will have an incentive to non-invest. Investment in technology is progressively more costly and has an impact on a small share of consumers. Nevertheless, over-investing in technology can be justified if “geek” consumers can be pivotal for adoption. By providing this type of subsidy, the manufacturer can fix a higher price and recover the cost of investment at $t = 2$. Manufacturer thus arbitrates between the two types of subsidies, choosing the combination that maximizes his profits.

2. Subsidies from Complementary Contents Producers (CCP)

In this section we first describe the CCP market, then we define the subsidies they can provide and we analyse their effect on adoption dynamics.

i. CCP market

Recall that the utility for a “non-geek” user is given by:

$$(42) U_j = \theta_j m(f_2) - (p_a + p_m)$$

Where p_m is the price and m is the fraction of complementary contents in the market as defined in (4). CCP market is composed by a large number (N) of identical companies (i) facing monopolistic competitions. Each company produces a single good which can be sold in the network associated with the new technology. There is free entry in the network, nevertheless in order to market a product the company suffers a positive cost of entry (which is technology specific and thus sunk), marginal costs are null:

$$(43) FC_i > 0, MC_i = 0 \quad \forall i$$

Each company maximizes profit in his share of the market:

$$(44) \max_{p_{m,i}} \pi_{i,2} = p_{m,i} f_{i,2}(f_1, p_m) - FC_i$$

Since companies are identical and there is free entry in the market for every observed p_d we can define m_i as a Boolean variable taking value 1 if the company enters the market. We thus have:

$$(45) m = \frac{M}{N} \text{ where } M = \sum_i m_i \forall i$$

And:

$$(46) m: \pi_i = p_m f_2(f_1, p_m) - m N F C_i = 0$$

$$(47) m = \frac{p_m * f_2(f_1, p_m)}{N F C_i}$$

For every manufacturer's choice, CCP market can end up in two alternative stable equilibria:

$$(48) m_{1,2} = \left\{ \begin{array}{ll} \frac{p_{m1} * f_1}{N F C_i} & \text{"non-geeks" don't adopt, low } m \\ \frac{p_{m2} * f_2}{N F C_i} & \text{"non-geeks" adopt, high } m \end{array} \right\}$$

ii. Timeline with Subsidies from CCP – reduction of p_m

Let's allow CCP to provide subsidies. For example they can reduce p_m . Subsidies from manufacturer occur after manufacturer has fixed his price. Non-geek users observe global price p and then decide on adoption.

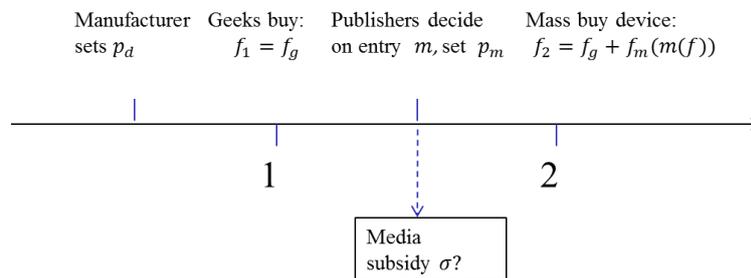


Fig.8 Timeline of Adoption dynamics with CCP subsidies

iii. Adoption Dynamics with Price Reduction from CCP

In this session we assume $g < f_{low}$ and $p_d^* \geq p_i$. This situation can arise from many different variables. For example, assuming $c > p_i$, the manufacturer cannot reduce the price of the device to p_i or he will have negative profits in both periods. Under these conditions, at $t = 1$ we have:

$$(49) \lambda(p) = f_{low}(p) - f_g(p_d^*) > 0 \text{ and } \Lambda(p) = \int_{f_g}^{f_{low}} f(p) - p_i df > 0$$

Additional subsidies are needed to solve the start-up problem. Fig.9 visually shows this situation for our example. The blue dotted line depicts $\lambda(p)$ while the red area represents $\Lambda(p)$.

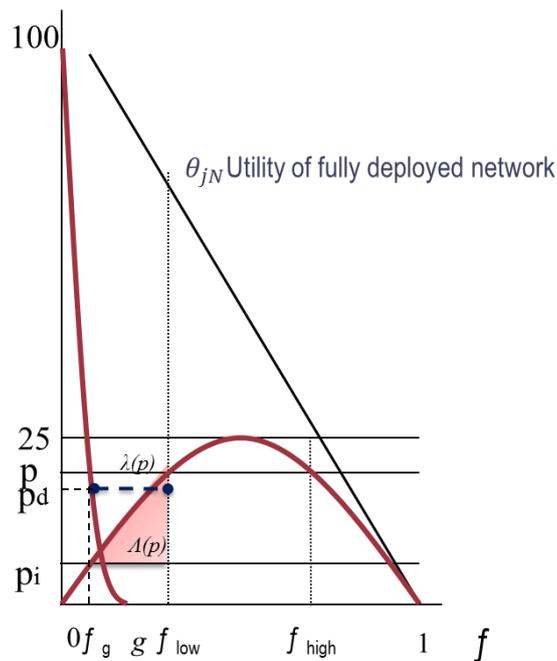


Fig.9 Additional Subsidies needed if $g < f_{low}$ and $p_d^* \geq p_i$

Having identified the needed subsidies, let's examine the impact CCP can have on adoption. Suppose that each CCP can make an investment σ_i to subsidize adoption. In our case study of Publishers and e-readers, it can be an investment to create a more comfortable version rather than the PDF standard for written contents or to implement additional features to the existing Media (interactive links, archives, commentaries,

etc.). We have assumed that this type of subsidy will only impact the valuation of the network. We can make a further assumption that this investment is not detrimental for any consumer, thus $\frac{\partial \theta_{jN}}{\partial \sigma_i} \geq 0$.

Let's start analyzing CCP subsidies assuming $\frac{\partial \theta_{jN}}{\partial \sigma_i} = 0$, thus complementary contents does not increase the value of the network and CCP can provide subsidies only by reducing price of their goods.

Proposition 8: if device and complementary contents are perfect complement, meaning “non-geeks” consumers only considering $p = p_d + p_m$ making their adoption decision, then even assuming $\frac{\partial \theta_{jN}}{\partial \sigma_i} = 0$ CCP can provide subsidies to adoption. Moreover, these subsidies can be pivotal if

$$f_{low}(p_d) \leq f_g \leq f_{low}(p)$$

Proof: for any optimal couple $(p_d^*, p_m^* > 0)$ we have:

$$(50) \Lambda(p) = \int_{f_g}^{f_{low}} f(p) - p_i df \geq \int_{f_g}^{f_{low}} f(p_d^*) - p_i df$$

Thus CCP can reduce $p_m' < p_m^*$ and reduce the amount of needed subsidies. In fact:

$$(51) \Lambda(p(p_m')) = \int_{f_g}^{f_{low}} f(p(p_m')) - p_i df < \Lambda(p(p_m^*))$$

The maximum subsidy in this case is given by:

$$(52) \int_{f_g}^{f_{low}} f(p) - p_i df - \int_{f_g}^{f_{low}} f(p_d^*) - p_i df = \int_{f_{low}(p_d^*)}^{f_{low}(p)} f(p) df$$

If $f_{low}(p_d) \leq f_g \leq f_{low}(p)$, then the quantity of needed subsidies is:

$$(53) 0 \leq \Lambda(p) \leq \int_{f_{low}(p_d^*)}^{f_{low}(p)} f(p) df$$

But then $\forall f_g \in [f_{low}(p_d), f_{low}(p)]$ CCP can set opportunely p_m' such that $\Lambda(p(p_m')) = \Lambda(p)$, thus solving the start-up problem.

Now let's assume $\frac{\partial \theta_{jN}}{\partial \sigma_i} > 0$. CCP can increase valuation θ_{jN} by investing σ_i . Each company can choose to invest or not: if they do, they suffer extra costs. In our example we treat σ_i as a Boolean variable:

$$(54) \begin{cases} \sigma_i = 0, & \text{company does not invest} \\ \sigma_i = 1, & \text{company invests} \end{cases}$$

The extra fixed costs can then be introduced in the profit function as follows:

$$(55) \pi_{i,2} = p_{m,i} * (f_{i,2}(f_1, p_m)) - (1 + \sigma_i)FC_i$$

The effect of the subsidy is modeled as a linear increase in utility, depending on CCP decision. The new utility function can be written as:

$$(56) U_j = 100(1 + \sigma) \times (1 - m(f))$$

$$(57) \sigma = \sum_{i=1}^M \frac{\sigma_i}{N}$$

Proposition 9: if $\frac{\partial \theta_{jN}}{\partial \sigma_i} > 0$, the range in which CCP subsidies can be “pivotal” to network technology adoption is extended to $f'_{low}(p_d) \leq f_{low}(p_d) \leq f_g < f_{low}(p)$, where:

$$(58) f'_{low}(p_d) = 0.5 - \delta' \leq f_{low}(p_d)$$

$$(59) \delta' = \frac{1}{2} \sqrt{\left(1 - \frac{4p}{100(1+\sigma)}\right)} \geq \delta$$

Proof: the maximum achievable subsidy is obtained for $\sigma = m$, namely all companies that enter in the market invest to provide subsidy. Since all companies are identical, this is also the only positive subsidy reachable at equilibrium, the other possible equilibrium being $\sigma = 0$. If a positive subsidy is deployed, since $\frac{\partial \delta}{\partial \sigma} > 0$, $\frac{\partial f_{low}(p_d)}{\partial \sigma} \leq 0$, $f_{low}(p_d)$ will shift to the left as depicted in Fig.10 to reach $f'_{low}(p_d)$. Moreover, p_i increase to $p'_i = 100(1 + \sigma)f_g(1 - f_g) > p_i$. As a result, the needed subsidy is reduced from the blue area to the red area. Analytically:

$$(60) \Lambda'(p) \leq \int_{f_g(p_d^*)}^{f'_{low}(p_d)} f(p) - p'_i df < \int_{f_g(p_d^*)}^{f_{low}(p_d)} f(p) - p_i df$$

For every $\forall f_g \in [f'_{low}(p_d), f_{low}(p)]$ we can thus find the minimum value of σ that guarantees a successful deployment by setting:

$$(61) f'_{low}(p) = f_g$$

$$(62) g - \left(\frac{1}{\alpha}\right) \times \ln(1 + p_d) = 0,5 - \frac{1}{2} \sqrt{\left(1 - \frac{4p}{100(1+\sigma)}\right)}$$

And solving for σ .

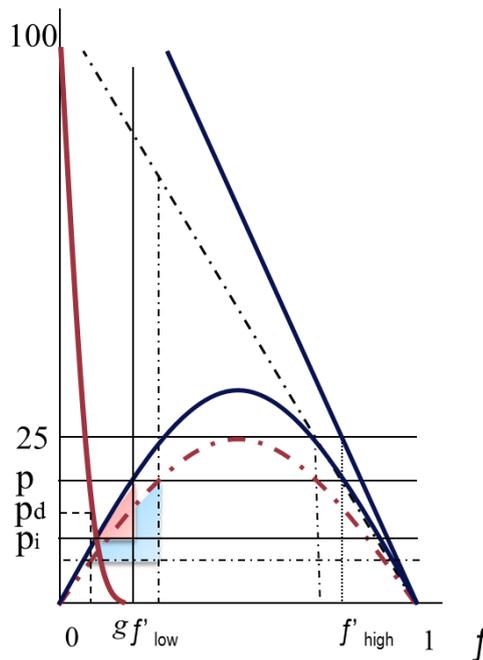


Fig.10 Additional Subsidies needed if $\frac{\partial \theta_{jN}}{\partial \sigma_i} > 0$

This type of subsidy, besides extending the set-ups in which it is possible to solve the start-up problem, can lead to a Pareto-superior final equilibrium where a larger share of consumers adopt the network technology and receive a higher surplus, while manufacturer obtains higher profits from the solution of the start-up problem (from the regularity condition).

3. Hold-up, Free-riding and Coordination Problems

CCP can provide a subsidy only if they are compensated so that the non negative profits constraint is satisfied. In fact, in the absence of coordination, investing is risky for CCP both because of horizontal and vertical information asymmetries. Each CCP controls a fraction $\frac{\sigma_i}{M}$ of the investment, so they do not have *a priori* guarantees that the needed optimal investment σ^* would be reached. Moreover, if manufacturer cannot commit on fixing the price for the device, they suffer a hold-up risk (recall that we assumed investment FC is technology specific). For a CCP the profit function becomes:

$$(63) \max_{p_m, \sigma_i} \pi'_{i,2} = p_{m,i} f'_{i,2}(f_1, p_m, \sigma_i) - (1 + \sigma_i) FC_i$$

Thus for the company to be able to invest the condition becomes:

$$(64) \Delta\pi(\sigma) = (\pi'_{i,2} - \pi_{i,2}) = p_m * (f'_{i,2} - f_{i,2}) \geq \sigma_i FC_i$$

The intuition is that this condition can be fulfilled only if the manufacturer commits on keeping a fixed price for the device and remunerates CCP willing to invest in their subsidies. We can thus examine two possible scenarios:

- i. Manufacturer can establish complete contracts with CCP
- ii. Incomplete contracts: hold-up and free-riding risk emerge for CCP

i. Timeline with complete contracts

The possibility of structuring complete contracts can be modelled similarly to vertical integration. After signing the contract, the monopolist manufacturer can solve the start-up problem efficiently, since he can count on CCP subsidies. At the end of the game, he has to remunerate CCP according to their investment. This situation is shown in Fig.11.

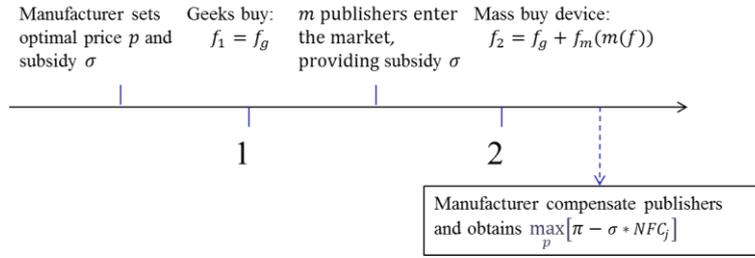


Fig.11 Timeline of Adoption dynamics with CCP subsidies and complete contracts

If $g \leq f_{low}$ and $f'_{low} < f_g < f_{low}$, thus only “network related” subsidies are pivotal the problem for the manufacturer becomes:

$$(65) \max_p \pi_d = \pi_2 - \sigma * NFC_i$$

$$\text{s. t. } f_1 \geq f_{low} \text{ or } \sigma * NFC_i \geq \int_{f_g}^{f_{low}} f(p) - p_i df$$

If $g > f_{low}$ and $f_g < f_{low}$, thus both “device related” and “network related” subsidies can be pivotal the problem for the manufacturer becomes:

$$\max_p [\pi(f'_{high}, p) - \sigma * NFC_i, \pi(f_{high}, p) - \alpha * FC]$$

$$\text{s. t. } \sigma * NFC_i \geq \int_{f_g}^{f_{low}} f(p) - p_i df \text{ or } \alpha * FC \geq \int_{f_g}^{f_{low}} f(p) - p_i df$$

Where the constraints represent the condition to solve the start-up problem with CCP subsidies or technological subsidies.

Proposition 10: If $g \leq f_{low}$ and $f'_{low} < f_g < f_{low}$ or if $g > f_{low}$ and $f_g < f_{low}$, establishing complete contracts can lead to a Pareto-superior equilibrium, with respect to the situation in which both firms act opportunistically

Proof: If $g \leq f_{low}$ and $f'_{low} < f_g < f_{low}$, subsidies from CCP are a necessary condition for adoption by “non-geeks”. In this case complete contracts allow to end up in $f'_{high} > f_g$ thus consumers are better off. Moreover, the manufacturer is better off since he does not provide subsidies and obtains $\max \pi_2 \geq \max \pi_1$ for the regularity

assumption. CCP obtains zero profit in both cases but at f'_{high} more firms enter the market. if $g > f_{low}$ and $f_g < f_{low}$, then we can set two conditions:

$$(66) \alpha * FC \geq \sigma * NFC_i - (f'_{high} - f_{high}) * (p' - p - c) \text{ and}$$

$$(67) f'_{high} - f_{high} \geq 0$$

Where the first term in (66) represents the additional costs if manufacturer provides “device related” subsidies while the second term is composed by the remuneration of CCP for their subsidies and delta profits with respect to the case in which the companies act separately. This condition, if respected, indicates that the manufacturer is better off coordinating with CCPs. Thus if only (66) holds, in the new equilibrium manufacturer and CCPs are better off but not consumers. On the other hand, if only (67) holds but not (66), then consumers are better off in the new equilibrium but manufacturer has an incentive in not stipulating the contracts. Thus if the technology is such that (66) and (67) hold, then establishing complete contracts between manufacturer and CCP leads to a Pareto-superior equilibrium enhancing social welfare.

The next section assume that manufacturer cannot commit on price and show that social welfare enhancing equilibria obtained above cannot be reached in the absence of complete contracts.

ii. Timeline with incomplete contracts

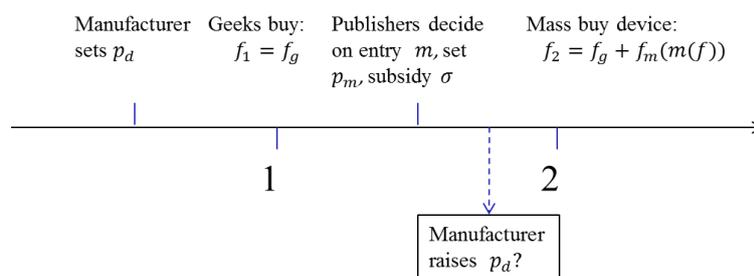


Fig.12 Timeline of Adoption dynamics with CCP subsidies and incomplete contracts

Proposition 11: If $g \leq f_{low}$ and $f'_{low} < f_g < f_{low}$, and complete contracts are not available, the Pareto-superior equilibrium depicted in the previous section cannot be attained. The risk of opportunistic behaviour leads to a suboptimal equilibrium.

Proof: We assume the same conditions as the previous section but this time we allow the manufacturer to change price of the device before non-geeks decide on adoption on $t = 2$. In this case, in the absence of complete contracts, manufacturer has an incentive to initially set price p_d according to the preceding schema, so it is compatible with CCP subsidies. Then once $f > f_{low}$ and m CCP have invested to enter and subsidized, manufacturer can raise the price p_d , obtaining higher profits. This will bring to the same equilibrium as before, since CCP have already suffered sunk cost and thus will prefer to adjust their price. At equilibrium we will have $p_m = 0$ and:

$$(68) \pi_d = \pi_2(f'_{high})$$

$$(69) \pi_m = -(1 + \sigma) * NFC_i$$

Anticipating this behavior, CCPs will not invest. Thus we will end up with a suboptimal equilibrium with a lower share of adopters f_g , and lower profits for the manufacturer as shown in table 1.

CCP	Investing	Wait and see
Manufacturer		
Keeping p_d	$\pi_2(f'_{high}) - \sigma * NFC_i; 0$	$\pi_1(f_g(p_d)); 0$
Changing p_d before $t = 2$	$\pi_2(f'_{high}); -(1 + \sigma) * NFC_i$	$\pi_1(f_g(p_d)); 0$

Table.1: Coordination problem with incomplete contracts

If we drop the assumption that CCP are identical, we will also have a coordination problem in the CCP market. When the start-up problem is not solved, each company will have an incentive to wait and see, eventually free-riding on the investment of other Media companies, once $f > f'_{low}$.

Going back to our case study of Publishing companies and e-readers, we observe the following: investment from Publishers seem to increase consumers' valuation of e-readers and their associated network. Their cooperation may be pivotal for non-geeks to adopt this new technology. In order to invest in the new distribution network, Media companies need to be guaranteed sufficient returns from their investment. Under current market conditions, publishing companies suffer considerable risks by investing in the new distribution networks: first of all, they suffer hold-up risk from manufacturers. In fact, each manufacturer has a dominant position and control distribution through his platform, thus can impact profitability of publishing companies in many ways. Moreover, they suffer a cannibalization risk on their traditional distribution network; this risk increases if they are forced to reduce prices in one distributive channel. Finally, if they subsidize the new network and there is free-entrance, they suffer a free-riding risk from other Media companies, which can wait and enter the market at a later stage without suffering the costs of subsidies. If complete contracts are available, the positive network externalities generated can be distributed efficiently to bring both sides of the market on-board and increase social welfare.

Conclusions

In this paper we show that in a two-sided market with network externalities, cooperation of complementary contents producers can be pivotal to reach the critical mass of adopters needed to solve the start-up problem of a new technology. Moreover, in case of cooperation, under given conditions a Pareto-superior final equilibrium can be reached. Nevertheless, when the technology giving access to the network is proprietary, complete contracts with the producers of complementary contents might be necessary to reach this equilibrium. We also show that for some technologies, over-investing to enhance technological characteristics might be profit maximizing, even if only a few consumers are actually valuating positively these technological innovations. In fact, those few customers can sometimes be essential to constitute an installed customers base large enough to solve the start-up problem.

These results allow for a reflection over recent anti-trust formal proceedings started by the European Commission to investigate sales of e-books. The main claim of this investigation is that recent contracts established by a group of publishers with the leader of tablets' manufacturer include some collusive agreements (i.e. MRP – minimum retail price and MFN – most favourite nation). While MRP can be often considered as negative distortions, in the light of our analysis of the case of Tablets and Media, we could question whether these contracts are the main distortion in this emerging market or a consequence of current regulation and market structure. In fact, under some market condition, a manufacturer could have an incentive in putting pressure on content price to increase the diffusion of their platform. Under incomplete contracts, the manufacturer can then internalize the network effects, so that this strategy results in a transfer from the media industry to subsidize the start-up of the technology. Moreover, publishers may also suffer further negative externalities introduced by the new distribution channel.

Finally we have seen that, even if digitized versions can be reproduced without cost, there exist a number of market distortions that may reduce the margins for publishers on the digital market to be lower than in the traditional ones. As an example, the physical distribution network in many European countries benefit from exemption regulations on vertical agreements and from favourable fiscal regimes (ex. VAT in France is 5% for physical books and 21% for digitized books). Moreover, publishers often need to reverse distribution fees to manufacturers, since they often act as exclusive distributors of digitized contents in their networks. Following these reasoning, it seems that while the cost of subsidizing early-adopters of the new network is being sustained by Media industry consistently, since prices are often lower than those for the traditional products, the structure of the digital market does not guarantee a recovery of this investment, due to hold up risk and the impossibility of controlling the different distribution channels strategically. Under these conditions, the model shows that establishing a complete contract with the digital distributors allows for reaching the optimal level of subsidies. Considering the results of the model, if the intention of the regulator is not only to enhance competition but also to favour universal access to new networks and to promote the creativity and the accessibility of cultural contents, it may be worth considering, in a more integrated perspective, all the factors that are actually preventing

the single market for digital contents to become a level playing field, starting with the regulation of digital distributors and the non-homogeneous taxation and exemption policies in the member states.

References

Artle, R. and Averous, C. "The Telephone System as a Public Good: Static and Dynamic Aspects." *The Bell Journal of Economics and Management Science*, Vol. 4, No. 1 (Spring 1973), pp. 89-100

Baumol, William J.; John C. Panzar and Robert D. Willig. 1983. "Contestable Markets: An Uprising in the Theory of Industry Structure: Reply." *The American Economic Review*, 73(3), 491-96.

Benhamou, Françoise. 2008. "L'économie De La Culture," *La Découverte*, coll. « Repères ».

Bernstein, F., Song, J.S. and Zheng X. 2005. "Free Riding in a Multi-Channel Supply Chain". *The Naval Research Logistics*. 2009;56(8):745-765.

Bomsel, Olivier, 2013. "Copyright and brands in the digital age: Internalizing the Externalities of Meaning", *Contemporary Economic Policy*, Vol. 31, Issue 1, pp. 126-134, 2013.

Bomsel, O. 2007. "Gratuit ! Du déploiement de l'économie numérique", *Folio Actuel*, Editions Gallimard.

Bomsel, O. and Ranaivason, H. "Decreasing Copyright Enforcement Costs: the Scope of a Graduated Response", *Review of Economic Research on Copyright Issues*, 2009, vol. 6(2), pp. 13-29

Buxmann, Peter; Jochen Strube and Gerrit Pohl. 2007. "Cooperative Pricing in Digital Value Chains : The Case of Online Music." *Journal of Electronic Commerce Research* 1 . 8 (2007) : pp. 32-40.

Cattani, K., Gilland, W. and Swaminathan, J. 2004. "Coordinating traditional and internet supply chains", invited contribution to Simchi-Levi, D., Wu,D. and Shen,Z. 2004. "Handbook of Quantitative Supply Chain Analysis Modeling in the E-Business Era, *International Series in Operations Research and Management Science*, Kluwer Academic Publishers.

- David, A. Malueg and Schwartz Marius.** 2006. "Compatibility Incentives of a Large Network Facing Multiple Rivals". *Journal of Industrial Economics*, 54(4), 527-67.
- Farrell, J. and Klemperer Paul.** 2006. "Co-Ordination and Lock-In: Competition with Switching Costs and Network Effects." *Handbook of Industrial Organization, Elsevier.*
- Farrel, J. and Saloner.** 1986. "Installed Base and Compatibility: Innovation, Product Preannouncements, and Predation". *The American Economic Review (AER)*, 76(5), 940 - 55.
- Gentzkow, Matthew A. and Jesse M. Shapiro.** 2010. "Ideological Segregation Online and Offline." *The Quarterly Journal of Economics (2011).*
- George, J. Stigler.** 1961. "The Economics of Information." *Journal of Political Economy*, 69.
- Heeb, R.** 2003. "Innovation and Vertical Integration in Complementary Markets." *Journal of Economics & Management Strategy*, 12(3), 387-417.
- Hogendorn, Christiaan and Stephen Ka Yat Yuen.** "Platform Competition with Must-Have Components." *The Journal of Industrial Economics, Vol. 57, Issue 2, pp. 294-318, June 2009.*
- Inceoglu, F. and Park, M.** 2011. "Diffusion of a New Product under Network Effects: The U.S. DVD Market." *Applied Economics*, 2011, vol. 43, issue 30, pages 4803-4815
- Katz, Michael L. and Carl Shapiro.** 1985. "Network Externalities, Competition, and Compatibility." *The American Economic Review*, 75(3), 424-40.
- Laffont, Jean-Jacques and et al.** 2003. "Internet Interconnection and the Off-Net-Cost Pricing Principle." *RAND Journal of Economics*, 34(2), 370-90.
- Matthew, Gentzkow.** 2007. "Valuing New Goods in a Model with Complementarities: Online Newspapers." *American Economic Review, American Economic Association*, vol. 97(3), pages 713-744, June
- Nelson, Phillip.** 1970. "Information and Consumer Behavior." *Journal of Political Economy*, 78(2), 311-29.

- Rochet, Jean Charles and Jean Tirole.** 2008. "Tying in Two-Sided Markets and the Honor All Cards Rule." *International Journal of Industrial Organization*, 26(6), 1333-47.
- Rochet, Jean-Charles.** 2003. "Platform Competition in Two-Sided Markets." *Journal of the European Economic Association MIT Press*, 1(4).
- Rohlfs, Jeffrey.** 1974. "A Theory of Interdependent Demand for a Communications Service." *The Bell Journal of Economics and Management Science*, 5(1), 16-37.
- Ryan, Stephen and Catherine Tucker.** 2008. "Heterogeneity and the Dynamics of Technology Adoption." *Quantitative Marketing and Economics* 10.1 (2011): 63–109.
- Shankar, V. and Bayus, B.** 2002. "Network Effects and Competition: An Empirical Analysis of the Home Video Game Industry." *Strategic Management Journal*, 24 (2003), 375-384.
- Simon, Daniel H. and Vrinda Kadiyali.** 2007. "The Effect of a Magazine's Free Digital Content on Its Print Circulation: Cannibalization or Complementarity?" *Information Economics and Policy*, 19(3-4), 344-61.
- Tucker, C.** 2008. "Identifying formal and informal influence in technology adoption with network externalities", *Management Science* 55 (12), 2024-2039

Chapter 3

Pricing Copyrighted Content in the Digital Era: The case of Magazines' Industry

Abstract

This paper moves on to the economic issues raised by digitization and by the roll-out of an innovative support such as Reading Tablets on the Press Magazine market. The switch from a “physical analog model” to a “digitized model”, by separating the concepts of meaningful expression from the support for publishing, imposes a rethinking of media industries' business models and copyright frameworks. Smartphones and Tablets represent a new medium allowing for the diffusion of copyrighted contents in digitized formats. Their penetration rate will impact the share of Media revenues that will be exchanged online and the cannibalization rate with respect to physical distribution channels. This paper analyzes these issues through a pricing model for copyrighted contents in a two-sided market with multi-channel distribution. We analyze both the case of a firm producing only on one market (digital or physical) and of a firm producing the same content in different versions in the two markets. We find that: (i) in the digital market the “free dailies” business model is sustainable only if the number of publishers is limited. (ii) Publishers that are active already in the traditional channel with relevant market shares should “defend” their market share setting higher prices for the digital versions of their products. (iii) Unless both the advertising revenues per copy and the total sales in the digital markets grow larger than the traditional market, a traditional publisher should keep operating in the traditional market. (iv) If the total cannibalization grows to be more than proportional, the optimal strategy for a publisher can be not to produce the digital version of a given product.

Résumé

Ce papier analyse les questions économiques soulevées par la numérisation et par la parution des nouveaux réseaux et supports innovant comme les Tablettes numériques dans le marché de la Presse Magazine. Le passage d'un «modèle analogique physique» à un «modèle numérique", en séparant les concepts d'expression signifiante et le support qui permet sa circulation auprès d'un large publique, impose de repenser les procédés de création et production dans plusieurs domaines de l'industrie des Médias. Chaque lecteur numérique représente en effet un nouveau medium, permettant la diffusion de contenus protégés par copyright en formats numériques. Leur taux de pénétration et le taux de cannibalisation par rapport aux canaux physiques auront donc un impact sur la partie du chiffre d'affaires de l'industrie qui sera généré en ligne. Cet article analyse ces variables clés à travers un modèle de tarification pour les contenus protégés par le droit d'auteur dans un marché biface avec canaux de distribution multiples. Nous analysons le cas d'une entreprise produisant sur un seul marché (numérique ou physique) et d'une entreprise produisant le même contenu dans différentes versions dans les deux marchés. Nous constatons que: (i) dans le marché numérique, le modèle de business dit de la « presse gratuite » peut être rentable exclusivement si le nombre d'entreprises est limité. (ii) Les éditeurs qui sont déjà actifs dans le marché traditionnel et qui disposent d'une partie de marché élevé ont intérêt à défendre ces parties de marché en enlèvent le prix des versions numériques de leur produits. (iii) Seulement si les recettes publicitaires pour chaque copie et les ventes globales dans le marché numérique supèrent celles du marché traditionnel, un éditeur actif dans les deux marchés peut considérer l'option d'arrêter la production dans le marché physique. (iv) Si l'effet de cannibalisation devient plus que proportionnel, la stratégie optimale pour un éditeur peut être celle de ne pas produire aucune version numérique d'un produit donné.

Introduction

The economic issues raised by digitization of information goods have been largely studied by economists. Digitization (Shapiro 1998) of copyrighted goods have had a growing impact on Media industries since it allows for a much cheaper and faster circulation of contents, the drawback being the increase of transaction's costs, cannibalization of traditional industries and the creation of new challenges for legal institutions such as massive piracy and Creative Commons. Varian, H. (1995) introduces the problem of pricing goods with heterogeneous evaluations and a cost structure with high fixed costs – or costs of the first copy – and negligible marginal costs. He shows how engaging in price discrimination and bundling techniques in these cases lead to a situation in which both the industry and consumers are better off. By differentiating the product the market can be segmented and revenues can be recovered also from users with low willingness to pay without destroying the value from segments of consumers with a high-willingness. Deneckere and McAfee (1994) show that even the conscious use of product degradation can make all parties strictly better off under specific circumstances. In addition to differentiation, bundling is a price discrimination technique which is particularly important when dealing with information goods and experience goods (Nelson 1970), since a utility evaluation can be made only after the consumption of the good and the heterogeneity in evaluations can be important. Bundling consist in offering distinct products for sale as one package. Nalebuff, B. (1999) shows how this tool is effective in auto-sorting consumers into different groups according to their willingness to pay. Bundling could be effective, under specific circumstances, even if products are partial substitutes, as it is in the case of thematic channels in pay TV, or as it is likely to be the case with different versions of the same media . The effectiveness of multi-form bundling has been studied by Koukova, N., Kannan, P.K. and Ratchford, B. (2008). They show that complementarity exists between different formats and consumers tend to value them positively proportionally to the awareness they have about the differences between formats. Bakos and Brynjolfsson (2000) show that the optimal strategy for information goods (with low marginal cost) is pure bundling, while Venkatesh, R. and Chatterjee (2006) have analyzed the magazine markets the magazine market finding that it is always profit-enhancing for publishers to

offer digitized versions although the domain of optimality of pure bundling is more limited. Despite all these contributions showing the good opportunities brought by new media, publishing companies have been struggling to define their optimal pricing and marketing mixes in a context of increasing digitization. In the case of magazine publishing, the complexity of the profit maximization problem is substantially increased when digital versions are offered: the multiplication of substitutable versions and distribution channels tend to sum up with the uncertainty on the future evolution and on the competitive and legal framework of the digital market.

Magazines are publishing (and distribution) platforms, bundling collections of articles subject to copyright, selected, edited and published on a regular schedule under a publishing brand. They are generally financed by advertising, by a purchase price and by pre-paid subscriptions. The utility of this product is made up of expressions of various kinds (texts, photos, covered by copyrights) gathered within articles under a publishing brand and coupled with a support allowing for its diffusion. Although generally included in the same industry, a magazine differs from a newspaper or a book in at least two crucial aspects: the first is its specific life-cycle, which is far shorter than a book but longer than a newspaper. The second is the level of elaboration of the information by the authors (which can approximate the human capital embedded in the good), which is again in between the other two goods. For almost a decade, while the digital market was limited to PC as a support and to “free dailies business model, magazines’ publishers did not make much effort to enter the digital market, perceiving it as an unprofitable niche and a limited treat, especially due to the low compatibility of digital supports with the exploitation of the magazine’s utility. Innovations such as smartphones and tablets have increased the utility for consumers of digitized written contents and attracted more advertising revenues in the market, making it more attractive for magazine publishers. Nevertheless, despite the strong efforts of many publishers in the past years, the optimal strategy to exploit digitization in the magazine industry has not yet been identified. After a decade during which publishing brands have gone on-line for free or as *freemium* models, new paying models are struggling in a context of increased competition and reduced historical market power. Moreover, the introduction on the market of new versions with higher degrees of substitutability has increased the concerns about the future of the traditional industry.

The objective of this paper is to identify the optimal pricing strategy for an agent who is producing physical goods which can be offered also as a digitized version. The exploration of this complex question can be helpful to publishers and can be extended to other markets with similar characteristics in order to answer common questions such as: Under what product-market conditions would it be profitable to offer a digital version of a product? How effective can versioning and bundling tools be in a context of multi-channel distribution? Would digitization “kill” the traditional distribution channels in the long run? In order to answer these questions the paper analyzes, through a simplified model, the pricing problem of a publisher who is assumed to operate in a monopolistic competition, selling a single differentiated (copyrighted) product which can be available to consumers in multiple versions (physical or digitized). First we specify the different sustainable business models in the publishing industry. Then we show that the “free dailies” are hardly sustainable as the offer on the digital market grows and if a publisher has a positive pricing model in the traditional market. Moreover, we find that traditional publishers with relevant shares in the market should try to defend the value of their product by applying a higher positive price when they enter the digital market. Finally, we analyze the market conditions that will eventually lead to a complete cannibalization of the traditional market.

The remainder of this paper is structured as follows: the next section introduces the standard model of publisher in the traditional physical market. Then we set some hypotheses about the digital market and we define the model of a publisher producing a digital differentiated product. In the fourth section, we establish a link between the markets to study the pricing strategy of a magazine publisher producing both a paper and a digitized version of his product. Section five concludes outlining the results of our model and tackling the related policy issues as well as future research developments.

A traditional economic model for publishing firms

The magazines' market has been traditionally characterized by a large number of small firms with a few companies holding large portfolios of brands of relevant market shares. The market is traditionally considered as concentrated in the top tier and more competitive in the lower tiers. A publisher is a firm selling edited pieces of information under a brand or a portfolio of brands. Each brand identifies a product referred as a magazine, which is assumed to be differentiated from the other goods in the market. The hypothesis that magazines are differentiated despite the fact that they often rely on the same sources of information, is based on two elements: first of all magazines are bundles of copyrighted contents, which by definition cannot be replicated exactly without incurring in a violation of intellectual property. The second element is the brand, which is the common differentiating tool discussed in previous literature.

We assume that the physical global market is composed of n firms indexed by $j = 0, \dots, n$ each producing, for simplicity, a single differentiated good. We also assume that the consumer's market is composed of a mass of consumers denoted S , with a strictly quasi-concave utility function, which is normalized for simplicity to the unit $S=1$. The physical market has been active for a number of periods before the digital market starts, so we assume that the entry game in this market has already been solved and thus n is historically predetermined and each firm j starts the new game with a given endowment derived from his past history (i.e. investment in differentiation), which is represented by her initial share of the global market and is denoted \bar{s}_j . We further assume that the firm faces a down-sloping demand that depends on the price set by the firm and on the mean price set in the market which is denoted $\bar{p} = \frac{\sum_{i=1}^N p_i^*}{N}$. The demand for the firm can be written:

$$(1) \quad q_j(p_1, \dots, p_j, \dots, p_N) = f_j(\bar{s}_j, p_j, \bar{p})$$

Perhaps the simplest explicit form for this demand function can be retrieved assuming a simple linear relation and writing:

$$(2) q_j(p_1, \dots, p_j, \dots, p_N) = \bar{s}_j - bp_j - d(p_j - \bar{p})$$

Parameter d thus represents the degree of substitutability of a good. When d approaches 0, the pricing decision of competitors does not affect the firm's demand while when $d = b$, the pricing decision of competitors has the same relevance for the firm as its own pricing strategy. Finally, when d approaches the infinite, goods become perfect substitutes. Rearranging the terms, this demand can be rewritten as:

$$(3) q_j(p_1, \dots, p_j, \dots, p_N) = \bar{s}_j - \left(b + d \frac{N-1}{N}\right) p_j + d \frac{\sum_{i \neq j} p_i^*}{N}$$

The cost function faced by publishers is composed of a fixed part (F) and a variable part (c_j). The former represents all the costs which are needed to produce the first copy of content, such as authors' wages, editors and support services provided by the publisher. The variable costs includes the production of each additional copy, transport and distribution cost. We can write:

$$(4) C_j(q_j) = c_j q_j + F$$

The publisher's revenues are composed of the selling price and advertising revenues, which are a function of the diffusion of the magazine and are defined as follow:

$$(5) A_j = g(q_j)$$

In order to keep the model simple we can assume a linear form for the advertising revenues, as we did for the demand function. The previous equation becomes then:

$$(6) A_j(q_j) = \bar{\gamma} q_j T$$

The problem for the firm is to set the price and quantity that maximizes his profit function in the paper market, which can be written:

$$(7) \max_{q_j} \pi_j(q_j, p_j, \bar{p}, C_j, A_j)$$

or explicitly

$$(8) \max_{q_j \geq 0} \pi_j = p_j(q_j) q_j + A_j(q_j) - C_j(q_j)$$

To solve the problem we can apply the first order condition that simply reads:

$$(9) \text{ F.O.C. } \frac{\Delta p_j(q_j)q_j}{\Delta q_j} + \frac{\Delta A_j(q_j)}{\Delta q_j} = \frac{\Delta C_j(q_j)}{\Delta q_j}$$

The inverse demand reads:

$$(10) \quad p_j(q_j) = \frac{\bar{s}_j + d \frac{\sum_{i \neq j} p_i^*}{N} - q_j}{b + d \frac{N-1}{N}}$$

Let's call $\frac{\sum_{i \neq j} p_i^*}{N} = \hat{p}$ and $d \frac{N-1}{N} = \hat{d}$ and we can solve setting:

$$(11) \quad p_j(q_j) = \frac{\bar{s}_j + d\hat{p} - q_j}{b + \hat{d}}$$

$$(12) \quad \frac{\Delta D(q_j)q_j}{\Delta q_j} = \frac{\bar{s}_j + d\hat{p} - 2q_j}{b + \hat{d}}$$

Using equation 3, 4 and 6, we can solve to find the optimal price for firm j .

$$(13) \quad \frac{\bar{s}_j + d\hat{p} - 2q_j}{b + \hat{d}} + \bar{\gamma} = c_j$$

$$(14) \quad q_j^* = \frac{1}{2} [\bar{s}_j + d\hat{p} + (b + \hat{d})(\bar{\gamma} - c_j)]$$

From this equation we can establish the optimal pricing scheme for the firm as follows:

$$(15) \quad p_j^* \begin{cases} 0 & \text{if } \bar{\gamma} \geq \frac{\bar{s}_j + d\hat{p}}{b + \hat{d}} + c_j \\ \frac{1}{2} \left[\frac{\bar{s}_j + d\hat{p}}{b + \hat{d}} + c_j - \bar{\gamma} \right] & \text{otherwise} \end{cases}$$

The resulting profit is:

$$(16) \quad \pi_j^* = (p_j^* - c_j + \bar{\gamma})q_j^* - F$$

$$(17) \quad \pi_j^* = \left(\frac{1}{2} \left[\frac{\bar{s}_j + d\hat{p}}{b + \hat{d}} - c_j + \bar{\gamma} \right] \right) * \left(\frac{1}{2} [\bar{s}_j + d\hat{p} + (b + \hat{d})(\bar{\gamma} - c_j)] \right) - F$$

$$(18) \quad \pi_j^* = \frac{1}{4(b + \hat{d})} [\bar{s}_j + d\hat{p} + (b + \hat{d})(\bar{\gamma} - c_j)]^2 - F$$

Analyzing this result in terms of the parameter γ allows us to specify different categories of media goods in the publishing industry, corresponding to different business models. First of all, we can establish the necessary conditions for a publisher

who relies exclusively on advertising revenues (i.e. free dailies). In fact if the coefficient of advertising revenues is sufficiently high, namely:

$$(19) \quad \bar{\gamma} \geq \frac{\bar{s}_j + d\hat{p}}{b + \hat{d}} + c_j$$

The strategy of setting $p_j = 0$ is optimal for firm j . This strategy corresponds to maximizing diffusion of the goods to reach:

$$(20) \quad q_j^{max} = \bar{s}_j + d\hat{p}$$

And a profit of:

$$(21) \quad \pi_j = (\bar{s}_j + d\hat{p}) * (\bar{\gamma} - c_j) - F$$

The other extreme case is when $\bar{\gamma} = 0$, which is the case of products which cannot rely on advertising (i.e. can be the case for books, which usually do not include advertising pages). In this case we have the traditional monopoly solution which in this case reads:

$$(22) \quad q_j^* = \frac{1}{2} [\bar{s}_j + d\hat{p} - (b + \hat{d})c_j]$$

$$(23) \quad p_j^* = \frac{1}{2} \left[\frac{\bar{s}_j + d\hat{p}}{(b + \hat{d})} + c_j \right]$$

$$(24) \quad \pi_j = \frac{1}{2} \left[\frac{\bar{s}_j + d\hat{p}}{(b + \hat{d})} - c_j \right] * \frac{1}{2} [\bar{s}_j + d\hat{p} - (b + \hat{d})c_j] = \frac{1}{4(b + \hat{d})} [\bar{s}_j + d\hat{p} - (b + \hat{d})c_j]^2 - F$$

To conclude the analysis of the physical model by characterizing the mean price \bar{p}

.Recall that we defined $\hat{p} = \frac{\sum_{i \neq j} p_i^*}{N}$. Thus for every firm j we can write:

$$(25) \quad \hat{p}_j = \frac{1}{N} \sum_{i \neq j} p_i^* = \frac{1}{N} \left[\left(\frac{1}{2(b + \hat{d})} \sum_{i \neq j} (\bar{s}_i + d\hat{p}_i) \right) + \sum_{i \neq j} \left(\frac{c_i}{2} - \frac{\bar{\gamma}}{2} \right) \right]$$

Taking the sum of \hat{p}_j we obtain:

$$(26) \quad \sum_{j=1}^N \hat{p}_j = \sum_{j=1}^N \frac{1}{N} \left[\left(\frac{1}{2(b + \hat{d})} \sum_{i \neq j} (\bar{s}_i + d\hat{p}_i) \right) + \sum_{i \neq j} \left(\frac{c_i}{2} - \frac{\bar{\gamma}}{2} \right) \right]$$

We know that $\sum_{i \neq j} \bar{s}_i = S - \bar{s}_j = 1 - \bar{s}_j$ and $\sum_{i \neq j} \hat{p}_i = (N - 2)\bar{p} + p_j$ so we can write:

$$(27) \quad \hat{p}_j = \frac{1}{N} \left(\frac{1}{2(b+\hat{d})} (1 - \bar{s}_j) + \frac{d}{2(b+\hat{d})} ((N-2)\bar{p} + p_j) \right) + \sum_{i \neq j} \frac{c_i}{2} - (N-1) \frac{\bar{y}}{2}$$

Summing both terms of the above formula and defining $C = \sum_{i=1}^N c_i$ we get:

$$(28) \quad \bar{p}^* = \frac{1}{N} \left(\frac{1}{2(b+\hat{d})} + \frac{d}{2(b+\hat{d})} N\bar{p}^* \right) + \frac{1}{2} C - N \frac{1}{2} \bar{y}$$

Finally, we can solve for \bar{p} and we get:

$$(29) \quad \bar{p}^* \left[1 - \frac{d}{2(b+\hat{d})} \right] = \frac{1}{N} \left(\frac{1}{2(b+\hat{d})} + \frac{1}{2} C - N \frac{1}{2} \bar{y} \right)$$

$$(30) \quad \bar{p}^* = \frac{b+\hat{d}}{2(b+\hat{d})-d} \left[\frac{1}{N(b+\hat{d})} + \frac{C}{N} - \bar{y} \right]$$

We can now define $\lambda = \frac{b+\hat{d}}{2(b+\hat{d})-d}$ and write:

$$(31) \quad \bar{p}^* = \lambda \left[\frac{1}{N(b+\hat{d})} + \frac{C}{N} - \bar{y} \right]$$

We can see from this result that the mean price in the industry at equilibrium depends positively on the mean marginal cost and negatively on the advertising revenues, while the intercept depends on the number of firms in the market and on price elasticities.

Using this result, we can further characterize the optimal response of the single firm:

$$(32) \quad p_j^* = \frac{\bar{s}_j + d\hat{p}}{2(b+\hat{d})} + \frac{c_j}{2} - \frac{\bar{y}}{2} = \frac{\bar{s}_j + d(\bar{p} - \frac{1}{N}p_j^*)}{2(b+\hat{d})} + \frac{c_j}{2} - \frac{\bar{y}}{2}$$

$$(33) \quad p_j^* \left[1 + \frac{\frac{d}{N}}{2(b+\hat{d})} \right] = \frac{\bar{s}_j + d\bar{p}}{2(b+\hat{d})} + \frac{c_j}{2} - \frac{\bar{y}}{2}$$

$$(34) \quad p_j^* = \frac{b+\hat{d}}{2(b+\hat{d}) + \frac{d}{N}} \left[\frac{\bar{s}_j + d\bar{p}}{(b+\hat{d})} + c_j - \bar{y} \right]$$

We can now define $\mu = \frac{b+\hat{d}}{2(b+\hat{d}) + \frac{d}{N}}$ and write:

$$(35) \quad p_j^* = \mu \left[\frac{\bar{s}_j + d\bar{p}}{(b+\hat{d})} + c_j - \bar{y} \right]$$

The above reasoning can be summarized as follows:

Proposition 1: if the economy is composed of a single market for the differentiated good, under the hypotheses set above, we have that $p_j^* \in \left[0; \mu \left[\frac{\bar{s}_j + d\bar{p}}{(b+\hat{a})} + c_j \right] \right] \forall j$. The optimal price p_j^* of a specific differentiated good depends on the coefficient $\bar{\gamma}$, which can be interpreted as the relative weight of advertising revenues for firm j .

Based on coefficient $\bar{\gamma}$, we can identify three categories of products with different business models:

- If $\bar{\gamma} \geq \mu \left[\frac{\bar{s}_j + d\bar{p}}{(b+\hat{a})} + c_j \right]$, the firm's strategy is to maximize diffusion, setting $p_j^* = 0$. In the publishing industry this may represent the business model of *free dailies*, which rely exclusively on advertising revenues.
- If $0 < \bar{\gamma} < \mu \left[\frac{\bar{s}_j + d\bar{p}}{(b+\hat{a})} + c_j \right]$, the firm's strategy is to find the optimal balance between a good margin on kiosk sales and a sufficient diffusion to capture advertisers interest. This is the case of the majority of *magazines and newspapers*
- If $\bar{\gamma} = 0$, the firm's strategy is to maximize profits from stall sales revenues. In publishing this represents the business model for *books*.

In this paragraph we have outlined that pricing strategy in the presence of linear advertising revenues, which may vary consistently from one differentiated good to another. We have then identified three categories of products based on the relative weight of advertising revenues in the business model. Moving from this setup, we will now assume that in addition to the *physical market*, there is the opportunity to exploit an emerging market, namely the *digital market*. Each publisher should decide whether to offer a digitized version and to establish a new pricing strategy for his product. In the next section we first discuss a number of hypotheses related to the new market and then we proceed to complete the pricing model for a publisher facing a new emerging market.

Pricing differentiated goods in the digital market

The advents of the Internet, bit-encoding techniques and platform innovations such as the creation of smartphone and tablets have created new ways of conducting business in many fields of the economy. In some industries such as in the media markets, digitization has brought a revolution in the business model of traditional firms. They allow for the creation of new products with specific cost functions and distribution channels and for the creation of new markets, characterized by specific competitive environments and regulations. On the supply side, digitization of press magazines relaxes the traditional constraints of the industry such as physical dimensions, costs of producing a copy and limitations to diffusion. The increased flexibility on the cost side in turn results in enhanced discrimination opportunities for the firms. On the drawbacks, the digital revolution complicates the pricing problem, introducing cannibalization and coordination problems among physical and digital value chains.

In order to keep the model simple, we focus on the strategic pricing decisions of a single firm j producing two different versions of the same product: the traditional physical product and a digital version characterized by the same content but different support and format. In reality, we observe that the pricing decisions depend also on the interactions of each media firm with physical and digital distributors, which may have different strategies, different competitive environments and different market power. In this paper we will disregard these interactions, leaving their treatment to a separate paper.

In order to adapt the basic model to the digital context, that we generally identify with a subscript d , we need to introduce a number of hypotheses in addition to those discussed in the previous section. First of all, one of the positive impacts of digitization is the consistent reduction of the marginal cost of reproduction of copyrighted contents. For the sake of simplicity we will thus assume that the marginal cost c_j is null when the good sold is in digital format. We use the notation $c_{j,d} = 0$. On the other hand, producing and selling the additional product involves emerging costs F_d which are assumed to be fixed.

$$(36) \quad C_{j,d} = F_d$$

These costs include all the investment needed for the firm to conceive, produce and market the new product. This time we assume that the digital global market has no history and is composed of m potential firms indexed by $j = 0, \dots, m$ each producing, for simplicity, a single differentiated good. Among the potential firms, we can identify two groups: the first group is composed of firms which are already active in the physical market while firms in the second group will eventually operate exclusively in the digital market. Let's start our analysis of the digital market by assuming that it is unrelated to the physical. We also assume that the potential digital market is composed of a share $\bar{\beta}$ of the total mass of consumers S . This assumption derives from the fact that in order to have access to the digital version of a product j , a consumer needs to be equipped with a specific device. Coefficient $\bar{\beta}$ represents the percentage of the total population which is capable of accessing the digital market. Finally, we assume that in the new market each firm starts with a null endowment. If the markets are unrelated, the firms are thus symmetric. Resuming we have that:

$$(37) \quad \bar{s}_{j,d} = \frac{\bar{\beta}S}{m} \quad \forall j = 0, \dots, m$$

As we did earlier in the paper, we consider that each firm faces a down-sloping demand and that there is free entry in the new market. The demand function for the firm depends on the number of firms entering the market and on prices set by those firms. We can write:

$$(38) \quad q_{j,d}(p_{1,d}, \dots, p_{j,d}, \dots, p_{M,d}, m) = f_{j,d}(p_{j,d}, \bar{p}_d, m)$$

Where $\bar{p}_d = \frac{\sum_{i=1}^M p_{i,d}^*}{M}$ is the mean price emerging in the digital market. We can explicit this demand function assuming a linear relation and writing:

$$(39) \quad q_{j,d}(p_{1,d}, \dots, p_{j,d}, \dots, p_{M,d}, m) = \bar{\beta}S \left(\frac{1}{m} - b_d p_{j,d} - d_d (p_{j,d} - \bar{p}_d) \right)$$

Normalizing the S mass of consumers to one we can simplify the demand faced by the firm to:

$$(40) \quad q_{j,d}(p_{1,d}, \dots, p_{j,d}, \dots, p_{M,d}, m) = \bar{\beta} \left(\frac{1}{m} - b_d p_{j,d} - d_d (p_{j,d} - \bar{p}_d) \right)$$

As we have seen earlier, parameter d_d represents the degree of substitutability of a good in the digital market. Rearranging the terms of the sum, this demand can be rewritten as:

$$(41) \quad q_{j,d}(p_{1,d}, \dots, p_{j,d}, \dots, p_{M,d}, m) = \frac{\bar{\beta}}{m} - \bar{\beta} \left(b_d + d_d \frac{M-1}{M} \right) p_{j,d} + \bar{\beta} d_d \frac{\sum_{i \neq j} p_{i,d}^*}{M}$$

Let's call $\frac{\sum_{i \neq j} p_{i,d}^*}{M} = \hat{p}_d$ and $d_d \frac{M-1}{M} = \hat{d}_d$ and we can simplify this expression to get:

$$(42) \quad q_{j,d}(p_{1,d}, \dots, p_{j,d}, \dots, p_{M,d}, m) = \frac{\bar{\beta}}{m} - \bar{\beta} (b_d + \hat{d}_d) p_{j,d} + \bar{\beta} d_d \hat{p}_d$$

The revenues of the publishers in the digital market are composed by the selling price and by advertising revenues, similarly to the physical market, we can thus define the advertising revenues in the digital market as follows:

$$(43) \quad A_{j,d} = g(q_{j,d})$$

Or explicitly:

$$(44) \quad A_j(q_{j,d}) = \bar{\gamma}_d q_{j,d} T$$

The maximization problem for a firm operating in the digital market can be thus written:

$$(45) \quad \max_{q_{j,d} \geq 0} \pi_{j,d}(q_{j,d}, p_{j,d}, \bar{p}_d, C_{j,d}, A_{j,d})$$

Or

$$(46) \quad \max_{q_{j,d} \geq 0} \pi_{j,d} = p_{j,d}(q_{j,d}) q_{j,d} + A_{j,d}(q_{j,d}) - C_{j,d}$$

From (31) we find:

$$(47) \quad p_{j,d}(q_{j,d}) = \frac{\frac{1}{m} + d_d \hat{p}_d}{(b_d + \hat{d}_d)} - \frac{q_{j,d}}{\bar{\beta} (b_d + \hat{d}_d)}$$

If we assume that the digital and physical market are not related, since firms are symmetric in the digital market, it follows that we will have at equilibrium:

$$(48) \quad p_{j,d}^*(q_{j,d}^*) = \frac{\sum_{i \neq j} p_{i,d}^*}{M} \quad \forall j = 1, \dots, M$$

The demand for each firm will thus be:

$$(49) \quad q_{j,d}(p_{j,d}, \hat{p}_d, m) = \bar{\beta} \left(\frac{1}{m} - b_d p_{j,d} \right)$$

$$(50) \quad p_{j,d}(q_{j,d}) = \frac{1}{mb_d} - \frac{1}{\bar{\beta} b_d} q_{j,d}$$

The F.O.C. for each firm reads:

$$(51) \quad \frac{1}{mb_d} - 2 \frac{q_{j,d}}{\bar{\beta} b_d} + \bar{\gamma}_d = 0$$

$$(52) \quad q_{j,d}^* = \frac{1}{2} \bar{\beta} b_d \left(\frac{1}{mb_d} + \bar{\gamma}_d \right)$$

$$(53) \quad p_{j,d}^*(q_{j,d}^*) = \frac{1}{2} \left(\frac{1}{mb_d} - \bar{\gamma}_d \right)$$

And the optimal profit for each firm will be:

$$(54) \quad \pi_{j,d}^* = \frac{1}{4} \bar{\beta} b_d \left(\frac{1}{mb_d} + \bar{\gamma}_d \right)^2 - F_d$$

As we did for the physical market, we can establish the necessary conditions for a publisher who relies exclusively on advertising revenues (i.e. free web-sites). If

$$(55) \quad \bar{\gamma}_d \geq \frac{1}{mb_d}$$

It is optimal for publisher j to set $p_{j,d}^* = 0$. The maximum share of the market that firm j is able to reach is:

$$(56) \quad q_{j,d}^{\max}(0, m) = \frac{\bar{\beta}}{m}$$

And the resulting profit is:

$$(57) \quad \pi_{j,d} = \frac{\bar{\beta}}{m} \bar{\gamma}_d - F_d$$

On the other hand, when $\bar{\gamma}_d = 0$ or very close to zero, which could be the case of many digital publications such as websites or blogs in the start-up phase, the solution of the maximization problem gives:

$$(58) \quad q_{j,d}^* = \frac{\bar{\beta}}{2m}$$

$$(59) \quad p_{j,d}^* = \frac{1}{2mb_d}$$

This gives us the range of optimal price for a digital differentiated product depending on its capability of generating advertising revenues.

$$(60) \quad p_{j,d}^*(\bar{\gamma}_d) \in \left[0; \frac{1}{2mb_d}\right]$$

However, since we have free-entry in the market, in the long run firms will not be able to have positive profits. We should thus examine the entry problem the digital market to define the equilibrium in this market. We can solve for m^* by setting the condition: $\pi_{j,d}^* = 0 \forall j = 1, \dots, m$:

Recall that the profit for a firm j in the digital market are given by:

$$(61) \quad \pi_{j,d}^* = p_{j,d}(q_{j,d})q_{j,d} + \bar{\gamma}_d q_{j,d} - F_d = 0$$

$$(62) \quad \pi_{j,d}^* = \frac{1}{4}\bar{\beta}b_d \left(\frac{1}{mb_d} + \bar{\gamma}_d\right)^2 = F_d$$

From this expression we can calculate the number of firms at equilibrium in the digital market:

$$(63) \quad m_{1,2}^* = \frac{-b_d\bar{\gamma}_d \pm \sqrt{(b_d\bar{\gamma}_d)^2 + \frac{4b_d F_d}{\bar{\beta}} - (b_d\bar{\gamma}_d)^2}}{(b_d\bar{\gamma}_d)^2 - \frac{4b_d F_d}{\bar{\beta}}} = \frac{-b_d\bar{\gamma}_d \pm \sqrt{\frac{4b_d F_d}{\bar{\beta}}}}{(b_d\bar{\gamma}_d)^2 - \frac{4b_d F_d}{\bar{\beta}}}$$

As we can see, since m must be non-negative and since in normal conditions $F \gg \bar{\gamma}_d$ (being the total fixed cost compared to the per copy advertising revenue), we are left with only one possible equilibrium:

$$(64) \quad m^* = \left[b_d\bar{\gamma}_d + \sqrt{\frac{4b_d F_d}{\bar{\beta}}} \right] \left[1 / \left(\frac{4b_d F_d}{\bar{\beta}} - (b_d\bar{\gamma}_d)^2 \right) \right]$$

As expected, we find that the advertising revenues ($\bar{\gamma}_d$) and the development of the market ($\bar{\beta}$) have a positive impact on the number of firms at equilibrium. On the other hand, the fixed cost has a negative impact on entry. If the advertising revenues are sufficiently high, we will have:

$$q_{j,d}^* = \frac{\bar{\beta}}{m}$$

$$p_d^* = 0$$

$$(65) \quad \pi_{j,d}^* = \frac{\bar{\beta}}{m} \bar{\gamma}_d - F_d = 0$$

$$(66) \quad m^* = \frac{\bar{\beta} \bar{\gamma}_d}{F_d} \geq \sqrt{\frac{\bar{\beta}}{b_d F_d}}$$

Finally if the firms in the market cannot rely on advertising, the equilibrium number of firms is given by:

$$(67) \quad \pi_{j,d}^* = \frac{1}{4} \bar{\beta} b_d \left(\frac{1}{m b_d} \right)^2 - F_d = 0$$

$$(68) \quad m^*_{1,2} = \pm \sqrt{\frac{1}{4} \frac{\bar{\beta}}{b_d F_d}}$$

As before, we only have one equilibrium which is feasible, given by $m^* = \frac{1}{2} \sqrt{\frac{\bar{\beta}}{b_d F_d}}$.

Proposition 2: If the digital market is totally unrelated with the physical one, under the hypotheses set above, we have that the equilibrium price is in the range $p_d^* \in \left[0; \sqrt{\frac{F_d}{\bar{\beta} b_d}} \right]$. The optimal price depends on coefficient $\bar{\gamma}_d$, and it is common to every firm $j \in [1 \dots m^*]$. If

- If $\bar{\gamma}_d \geq \sqrt{\frac{F_d}{\bar{\beta} b_d}}$ the optimal strategy for every firm is to maximize diffusion, and the equilibrium price is $p_d^* = 0$. If the advertising revenues are sufficiently attractive, since there are no marginal costs and no historical average price, every firm that can enter into the market has an incentive to maximize diffusion.

- If $0 \leq \bar{\gamma}_d < \sqrt{\frac{F_d}{\beta b_d}}$, the firms strategy is to charge the share of the average cost of production that is not covered by advertising.

Proposition 3: If the utility that consumers derive from digital contents is assumed to be strictly increasing and strictly concave, provided a market with symmetric firms with zero marginal cost of production, the market equilibrium is efficient, conditional on $m > \frac{\bar{\beta}\bar{\gamma}_d}{F_d}$, when the emerging price in the market is $p_d^* = 0$ and the quantity of goods consumed is $q_d^* = \sum_{j=1}^M q_{j,d}^* = M \frac{F_d}{\bar{\gamma}_d}$. In this equilibrium, all firms charge the marginal cost for their digital product and differentiation is maximal. It is thus always preferable to have higher advertising revenues in the market.

However, in a context with advertising and entry cost, it is not clear whether a policy scheme should aim to maximize the diffusion of digital contents, encouraging new entries. Characterizing a social optimum is particularly complex in this case, even considering the digital market as a separate entity. In fact, in our analysis we disregarded the quality of content. Increasing differentiation may lead to lower mean quality of content, thus reducing the marginal utility of consumers for additional content. Moreover, increasing advertising can impact the utility of consumers and introduces a number of externalities between industries, both in a vertical (advertiser-content) and in an horizontal (contents competing for advertising investments) directions.

Pricing differentiated goods available in substitutable versions

The above reasoning can lead to quite different results when we allow for possible interactions among the two markets. The introduction of digitized versions allows for increased version and bundling opportunities for those firms already active in the physical market. The same written content, thanks to bit-encoding techniques, can be offered to consumers in many more ways: through a website, in Portable Document

Format⁷, through smartphone and tablets specific application, through content aggregators or social networks, etc. Moreover, different versions can be digitally combined (bundled) in virtually infinite ways, thanks to the relaxation of physical constraints. In fact, the traditional bundles offered in the publishing industry, subscriptions (bundle of editions) and bundle of titles can be significantly expanded while new bundling options, the coupling of different versions of the same contents, emerge.

Nevertheless, a digitized version could be a substitute product for the hardcopy, sharing the same contents: we may argue about the degree of substitutability of digital versions not being perfect, but overall the economic literature has shown some cannibalization effect between physical and digital copies of the same product. To model these effects, we introduce in the model two exogenous parameters $\bar{\alpha}$ and $\bar{\alpha}_d$ which are representative of the reduction of physical sales due to cannibalization effect of new market ($\bar{\alpha}$) and of the effect of physical sales on digital sales ($\bar{\alpha}_d$). If a firm j decides to sell a digital version of its physical product, the quantity of physical goods sold will thus depend also on the quantity of digital units of the goods that are sold and vice-versa. The demand for the firm can be written

$$(69) \quad q_{tot}(\dot{p}, \dot{p}_d, m) = f_j(\bar{s}_j, p_j, \bar{p}, p_{j,d}, \bar{p}_d, m) = q_j(\dot{p}, \dot{p}_d) + q_{j,d}(\dot{p}, \dot{p}_d, m, \bar{\beta}, \bar{\alpha}_d)$$

Where:

$$\dot{p} = \begin{pmatrix} p_1 \\ \cdot \\ \cdot \\ p_j \\ \cdot \\ \cdot \\ p_N \end{pmatrix} \text{ and } p_{j,d} = p_d \quad \forall j \in m$$

The relation between digital sales and physical sales is once again assumed to be linear for simplicity, we can thus write the demand for the physical version of the two product firm as follows:

⁷ Commonly called PDF, it is a digitized fac-simile of a document

$$(70) \quad q_j(\dot{p}, \dot{p}_d) = \bar{s}_j - bp_j - d(p_j - \bar{p}) + \tilde{b}p_{j,d} + \tilde{d}(p_{j,d} - \bar{p}_d)$$

Since firms have no market power in the digital market, we have simply:

$$(71) \quad q_j(\dot{p}, \dot{p}_d) = \bar{s}_j - (b + d)p_j + d\bar{p} + \tilde{b}\bar{p}_d$$

This formulation implies that the demand on the traditional market depends now as well on the pricing of the digital version and on the mean price of the competitors in the digital market. As a consequence, the strategy of a firm j in the digital market can be different depending on whether the firm is already active in the physical market and on how the two markets are interconnected. We now assume that there exist two groups of firms in the digital market: the two product firms that are active on both markets (asymmetric) and the single product firms that are active only in the digital market (symmetric). We assume that firms that are already active in the traditional market will become two product firms, will firms that are inactive need to decide whether to enter the new market or not. We define $m_1 = N$ the group of firms of type 1, active on both markets and $m_2 = \{m^*\} - \{m_1\}$ the group of firms of type 2. Following the same reasoning, the demand for firm j in the digital market can be written:

$$(72) \quad q_{j,d}(\dot{p}, \dot{p}_d, m) = \bar{\beta} \left(\frac{1}{m} - b_d \bar{p}_d + \tilde{b}_d p_j + \tilde{d}_d \bar{p} \right)$$

$$(73) \quad q_{j,d}(\dot{p}, \dot{p}_d, m) = \left[\bar{\beta} \left(\frac{1}{m} - b_d \bar{p}_d + (\tilde{b}_d + \tilde{d}_d) p_j + \tilde{d}_d \hat{p} \right) \right]$$

$$(74) \quad \bar{p}_d = \frac{1}{2b_d \bar{\beta}} \left[\bar{\beta} \left(\frac{1}{m} + (\tilde{b}_d + \tilde{d}_d) p_j + \tilde{d}_d \hat{p} \right) - b_d \bar{y}_d \right]$$

$$(75) \quad \pi = \frac{1}{4b_d \bar{\beta}} \left[\bar{\beta} \left(\frac{1}{m} - b_d \bar{p}_d + \tilde{b}_d p_j + \tilde{d}_d \bar{p} \right) + b_d \bar{y}_d \right]^2 - F_d$$

Finally, the cost function for a two product firm j becomes:

$$(76) \quad C_j^{tot}(q_j, q_{j,d}) = c_j q_j + F^{tot}$$

Where $F^{tot} = F + F_d$ is the sum of the investment needed to operate in the two markets. For simplicity, we assume that each firm can produce a single digital version of its differentiated physical good. If a firm is already active in the physical market, it can use its market power and the extra profits in the physical market to develop the digital one. We will also assume that firm j has total control of both its traditional and

its digital retailing network. This hypothesis limits our model to a specific type of digital distribution, which may not be suitable for all firms. In reality, firms going digital have a number of available strategies, each of which involves complex economic tradeoffs which deserve an in depth discussion which is not the purpose of this paper. We can thus proceed to solving the maximization problem as we did in the previous sections. The total revenues from the advertising sector will be the sum of the two incomes:

$$(77) \quad A_j^{tot} = g(q_j, q_{j,d})$$

Or explicitly:

$$(78) \quad A_j^{tot}(q_j, q_{j,d}) = \bar{\gamma}q_j + \bar{\gamma}_d q_{j,d}$$

The problem for a two products firm j is to maximize their global profit function. The maximization problem can be written:

$$(79) \quad \max_{p_j \geq 0, p_{j,d} \geq 0} \pi_j^{tot}(q_{tot}(\dot{p}, \dot{p}_d, m), C_j^{tot}, A_j^{tot})$$

or explicitly

$$(80) \quad \max_{p_j \geq 0, p_{j,d} \geq 0} \pi_j = q_j(\dot{p}, \dot{p}_d)(p_j + \bar{\gamma} - c_j) + q_{j,d}(\dot{p}, \dot{p}_d, m)(p_{j,d} + \bar{\gamma}_d) - F^{tot}$$

The first conditions we need to apply are the following:

$$(81) \quad F.O.C.1 \quad \frac{\Delta \pi_j}{\Delta p_j} = \frac{\Delta R_j(q_j)p_j}{\Delta p_j} + \frac{\Delta R_{j,d}(q_{j,d})p_{j,d}}{\Delta p_j} = 0$$

We can then turn to the digital market and set the maximization condition as follows:

$$(82) \quad F.O.C.2 \quad \frac{\Delta \pi_j}{\Delta p_{j,d}} = \frac{\Delta R_{j,d}(q_{j,d})p_{j,d}}{\Delta p_{j,d}} + \frac{\Delta R_j(q_j)p_j}{\Delta p_j} = 0$$

This condition implies that the marginal revenue obtained by producing one unit of output in the new market should equalize the marginal cost plus the eventual costs of cannibalization in the other market. To solve the problem we start by setting the profit equation and calculating the first order condition:

$$\pi_j = [\bar{s}_j - (b + \hat{d})p_j + d\hat{p} + \tilde{b}\bar{p}_a](p_j + \bar{\gamma} - c_j) + \left[\bar{\beta} \left(\frac{1}{m} - b_a\bar{p}_a + (\tilde{b}_a + \tilde{d}_a)p_j + \tilde{d}_a\hat{p} \right) \right] (\bar{p}_a + \bar{\gamma}_a) - F^{tot}$$

$$(83) \quad \frac{\Delta\pi_j}{\Delta p_j} = [\bar{s}_j - 2(b + \hat{d})p_j + d\hat{p} + \tilde{b}\bar{p}_a] - (b + \hat{d})(\bar{\gamma} - c_j) + \bar{\beta}(\tilde{b}_a + \tilde{d}_a)(\bar{p}_a + \bar{\gamma}_a) = 0$$

From the F.O.C. we obtain:

$$(84) \quad p_j^* = \frac{1}{2(b + \hat{d})} \left[\bar{s}_j + d\hat{p} - (b + \hat{d})(\bar{\gamma} - c_j) + \bar{\beta}(\tilde{b}_a + \tilde{d}_a)\bar{\gamma}_a + (\tilde{b} + \bar{\beta}(\tilde{b}_a + \tilde{d}_a))\bar{p}_a \right]$$

To complete the characterization of the model we need to treat the mean prices \bar{p} .

Recall that we defined: $\hat{p} = \frac{\sum_{i \neq j} p_i^*}{N}$. Thus for every firm j we can write:

$$\hat{p}_j = \frac{1}{N} \sum_{i \neq j} p_i^* = \frac{1}{N2(b + \hat{d})} \sum_{i \neq j} \left\{ [\bar{s}_i + d\hat{p}_i - (b + \hat{d})(\bar{\gamma} - c_i) + \bar{\beta}(\tilde{b}_a + \tilde{d}_a)\bar{\gamma}_a + (\tilde{b} + \bar{\beta}(\tilde{b}_a + \tilde{d}_a))\bar{p}_a] \right\}$$

We know from the previous section that: $\sum_{i \neq j} \bar{s}_i = S - \bar{s}_j = 1 - \bar{s}_j$ that $\sum_{i \neq j} \hat{p}_i = (N - 2)\bar{p} + p_j$ and we can write:

$$\hat{p}_j = \frac{1}{N} \sum_{i \neq j} p_i^* = \frac{1}{N2(b + \hat{d})} \left[(1 - \bar{s}_j) + d[(N - 2)\bar{p} + p_j] - (N - 1)(b + \hat{d})\bar{\gamma} + (N - 1)\bar{\beta}(\tilde{b}_a + \tilde{d}_a)\bar{\gamma}_a + (b + \hat{d}) \sum_{i \neq j} c_i + (N - 1)(\tilde{b} + \bar{\beta}(\tilde{b}_a + \tilde{d}_a))\bar{p}_a \right]$$

Taking the sum of \hat{p}_j we obtain:

$$\begin{aligned} \sum_{j=1}^N \hat{p}_j &= \sum_{j=1}^N \frac{1}{N} \sum_{i \neq j} p_i^* \\ &= \frac{1}{N2(b + \hat{d})} \sum_{j=1}^N \left[(1 - \bar{s}_j) + d[(N - 2)\bar{p} + p_j] - (N - 1)(b + \hat{d})\bar{\gamma} + (N - 1)\bar{\beta}(\tilde{b}_a + \tilde{d}_a)\bar{\gamma}_a + (b + \hat{d}) \sum_{i \neq j} c_i + (N - 1)(\tilde{b} + \bar{\beta}(\tilde{b}_a + \tilde{d}_a))\bar{p}_a \right] \end{aligned}$$

Summing both terms of the above formula and defining $C = \sum_{i=1}^N c_i$ we get:

$$\begin{aligned} (N - 1)\bar{p}^* &= \frac{1}{N2(b + \hat{d})} \left\{ (N - 1) + d(N - 1)N\bar{p} - (N - 1)N(b + \hat{d})\bar{\gamma} + (N - 1)N\bar{\beta}(\tilde{b}_a + \tilde{d}_a)\bar{\gamma}_a \right. \\ &\quad \left. + (b + \hat{d})(N - 1)C + (N - 1)N(\tilde{b} + \bar{\beta}(\tilde{b}_a + \tilde{d}_a))\bar{p}_a \right\} \end{aligned}$$

Which after some calculation gives us:

$$(85) \bar{p}^* = \frac{1}{2(b+\hat{d})} \left\{ \frac{1}{N} + d\bar{p} - (b+\hat{d})\bar{\gamma} + \bar{\beta}(\tilde{b}_d + \tilde{d}_d) \bar{\gamma}_d + (b+\hat{d})\frac{c}{N} + (\tilde{b} + \bar{\beta}(\tilde{b}_d + \tilde{d}_d)) \bar{p}_d \right\}$$

$$(86) \bar{p}^* = \frac{1}{2(b+\hat{d})-d} \left\{ \frac{1}{N} - (b+\hat{d})\bar{\gamma} + (b+\hat{d})\frac{c}{N} + (\tilde{b} + \bar{\beta}(\tilde{b}_d + \tilde{d}_d)) \bar{p}_d + \bar{\beta}(\tilde{b}_d + \tilde{d}_d) \bar{\gamma}_d \right\}$$

As we can see the mean price in the traditional sector is now a function of the advertising revenues in both markets, of marginal costs and of the price emerging in the digital market. The effect of these additional variables depends on the development of the digital market and on the sign of the externalities between markets. To complete the model we need to analyze the price emerging in the digital market. If we assume that all the firms entering the market are two-products firms, we have that, for each firm:

$$(87) \bar{p}_d = \frac{1}{2b_d\bar{\beta}} \left[\bar{\beta} \left(\frac{1}{m} + \tilde{b}_d \frac{1}{2(b+\hat{d})} \right) [\bar{s}_j + d\hat{p} - (b+\hat{d})(\bar{\gamma}-c_j) + (\tilde{b}_d + \tilde{d}_d) \bar{\gamma}_d + (\tilde{b} + \bar{\beta}(\tilde{b}_d + \tilde{d}_d)) \bar{p}_d] + \tilde{d}_d\bar{p} - b_d\bar{\gamma}_d \right]$$

Which after calculations gives:

$$(88) \bar{p}_d = \frac{1}{4b_d \left((b+\hat{d}) + \frac{d}{n} \right) - \tilde{b}_d(\tilde{b} + \bar{\beta}(\tilde{b}_d + \tilde{d}_d))} \left[\left[2(b+\hat{d}) + \frac{d}{n} \right] \left[\frac{1}{m} - b_d\bar{\gamma}_d \right] + \tilde{b}_d[\bar{s}_j + (b+\hat{d})(c_j - \bar{\gamma}) + \tilde{d}_d\bar{p} + \bar{\beta}(\tilde{b}_d + \tilde{d}_d) \bar{\gamma}_d] \right]$$

We know that at equilibrium all the firms will set a price equal to the mean price, so if the firms in the market are mixed, we have that:

$$(89) \bar{p}_d' = \frac{1}{m} \left\{ \frac{1}{4b_d \left((b+\hat{d}) + \frac{d}{n} \right) - \tilde{b}_d(\tilde{b} + \bar{\beta}(\tilde{b}_d + \tilde{d}_d))} \sum_{i \in m_1} \left[\left[2(b+\hat{d}) + \frac{d}{n} \right] \left[\frac{1}{m} - b_d\bar{\gamma}_d \right] + \tilde{b}_d[\bar{s}_j + (b+\hat{d})(c_j - \bar{\gamma}) + \tilde{d}_d\bar{p} + \bar{\beta}(\tilde{b}_d + \tilde{d}_d) \bar{\gamma}_d] \right] + \frac{1}{2b_d} \sum_{i \in m_2} \left[\frac{1}{m} - b_d\bar{\gamma}_d \right] \right\}$$

The price in the digital market depends positively on the market share of the entering firms in the traditional market. Having defined the model, we can treat the entry game comparing profits of entry with the profits of non-entry. The profit for the two products firm at equilibrium will be given by:

$$(90) \quad \pi_j^e = q_j^*(\bar{p}^*, \bar{p}_d^*)(p_j^* + \bar{\gamma} - c_j) + q_{j,d}^*(\bar{p}^*, \bar{p}_d^*, m^*)(\bar{p}_d^* + \bar{\gamma}_d) - F^{tot}$$

$$(91) \quad \pi_j^e = [\bar{s}_j - (b+d)p_j + d\bar{p} + \tilde{b}p_{j,d}](p_j^* + \bar{\gamma} - c_j) + \bar{\beta} \left(\frac{1}{m} - b_d\bar{p}_d + \tilde{b}_d p_j + \tilde{d}_d\bar{p} \right) (\bar{p}_d + \bar{\gamma}_d) - F - F_d$$

On the other hand, the profit for firm j if it does not enter the digital market is given by:

$$(92) \quad \pi_j^{ne} = q_j^*(p_{j,ne}^*, \bar{p}_d)(p_j^* + \bar{\gamma} - c_j) - F$$

$$(93) \quad \pi_j^{ne} = (\bar{s}_j - (b + d)p_{j,ne}^* + d\bar{p}_{ne}^* + \tilde{b}\bar{p}_d)(p_{j,ne}^* + \bar{\gamma} - c_j) - F$$

$$(94) \quad p_{j,e}^* = \frac{1}{2(b+\hat{d})} \left[\bar{s}_j + d\hat{p} - (b + \hat{d})(\bar{\gamma} - c_j) + \bar{\beta}(\tilde{b}_d + \tilde{d}_d)\bar{\gamma}_d + (\tilde{b} + \bar{\beta}(\tilde{b}_d + \tilde{d}_d))\bar{p}_d \right]$$

$$(95) \quad p_{j,ne}^* = \frac{1}{2(b+\hat{d})} \left[\bar{s}_j + d\hat{p} - (b + \hat{d})(\bar{\gamma} - c_j) + \tilde{b}\bar{p}_d \right]$$

$$(96) \quad p_{j,e}^* - p_{j,ne}^* = \frac{1}{2(b+\hat{d})} \left[\bar{\beta}(\tilde{b}_d + \tilde{d}_d)(\bar{p}_d + \bar{\gamma}_d) \right]$$

$$(97) \quad \pi_j^{ne} = \frac{1}{4(b+\hat{d})} \left[\bar{s}_j + d\hat{p} - (b + \hat{d})(\bar{\gamma} - c_j) + \tilde{b}\bar{p}_d \right]^2 - F$$

Substituting (91) in the profit function for the firm entering the digital market we obtain:

$$\begin{aligned} \pi_j^e = & \left(\bar{s}_j + d\hat{p} + \tilde{b}\bar{p}_d - (b + \hat{d}) \left(p_{j,ne}^* + \frac{1}{2(b + \hat{d})} [\bar{\beta}(\tilde{b}_d + \tilde{d}_d)(\bar{p}_d + \bar{\gamma}_d)] \right) \right) \left(p_{j,ne}^* + \bar{\gamma} - c_j \right. \\ & \left. + \frac{1}{2(b + \hat{d})} [\bar{\beta}(\tilde{b}_d + \tilde{d}_d)(\bar{p}_d + \bar{\gamma}_d)] \right) + \bar{\beta} \left[\frac{1}{m} - b_a\bar{p}_d + \tilde{d}_d\hat{p} \right] (\bar{p}_d + \bar{\gamma}_d) - F - F_d \end{aligned}$$

We can now impose our entry condition which is:

$$\pi_j^e \geq \pi_j^{ne}$$

Intuitively, the profit in the digital market should be higher than the entry cost plus the effect of externalities (recall that we still have not done any assumption on the sign of these externalities). This has an impact on the level of entry in the digital market. The marginal firm j that will enter the digital market is the one for which:

$$\pi_j^e - \pi_j^{ne} = 0$$

Substituting for $p_{j,e}^*, p_{j,ne}^*$ we have:

$$\begin{aligned} \pi_j^e - \pi_j^{ne} = & \left[\frac{1}{2} [\bar{s}_j + d\hat{p} + (b + \hat{d})(\bar{\gamma} - c_j) - \bar{\beta}(\tilde{b}_d + \tilde{d}_d)\bar{\gamma}_d + (\tilde{b} - \bar{\beta}(\tilde{b}_d + \tilde{d}_d))\bar{p}_d] - \frac{1}{2} [\bar{\beta}(\tilde{b}_d + \tilde{d}_d)(\bar{p}_d + \bar{\gamma}_d)] \right] \left[\frac{1}{2(b + \hat{d})} [\bar{\beta}(\tilde{b}_d + \tilde{d}_d)(\bar{p}_d + \bar{\gamma}_d)] \right] \\ & - \frac{1}{2} [\bar{\beta}(\tilde{b}_d + \tilde{d}_d)(\bar{p}_d + \bar{\gamma}_d)] \left(\frac{1}{2(b + \hat{d})} [\bar{s}_j + d\hat{p} + (b + \hat{d})(\bar{\gamma} - c_j) + \bar{\beta}(\tilde{b}_d + \tilde{d}_d)\bar{\gamma}_d + (\tilde{b} + \bar{\beta}(\tilde{b}_d + \tilde{d}_d))\bar{p}_d] \right) \\ & + \bar{\beta} \left[\frac{1}{m} - b_a\bar{p}_d + \tilde{d}_d\hat{p} \right] (\bar{p}_d + \bar{\gamma}_d) - F_d \end{aligned}$$

Which after calculations gives:

$$\pi_j^e - \pi_j^{ne} = \left[\frac{1}{2} [\bar{s}_j + d\bar{p} + (b + \hat{d})(\bar{y} - c_j) + \tilde{b}\bar{p}_d] - [\bar{\beta}(\tilde{b}_d + \tilde{d}_d)(\bar{p}_d + \bar{y}_d)] \right] \left[\frac{1}{2(b + \hat{d})} [\bar{\beta}(\tilde{b}_d + \tilde{d}_d)(\bar{p}_d + \bar{y}_d)] \right]$$

$$- \frac{1}{2} [\bar{\beta}(\tilde{b}_d + \tilde{d}_d)(\bar{p}_d + \bar{y}_d)] \left(\frac{1}{2(b + \hat{d})} [\bar{s}_j + d\hat{p} + (b + \hat{d})(\bar{y} - c_j) + \bar{\beta}(\tilde{b}_d + \tilde{d}_d)\bar{y}_d + (\tilde{b} + \bar{\beta}(\tilde{b}_d + \tilde{d}_d))\bar{p}_d] \right)$$

$$\pi_j^e - \pi_j^{ne} = \left[\bar{\beta} \left(\frac{1}{m} - b_d\bar{p}_d + \tilde{b}_d p_{j,e}^* + \tilde{d}_d\bar{p} \right) \right] (\bar{p}_d + \bar{y}_d) - \frac{3}{4(b + \hat{d})} [\bar{\beta}(\tilde{b}_d + \tilde{d}_d)(\bar{p}_d + \bar{y}_d)]^2 - F_d = 0$$

Rearranging (89) we have that:

$$\frac{1}{m} = \frac{F_d}{\bar{\beta}(\bar{p}_d + \bar{y}_d)} + \frac{3[\bar{\beta}(\tilde{b}_d + \tilde{d}_d)]^2}{4\bar{\beta}(b + \hat{d})} (\bar{p}_d + \bar{y}_d) + b_d\bar{p}_d - \tilde{b}_d p_{j,e}^* - \tilde{d}_d\bar{p}$$

This is the minimum share of the market that is required for firm j to enter the market. The market share required by the marginal firm depends negatively on the rate of development of the digital market in the start-up phase and positively on entry cost. While these results are straightforward, the effect of pricing, advertising revenues and physical market share depends on the amplitude of the externalities. Let's analyse the possible scenarios. We observe the variations in prices and number of firms entering the digital market as the digital market develops and as the external effects increase. First of all let's analyze the "start-up phase" of the new market, in which $\tilde{b} = 0$, $\tilde{b}_d + \tilde{d}_d \in [0; 1]$ and $\bar{\beta} \in [0; 1]$. This means that the price of the digital version does not affect the quantity sold in the physical market, while the diffusion of the brand in the traditional market has a positive (moderate effect) on digital sales. First of all, if $\bar{\beta} = 0$, meaning that the digital devices are not in the market we have $m^* = 0$ and we get back to the results of the initial situation in which the existing market is the traditional one. On the other hand, if $\bar{\beta} = 1$, meaning the digital market has reached the same level of development (i.e. same global demand) of the traditional one, we have that:

$$\frac{1}{m} = \frac{F_d}{(\bar{p}_d + \bar{y}_d)} + \frac{3[(\tilde{b}_d + \tilde{d}_d)]^2}{4(b + \hat{d})} (\bar{p}_d + \bar{y}_d) + b_d\bar{p}_d - \tilde{b}_d p_{j,e}^* - \tilde{d}_d\bar{p}$$

Proposition 4: in a context in which a firm operates in two equally fully developed markets (same S and $\bar{\beta} = 1$) with different structure, the optimal price for the new version is in the range:

$$(98) \bar{p}_d' \in \left[\frac{1}{2b_d} \left[\frac{1}{m} - b_d \bar{\gamma}_d \right]; \frac{1}{2b_d \left[(2(b+\hat{d}) - \frac{d}{n}) - \bar{\beta}_d (\bar{b}_d + \bar{d}_d) \right]} \left[2(b+\hat{d}) - \frac{d}{n} \right] \left[\frac{1}{m} - \frac{b_d}{\bar{\beta}} \bar{\gamma}_d \right] + \bar{b}_d [\bar{s}_j + (b+\hat{d})(c_j - \bar{\gamma})] + \bar{d}_d \bar{p} + \bar{\beta} (\bar{b}_d + \bar{d}_d) \bar{\gamma}_d \right]$$

Depending on the composition of the new market. If there is substitutability between the products ($\bar{b}_d > 0$) the optimal pricing strategy for the digital version depends positively on the share of the physical market and negatively on physical marginal costs. The first result is straightforward: the higher the marginal cost of producing the traditional good, the higher should be the differential in price with the digital good. The other results deserve some reflections. The intuition is that a firm with a high share of the market in the traditional market has an incentive to protect that market, relatively to a firm with an irrelevant share, which has an incentive to maximize its diffusion in the new market. Both effects become more important if the cannibalization between the two products is higher. This effect is then mitigated or increased by the differential in price elasticity in the two markets.

Let's analyze now the cases in which the new market exceeds the size of the traditional one $\bar{\beta} \in [1; \infty]$. If the digital market grows larger than the traditional one, it may become more profitable to shut down the traditional production. We can set a new condition which is:

$$\pi_j^s \geq \pi_j^e$$

$$(99) \quad \pi_j^s = \frac{1}{4b_d \bar{\beta}} \left[\bar{\beta} \left(\frac{1}{m} - b_d \bar{p}_d + \bar{b}_d p_j + \bar{d}_d \bar{p} \right) + b_d \bar{\gamma}_d \right]^2 - F_d$$

$$\pi_j^e - \pi_j^s = \frac{1}{4(b+\hat{d})} \left[\bar{s}_j + d\hat{p} + (b+\hat{d})(\bar{\gamma} - c_j) + \bar{b} \bar{p}_d \right]^2 - [\bar{\beta} (\bar{b}_d + \bar{d}_d) (\bar{\gamma}_d + \bar{p}_d)]^2 - F$$

Proposition 5: The condition for a complete cannibalization of the traditional market is:

$$\bar{\beta} = \pm \sqrt{\frac{[\bar{s}_j + d\hat{p} + (b+\hat{d})(\bar{\gamma} - c_j) + \bar{b} \bar{p}_d]^2 - 4(b+\hat{d})F}{4(b+\hat{d})[(\bar{b}_d + \bar{d}_d)(\bar{\gamma}_d + \bar{p}_d)]^2}}$$

or

$$[\bar{s}_j + d\hat{p} + (b + \hat{d})(\bar{y} - c_j) + \tilde{b}\bar{p}_a]^2 - 4(b + \hat{d})F < 0$$

If these conditions are respected, then the optimal strategy is to shut down the traditional market and concentrate on the digital one. Once again, these conditions are harder to be verified if the historical share of the market of the firm is higher.

Conclusions

In this paper we have studied the pricing issues raised by the development of a digital market in the magazine publishing industry. The originality of the problem is that it combines a large number of economic issues which have hardly been tackled at all together in one model. Magazine publishing is a two-sided market, since advertisers and consumers both concur to the sustainability of a publication's business model. Magazines are differentiated goods, since they are subject to copyright but they compete for the leisure time of consumers. The digital market represent an opportunity to better discriminate between consumers, but producing a digitized version of the physical magazine means introducing a potentially substitutable product in the market, thus externalities between markets must be taken into consideration. Finally, digitized versions are produced at negligible marginal costs through a different retailing network, introducing multi-channel distribution problem such as free-riding in the business model.

We have thus studied the pricing problems for publishers operating in one single market and for publishers operating in both the traditional and the digital market. We set up a simple model based on the hypothesis that while the traditional market has a history due to the investments of different publishing brands, the firms that start their activity in the digital market face the same market conditions. Among the results, we find that in the digital market the "free dailies" business model is sustainable only if the number of publishers is very limited or the advertising revenues are very large. Moreover, we find that publishers that are active in the traditional channel with relevant market shares

should “defend” their market share by setting higher prices for the digital versions of their products, in order not to devalue them and to reduce cannibalization between the two markets. On the other hand, publishers which starts operating directly in the digital market or publishers with irrelevant market shares may have an interest in offering their products for free to maximize the diffusion and their share of advertising revenues. As for the general market trends, we find that unless both the advertising revenues per copy and the total sales in the digital markets grow larger than in the traditional market, a traditional publisher should keep operating in the traditional market. In addition, if the total cannibalization grows to be more than proportional, namely if for each digital copy sold we lose more than one in the traditional market due to substitutability and copyright infringements, then the optimal strategy for a publisher can be not to produce the digital version of a given product. In this case, the publisher could choose a digital strategy with less negative externalities such as marketing a new digital product or a multi-support bundle.

Bibliography

Adams, William James and Janet L. Yellen. 1976. "Commodity Bundling and the Burden of Monopoly." *The Quarterly Journal of Economics*, 90(3), 475-98.

Bakos, Y. and E. Brynjolfsson. 1999. "Bundling Information Goods: Pricing, Profits, and Efficiency." *Management Science*, 45(12), 1613-30.

Baumol, William J.; John C. Panzar and Robert D. Willig. 1983. "Contestable Markets: An Uprising in the Theory of Industry Structure: Reply." *The American Economic Review*, 73(3), 491-96.

Bomsel, Olivier, 2013. "Copyright and brands in the digital age: Internalizing the Externalities of Meaning", *Contemporary Economic Policy*, Vol. 31, Issue 1, pp. 126-134, 2013.

Bomsel, Olivier, 2011. "Do you speak European ? Media Economics, Multilingualism and the Digital Single Market, *Communications and Strategies*, n°82, 2nd Q.

Buxmann, Peter; Jochen Strube and Gerrit Pohl. 2007. "Cooperative Pricing in Digital Value Chains : The Case of Online Music." *Journal of Electronic Commerce Research* 1 . 8 (2007) : pp. 32-40.

Chen, Yeh-ning and Ivan Png. 2003. "Information Goods Pricing and Copyright Enforcement: Welfare Analysis." *Information Systems Research*, 14(1), 107-23.

Chu, C.S.; P. Leslie and A Sorensen. 2011. "Bundle-Size Pricing as an Approximation to Mixed Bundling," *American Economic Review* 101(1), February 2011.

Chuang, J. C. I. and M. A. Sirbu. 2000. "Network Delivery of Information Goods: Optimal Pricing of Articles and Subscriptions". Cambridge, *MIT Press*, August 2000.

Deleersnyder, Barbara; Inge Geyskens; Katrijn Gielens and Marnik G. Dekimpe. 2002. "How Cannibalistic Is the Internet Channel? A Study of the Newspaper Industry in the United Kingdom and the Netherlands." *International Journal of Research in Marketing*, 19(4), 337-48.

Epstein, Jay. 2005. "The Big Picture: The New Logic of Money and Power in Hollywood," *Random House Publishing Group*, 2006

Hogendorn, Christiaan and Stephen Ka Yat Yuen. "Platform Competition with Must-Have Components." *The Journal of Industrial Economics*, Vol. 57, Issue 2, pp. 294-318, June 2009.

Jeon, D. S. and D. Menicucci. 2006. "Bundling Electronic Journals and Competition among Publishers." *Journal of the European Economic Association*, 4(5), 1038-83.

Joseph, Farrell and Klemperer Paul. 2007. "Co-Ordination and Lock-In: Competition with Switching Costs and Network Effects." *Handbook of Industrial Organization*, Elsevier, edition 1, volume 3, number 1, 00.

Katz, Michael L. and Carl Shapiro. 1985. "Network Externalities, Competition, and Compatibility." *The American Economic Review*, 75(3), 424-40.

Koukova, Nevena T.; P. K. Kannan and Brian T. Ratchford. 2008. "Product Form Bundling: Implications for Marketing Digital Products." *Journal of Retailing*, 84(2), 181-94.

Liebowitz, Stan J. and Stephen E. Margolis. 2001. "Network Effects and the Microsoft Case." *Dynamic Competition and Public Policy: Technology, Innovation and Antitrust Issues*. Cambridge: Cambridge University Press.

Matthew, Gentzkow. 2007. "Valuing New Goods in a Model with Complementarities: Online Newspapers." *American Economic Review*, *American Economic Association*, vol. 97(3), pages 713-744, June

Nalebuff, Barry. 2004. "Bundling as an Entry Barrier" *Quarterly Journal of Economics*, 2004

Nelson, Phillip. 1970. "Information and Consumer Behavior." *Journal of Political Economy*, 78(2), 311-29.

Olivier, Bomsel and Ranaivoson Heritiana. 2009. "Decreasing Copyright Enforcement Costs: The Scope of a Gradual Response." *Review of Economic Research on Copyright Issues* 6, 2 (2009) 13-29

Rochet, Jean-Charles. 2003. "Platform Competition in Two-Sided Markets." *Journal of the European Economic Association, MIT Press*, 1(4).

Rohlfs, Jeffrey. 1974. "A Theory of Interdependent Demand for a Communications Service." *The Bell Journal of Economics and Management Science*, 5(1), 16-37.

Shankar, V. and Bayus, B. 2002. "Network Effects and Competition: An Empirical Analysis of the Home Video Game Industry." *Strategic Management Journal*, 24 (2003), 375-384.

Simon, Daniel H. and Vrinda Kadiyali. 2007. "The Effect of a Magazine's Free Digital Content on Its Print Circulation: Cannibalization or Complementarity?" *Information Economics and Policy*, 19(3-4), 344-61.

Venkatesh, R. and Chatterjee, R. 2006. "Bundling, Unbuilding, and Pricing of Multiform Products: The Case Magazine Content." *Journal of Interactive Marketing*, 20(2), 21-40.