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The digital distribution of copyrighted contents: Categorization and evaluation of business models

Preliminary version

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I. Introduction[1]

Are DRM and copy-protection technologies a necessary condition to build viable business models in the digital distribution of contents? How to subsidize contents and online services in the current "everything is for free" environment? In fact, it proves very uneasy to tackle these questions due to the emerging pre-shakeout phase of online markets for contents (Handke, 2006). In particular, current services are supplied by competitors with similar capabilities and resources (giants from media, software and consumer electronics industries) and the success of pure players such as Google and eBay makes it very difficult to draw relevant forecast without strong methodology. Moreover, the recent literature dealing with this question (Regner et al., 2006, Gee & Lubomira, 2006, Einhorn & Rosenblatt, 2005…) essentially focuses on general well-known categories (DRM-based models versus alternatives ones), which, in fact, do not integrate the great variety and volatility of existing models.

The aim of this paper is to propose an original method to categorize the numerous emerging business models in the distribution of digital contents and to test their economic viability. We consider all online services whatever the associated technology, the financing model and the actual market share and/or audience. We focus on three kinds of contents: music, movies and online press. We combine three empirical tools: Case survey, hierarchical classification and econometric analysis.

This paper is organised in three major sections. The first one is concerned with surveying the literature on emerging business models and DRM economics. A particular focus of this section is to draw specific criteria to feature and test the economic viability of business models from theoretical analyses. The second section aims at identifying different groups of strategies in terms of services and (usage) rights offered by firms on the one hand and in terms of financing and marketing methods on the other hand. For this purpose, HAC and moving centres methods are implemented on the basis of observations made for more than a hundred cases of websites involved in the distribution of digital contents. The last section is devoted to the econometric analysis of the dynamics of the sector. A model is developed to estimate the market and/or audience share of each firm conditionally on her choice of strategies (Fok, Franses & Paap, 2003). In particular, we envisage the importance of DRM and copy-protection technologies regarding the economic 'success' of business models.

[1] This paper is part of a study supported by French Research National Agency (ANR-05-JCJC-0204-01), which consists in evaluating DRM-based models and alternatives in the fields of digital distribution of cultural goods.

II. Emerging business models and DRM economics

The first section surveys the literature on emerging business models and DRM economics. A particular focus of this section is to draw specific criteria to feature business models.

II.1. Digital distribution of contents

Distribution encompasses the activities required to get products from their producers to their users (consumers or retailers). It combines logistics functions with information and promotion services. A distribution strategy sets the goals and means implemented by producers (direct selling) or by middlemen (distributors) in terms of services, channels, number of intermediaries, consumer profiling and pricing, property rights transfer, and financing and retailing methods.

In general, manufacturers do not distribute their products themselves. In fact, distribution aims at bringing closer supply and demand by reducing five types of 'distance': (1) *Geographical distance*: Distribution permits to exploit scale and scope economies associated with transport and logistics and to minimise transaction costs incurred by consumers and retailers ; (2) *Delays between production and buying decision/consumption*: Distribution has several advantages such as stocking of products, which might represent prohibitive costs for manufacturers and permits to reduce significantly the delay of delivery of products ; (3) *Information asymmetries*: The costs of collecting information from consumers and retailers generally are much lower for distributors than for producers because the formers benefit from a direct contact with users and these ones reduce their seeking and information costs thanks to the research and selection of products operated by distributors ; (4) *Relation gap between producers and final users*: Distributors and dealers benefit from repeated relationship with retailers and customers so that positive effects are created such as reputation, confidence and habits, which appear to be often more valuable than promotion campaigns of producers ; (5) *Institutional distance*: The transfer of property rights on the products actually is made by distributors/retailers when they stock, manipulate, promote and sell the product in such a way that middlemen can implement service innovations and lead consumers to pay higher prices.

Electronic methods of distribution appear to be a powerful way to minimise these distances. In particular, do middlemen still have a role to play in the field of digital contents? The following table summarizes some of the strength and weakness of digital distribution.

"Distance"	Digital distribution of contents
Geography	- Suppression of geographical distance and proximity constraint (dematerialisation) - Mobility of contents rather than of individuals - However, cultural, legal and social distances could keep on prevailing.
Time	- Costs of storage and large exposure/diversified supply permit to exploit efficiently demand reversal and contents with little audience (the "long tail"). - But it is not true for all contents such as VOD (cost of large-band networks and technical fluidity).
Information	- Automation of collect and computation of information on consumers and consumption of contents thanks to DRMs and monitoring techniques, which confer a market power to those who control them. - Information proximity could also permit the entry of new competitors (for instance, Apple first produced iPod and then associated it with iTunesMS). - But such technical tools could induce consumers to protect their "data" and then new kinds of information asymmetries might be created.
Relation/contact	- ICTs could also be used to build services to (re)create relational proximity between producers/distributors and consumers, i.e. thanks to the so-called "web 2.0". For instance, in the music industry, the old function of record dealers could come back by implementing recommendation and relationship functions. - Information and relation functions could ensure a better integration of the new conditions of demand formation on the Internet by taking into account the new forms of social interactions and information dissemination, the new possibilities of use, and creating some addiction effects.
Institution	- As for intellectual property and contrary to traditional property rights, DRMs allow producers or middlemen to define the set of possible uses of their digital contents when consumers legally get them. This possibility is however constrained both by the copyright law and by the contract binding intermediaries with rights holders. The "usability" of contents actually depends upon the bargaining power along the chain of distribution.

However, the benefits associated with the digitalization of distribution process depend upon the ability of service providers to use ICTs in order to create value and/or to control the value chain. DRM systems can play a major role in protecting digital contents and networks.

II.2. The role of DRM systems

Digital contents are non-rival goods whose access and utilisation are difficult to control and give rise to high costs of exclusion. It proves easy and cheap to make copies of digital contents, without any loss of quality or features, and to share them instantaneously with many (unknown) people using Internet or mobile devices. Copyright and traditional enforcement appears somewhat insufficient not only to exclude non-payers but also to control and to measure uses of digital contents.

DRM tools aim at enabling transactions on digital contents by increasing costs incurred by copiers. It can be time, technical costs such as resources necessary for individuals to circumvent technical protection, as well as psychological costs, i.e. the risk to be identified and caught when using P2P networks. Cryptology, watermarking and monitoring techniques can be combined to control access of and to trace the uses made from digital contents. The first is the model of paying TV or VOD, whereas the second task remains somewhat potential apart from movies.

According to Dhamija & Wallenberg (2003), DRM systems carry out two mains tasks. The first one is to convert digital contents into rival goods. DRM serves to enforce legal or contractual conditions of uses as designed by rights holders. In particular, they aim at preventing consumers from transferring contents from computers to physical devices (carriers, portable media players…) or from sharing the digital contents over friendship or P2P networks. Yet, one major drawback is the underlying incentive to circumvent and to break the DRM protection. The second objective is to limit the benefits from digital contents to those who have paid for it, i.e. creating excludable goods. Watermarking and fingerprinting techniques enable some ex-post monitoring by singularising each copy made from a work. So, distribution of contents can be secured and monitored. For instance, set-top-boxes can filter copies according to the (personalised) marks embedded in them. In so doing, ISPs might play the role of digital retailers (Sobel, 2003). A more decentralised way to exclude non-payers is the use of automatic indexers bots (Web crawlers) for automating the tracking of infringing copies and illegal users on the Internet. However, this kind of DRM gives rise to privacy concerns but also to determine who incurs the costs of development and maintenance of such tools.

Finally, as suggested by Boldrin & Levine (2002), DRM-based models are not a necessary condition to stimulate the production of new contents (and to compensate the rights owners of existing contents). They consider downstream licensing (the right to control the uses made from digital contents) as an inefficient "intellectual monopoly". So another way to tackle the non-rivalry and non-excludability nature of digital contents is to exploit them. It could be either public intervention - for instance, the setting of compulsory licenses as suggested by Netanel (2003) or Fisher (2003) - or the development of new market solutions. In each case, the exclusive nature of copyright is mitigated and downstream licensing is suppressed in such a way that there is no need for anti-copying devices.

However, such a typology (creating rivalry/creating excludability/none of them) is somewhat basic. First, actual market solutions can combine the two aspects of creating rivalry and excludability. Secondly, alternative business models based on indirect appropriability can implement DRM in order to create rivalry. For instance, solutions based on advertising can require preventing users to swap contents when they are associated with personalised or targeted ads in order to be delivered only to a specific audience. Redistribution of such contents can annihilate the value of the promotion campaign if the subsequent recipients don't match with the targeted audience. In the same way, mass advertising based on a large audience can require a wide circulation of contents but only accessible on specific platforms hosting the ads. So redistribution among final users can be detrimental if it leads to

circumvent the advertising campaign[2]. Therefore, one question is to determine how DRM tools are implemented in actual (or potential) business models.

III.3. Business models

Several papers categorise emerging business models concerning the electronic distribution of contents. They all follow the same approach, that is to build general models from specific cases and then some look at the role of DRM systems.

Einhorn & Rosenblatt (2005) envisage how to integrate P2P technology in DRM-based business models. In so doing, they list business models in the music industry. Interestingly, they look at the *services* provided by the different cases they analyse. "Versioning allows consumers to choose among a number of service options instead of being confined to any one." So DRM tools are necessary for these new market solutions to be efficient by preventing resale and arbitrage between categories of consumers (see also Meurer, 1997). Competing online services are differentiated on the set of services they offer to consumers from burning and transferring options to recommendation, rating and personalised playlist functions. This paper enumerates music services and explains that despite the use of DRM, business models have evolved with regard to consumers' tastes. However, this study is essentially descriptive and doesn't take into consideration other competing factors in order to assess the viability and evolution of the listed services. It cannot serve to predict what and under what conditions combinations of services, rights, and pricing might be successful.

Other studies provide more precise criteria to differentiate business models and to assess their viability. Gee & Lubomira (2006) focus on the market for DRM systems. They suggest that the lack of interoperability results from a socially optimal differentiation of business models. In fact, DRM acceptability and switching costs borne by consumers are challenged by the variety of business models. Business models are classified according to the sources of revenue: sales of operating systems, sales of DRM-compatible hardware, sales of contents or Web traffic (advertising), DRM licensing. Business models range from the elementary case of DRM licensing (indirectly associated with contents distribution) to the Microsoft case (which associates the 4 sources of revenue). However, this study only considers only one criterion (the source of revenues) and it does not look at alternative business models.

Regner *et al.* (2006) envisages a larger spectrum of business models in the field of music industry. They make the hypothesis that ICTs permit to design new business models by decoupling the

[2] It could be not the case if mass advertising is integrated into the content. In this case, DRM is only needed as a measurement and reporting tool.

functions of payment and rights transfer (scope of authorised uses) from the actual distribution of contents. Thereby, they categorise different models between two polar cases. On the one hand, DRM-based retail models strictly link payments and rights (payment conditions access to and rights of use of contents). On the other hand, free access to contents associated with a compulsory levy. Between these two cases five models are identified and characterised by a decreasing link between payments and rights: (1) soft DRM; (2) variable pricing; (3) super-distribution; (4) voluntary contributions and (5) complement-based revenues. From these various studies, we elaborate the table 1 (figuring in Appendix) to distinguish business models.

Finally, all the surveyed studies use specific cases to derive general categories. For instance, iTunes represents the unit sale model, AOL In2TV the advertising model, and so on. However, such an approach suffers from lack of precision because it doesn't measure intra-models differences and inter-models similarities. Moreover, it allows neither to determine the empirical representativeness of such models (only the visible part of the iceberg might be analysed), nor to study the evolution of models by identifying the (potential) factors of success or failure. In the following section, we adopt another approach. We survey as many cases as possible and then we codify them according to various criteria with some of them derived from the above literature. Then, data analysis is applied to highlight clusters of cases that have some consistency.

III. Categorisation of business models

Our purpose is to identify distribution models of digital contents (music, videos, online press). More precisely, we categorise different groups of strategies in terms of services and usage rights offered by firms ("S&R") on the one hand and in terms of financing and marketing methods ("F&C") on the other hand. For this purpose, hierarchical ascendant classification and moving centres methods are implemented on the basis of observations made for more than a hundred cases of websites involved in the distribution of digital contents. So a first step is to test the dependence between the two subsets of variables (S&R and C&F) and in case of dependence, a second step consists in characterising the combination between F&C and S&R models.

III.1. Elaboration of typologies

A database was elaborated from a survey of 137 websites from which digital contents can be legally obtained. These cases were classified by using about twenty classification variables, essentially qualitative and binary. The information necessary to produce profiles can be of five types:

- "Rights": This group of variables corresponds to the scope of use, i.e. the set of rights granted to users by providers of digital contents and copyright owners (limitation and duration of usage,

portability, shareability…). Regner *et al* (2006) uses this kind of variables to evaluate the service and digital contents ("convenience of use")[3]. By contrast, our approach consists in applying this criterion to differentiate services.

- "Services": Other variables qualify the services themselves rather than the possibilities associated with contents once obtained. This kind of variables encompasses the size of the online catalogue, the diversity of titles, the presence of premium contents and complementary products, the degree of customisation of services, the interactivity… all features that are associated to the service of delivering digital contents and perceived by consumers as vectors of differentiation.

- "Financing": We also consider the appropriability methods used by the service providers to recoup their costs and to compensate rights owners. It can be the revenues from sales of contents or sales of complementary/ancillary products. It can be also the receipts from advertising and the exploitation/resale of personal data. Currently, there is a crucial debate about the viability of direct appropriability with regard to advertising revenues, which are supposed to be more suited to the "everything-is-for-free" digital environment.

- "Commercialisation": Another category of variables concerns the marketing and pricing of digital contents. Pricing and versioning according to the set of possible uses; with regard to consumers' tastes; paying or free access to contents ; with or without ads and exploitation of personal data; and so on.

- "Firm characteristics": Apart from the active variables of classification - the ones used to establish typology by crossing S&R and F&C models -, the other analysis variables (size, partnership, resources…) characterises the firms that supply the services. This set of variables is used in the section IV to test the impact of the choice of business model on the web audience of the service.

Insert Table 2

To categorise and analyze the various business models, typologies are created by using two hierarchical classification methods: on the one hand, Hierarchical Ascendant Classification (HAC) to obtain dendrograms and on the other hand, Moving Centres Classification (MCC) in order to consolidate the partitioning obtained thanks to HAC[4].

[3] However, in their study, prediction appears to depend mostly on the perception of the researcher. In fact, some individuals might prefer fewer rights but more ergonomic services to singularize themselves from others (for instance, the first consumers of iTunesMS). A more scientific approach requires a specific consumer survey like the survey INDICARE (2005).

[4] Indeed, the main drawback of HAC is that it doesn't necessarily produce the lowest intra-group inertia if the number of classes is fixed a priori. To solve this problem, we apply MCC with the centroids calculated through the HAC.

III.2. Analysis of distribution models

Unsurprisingly, the typologies we obtain correspond partially to the kinds of contents (music/video/press): Some classes encompass mostly specific kinds of contents and others don't include any case associated with a given kind of contents. Nevertheless, most of the identified models are mixed in terms of contents.

As for S&R variables, the five identified models differ according to the number of cases. This is explained by the fact that online press services are mainly included on the S&R5 model altogether with approximately half of the music services. This model is based on the easy access to contents in terms of technical and legal constraints. By contrast, strong legal and technical constraints characterize S&R3 model, which encompasses the other half of music cases and most of the video services. Other models are generated with atypical cases - S&R1 and S&R2 models - and/or with specific contents (especially video contents) - S&R2 and S&R4 models.

Insert Table 3

Concerning C&F models, the five identified models are also heterogeneous with regard to the number of cases. Apart from the C&F2 model, which is specific to the online press, the various models are more composite in terms of contents than the S&R models. The largest model is the C&F5 model, which differs from other models because direct payment of contents doesn't prevail. By contrast, C&F2, C&F3 and C&F4 models are based on direct appropriability and often by price discrimination. Finally, C&F1 model is made of two atypical cases based on viral diffusion.

Insert Table 4

We show a correlation between S&R models with C&F models, because a significant number of combinations are not verified. This dependence link is strongly confirmed by a chi-square test of independence. The chi-square statistic is 73.6468 (with 16 degrees of freedom), which is significantly higher than the critical level at 1%.

Given this dependence, we elaborate a typology of cases by crossing S&R models and C&F models. A new classification is made on the basis of qualitative variables stipulating to which S&R and C&F models each case belongs. Two crossed models ('global models') encompass most of the cases: G4 model obtained by crossing S&R3 (strong legal and technical constraints) with C&F3 and C&F4

models (direct appropriability) and G5 model mixing together S&R4 and S&R5 models (easy access to contents) with C&F4 and C&F5 (indirect appropriability).

Insert Table 5

IV. The evaluation of business models

This section examines the impact of business models on the web audiences of the surveyed cases in online press. We focus on this kind of digital contents because it represents the majority of the surveyed cases and by now, we collect the audience data for all these cases but not for all music and video cases. Moreover, if some dominant models prevail in terms of cases, atypical models of online press coexist and prove very interesting to analyse with regard to their relative performance.

IV.1. Data

The evaluation of business models proposed in this paper builds on data collected by *Alexa* for the measurement of the audience of internet sites[5]. *Alexa* computes traffic indicators based on a three months moving average of aggregated historical traffic data from millions of *Alexa* toolbar voluntary users. The main indicator developed and published by *Alexa* is "Traffic Rank" which yields the position of the site in interest with respect to all the sites on the web. The main drawback of this indicator for the present study is that we are interested in the position of each site of online press in our database with respect to the other sites in the same database, not all sites on the web. Therefore we rather used a combination of the indicators "Reach" and "Page Views per User".

The "Reach" indicator measures the percentage of all internet users who visit a given site. The "Page Views per User" are the average numbers of unique pages viewed per user per day by the users visiting the site. Note that multiple page views of the same page made by the same user on the same day are counted only once. Once multiplied, the "Reach" and "Page Views per User" indicators yield a measure of the total number of visits of pages belonging to a same site. A main advantage of this last measure is that it takes account of the fact that a user may visit a site only once but views numerous pages of this same site which means that the impact of the site is higher than if it contains a sole page. The product between "Reach" and "Page Views per User" has been computed for each online press site in our database and then divided by the sum for all sites in the database so as to obtain a measure of the audience share. These audience shares serve as a basis for the development of an econometric analysis of the performance of business models.

[5] See http://www.alexa.com/site/help/traffic_learn_more

IV.2. An audience share attraction model

Our assessment of the success or failure of the different business models identified in the previous part builds on a popular econometric model in marketing research which is the market share attraction model (Cooper and Nakanishi, 1988). Market share attraction models can easily been adapted to obtain audience share attraction model. We first present the general idea and then turn to a discussion of what make audience share attraction models slightly different from market share attraction models.

The basic idea of any market or audience share attraction model is to capture two main features of the explained variable, the market or audience share, namely

- Each share takes a real value between zero and one
- The sum of shares systematically amounts to one

In order to take account of these two features and, therefore, to obtain consistent forecasts for instance, the share S_i^t for firm i at time t is has to be defined as the ratio between its attraction $A_i^t \geq 0$ and the sum of attractions for all firms:

$$S_i^t = \frac{A_i^t}{\sum_{j=1}^{I} A_j^t} \qquad (1)$$

This result is referred to as the market share theorem (Bell *et al*, 1975). In our model, we suppose that the attraction for firm i at time t is a function of observed characteristics $x_{k\,i}^t$ (with $k = 1,\cdots,K$) of that firm at this time and of its strategic choices. The strategic choices of interest here are dummy variables $z_{l\,i}^t$ taking value one if firm i has adopted the business model l at time t where all the possible business models are those examined in part III. The only restriction on the functional form of attractions is that they take positive values to make sure that the share is also positive. A standard specification is the following Cobb Douglass functional form:

$$A_i^t = \prod_{k=1}^{K} x_{k,ii}^{t\ \alpha k} \exp\left(\sum_{l=1}^{L} \beta_l z_{l\,i}^t + \omega_i^t \right) \qquad (2)$$

where ϖ_i^t are Gaussian random shocks with mean zero and standard deviation σ. These random shocks typically measure the influence of unobserved characteristics. Note that if x_{ki}^t is a dummy variable, then it should not be introduced in the multiplicative term but in the exponential term and in a linear form similarly to the dummies of strategic choice variables z_{li}^t.

An audience share attraction model departs from a basic market share attraction model due to the fact that shares are generally not observed for the whole population but only for a sample of observations (i.e. the visits of websites by peoples registered on *Alexa* in our study). Since we are interested in the audience share for the whole population rather than for the sample, we need to explicit the link between the two shares. For this purpose, we assume that the number n_i^t of visits of a site i at time t given that we observe a sample of N_t visits of all websites at this time is drawn from a multinomial probability distribution. Accordingly, the probability to obtain a combination $\{n_1^t,\cdots,n_I^t\}$ of visits for the different sites at time t is given by

$$\Pr\left[\{n_1^t,\cdots,n_I^t\}\right] = \frac{N_t!}{\prod_{i=1}^{I} n_i^t!}\prod_{i=1}^{I} p_i^t \tag{3}$$

where p_i^t stands for the audience share for the whole population whereas the audience share for the sample is $S_i^t = n_i^t/N_t$. The likelihood of the audience share attraction model is then obtained on the basis of the joint distribution of the $\{n_1^t,\cdots,n_I^t\}$ and $\{\varpi_1^t,\cdots,\varpi_I^t\}$. At this stage, it is particularly worthwhile to rewrite the likelihood as follows:

$$L = \prod_{t=1}^{T} \Pr\left[\{n_1^t,\cdots,n_I^t\}\right] * f\left(\{\varpi_1^t,\cdots,\varpi_I^t\}/\{n_1^t,\cdots,n_I^t\}\right) \tag{4}$$

where $f\left(\{\varpi_1^t,\cdots,\varpi_I^t\}/\{n_1^t,\cdots,n_I^t\}\right)$ denotes the probability distribution of $\{\varpi_1^t,\cdots,\varpi_I^t\}$ conditionally on the knowledge of $\{n_1^t,\cdots,n_I^t\}$, or equivalently $\{S_1^t,\cdots,S_I^t\}$ since $S_i^t = n_i^t/N_t$. Hence, taking the natural logarithm and rearranging we obtain

$$\ln L = \underbrace{\sum_{t=1}^{T} \ln \Pr\left[\{n_1^t,\cdots,n_I^t\}\right]}_{\ln L_n} + \underbrace{\sum_{t=1}^{T} \ln f\left(\{\varpi_1^t,\cdots,\varpi_I^t\}/\{S_1^t,\cdots,S_I^t\}\right)}_{\ln L_S} \tag{5}$$

As outlined in this expression, the maximisation of the log-likelihood with respect to the shares p_i^t ($i = 1,\cdots,I$) and to the parameters involved in the attractions A_i^t ($i = 1,\cdots,I$) can be separated in two maximisation programs: the maximisation of $\ln L_n$ which yields an estimator of the p_i^t ($i = 1,\cdots,I$) and the maximisation of $\ln L_S$ which yields estimators of the parameters in the A_i^t ($i = 1,\cdots,I$). Moreover, one easily checks that the estimator of each p_i^t is $S_i^t = n_i^t / N_t$ and that the maximisation of $\ln L_S$ is the standard maximisation program to estimate the parameters in a market share model where the shares are those observed for the sample of visits rather than for the whole population.

IV.3. Estimation results

We now focus on the estimates of the parameters of attractions in the audience share attraction model and, thus, on the maximisation of $\ln L_S$ in (5) with respect to parameters β_l and α_k as introduced in (2). A peculiar feature of the model is that each attraction A_i^t can be multiplied by a same constant term without modifying the audience shares. In order to take this peculiar feature into account, we use the base brand estimation procedure proposed by Fok Franses and Paap (2001). These authors suggest subtracting the natural logarithm of the audience share of a base brand to the natural logarithm of the audience share of the other firms so as to obtain a set of $I - 1$ log-linear equations that can be easily estimated with maximum likelihood. Their method implicitly consists in a normalisation of the base brand attraction to unity.

In other to test the importance and contribution of the different set of variables used to explain the audience shares, we have examined three different specifications. In the first specification we consider that attraction for firm i at time t only relies on its previously observed audience share. The estimation results reported in Table 1 clearly suggest that the parameter associated with the past audience share amounts to one so that the dynamics of audience share is described by a kind of random walk process. Indeed, we can use the Delta Method to compute the corresponding expectation of each audience share given audience shares at the previous date. If we denote by $g(\omega^t_1,\cdots,\omega^t_1,\Theta)$ the expression $A_i^t(\omega^t_i,\Theta) \Big/ \sum_{j=1}^{I} A_j^t(\omega^t_j,\Theta)$ of audience share for firm i at time t where Θ is the vector

of estimated parameters, the linear approximation of $g(\omega_1^t,\cdots,\omega_1^t,\Theta)$ when $\{\omega_1^t,\cdots,\omega_I^t\}$ is a vector of zeros is given by

$$\begin{aligned} g_i(\omega_1^t,\cdots,\omega_1^t,\Theta) = {} & g_i(0,\cdots,0,\Theta) \\ & + g_i(0,\cdots,0,\Theta)(1 - g_i(0,\cdots,0,\Theta))\,\omega_i^t \\ & - \sum_{j\neq i} g_i(0,\cdots,0,\Theta)\,g_j(0,\cdots,0,\Theta)\,\omega_i^t\omega_j^t \end{aligned} \qquad (6)$$

Given that the ω_i^t are independently distributed with zero as expected value, the expectation and variance of $g(\omega_1^t,\cdots,\omega_1^t,\Theta)$ may be evaluated by the two following expressions:

$$E\left[g_i(\omega_1^t,\cdots,\omega_1^t,\Theta)\right] = g_i(0,\cdots,0,\Theta) \qquad (7.a)$$

$$\begin{aligned} V\left[g_i(\omega_1^t,\cdots,\omega_1^t,\Theta)\right] = {} & \left(g_i(0,\cdots,0,\Theta)(1 - g_i(0,\cdots,0,\Theta))\right)^2\sigma^2 \\ & - \sum_{j\neq i} g_i(0,\cdots,0,\Theta)\,g_j(0,\cdots,0,\Theta)\,\sigma^2 \end{aligned} \qquad (7.b)$$

According to (7.a), the expression of an audience share with null random shocks may be used as a forecast of this audience share, while the prediction errors are assessed by (7.b). If the previous audience share is the sole explanatory variable in the model and its coefficient amounts to one, then the forecasted audience share exactly amounts to the previously observed audience share. In this sense, the model corresponds to a random walk dynamics.

Insert Table 12

When extending the model by incorporating some general characteristics of the firms as explanatory variables (see Table 2), the estimated coefficient of the previously observed audience share decreases though it remains statistically not different from one. According to a log likelihood ratio test, the whole contribution of the new variables is not statistically significant. At the same time none of the corresponding estimated coefficients can be considered as significantly different from zero.

Insert Table 13

In the more complete models which take account of the strategic choices of the firms in terms of business models, the whole contribution of the strategic dummies seems to be not significant

compared with the intermediate model (and the basic one) according to a log-likelihood ratio test and, again, none of the corresponding estimated coefficients are significantly different from zero. This is true both when we introduce dummy variables taking value one for those sites of online press which do not belong to the main business model of commercialisation and financing for online press (C&F5 in Table 4) and dummy variables taking value one for those sites of online press which do not belong to the main global business model for online press (G5 in Table 5). In the first case results are reported in Table 14 whereas Table 15 displays the estimation results in the second case. In these two estimations we did not take account of non standard model corresponding to only one site of online press. Indeed, the estimated coefficient for the dummy variable then captures the residual term associated with non observed variables or errors for the site rather than the impact of the strategic choice of the model.

Insert Table 14

Insert Table 15

V. Conclusion

This paper highlights and qualifies some dominant business models that encompass most of the surveyed cases. Our results confirm the links between the financing methods and the services provided by firms. Some atypical models are identified too. But their relative performances in terms of audience prove not significant in the case of online press. Consequently, adopting alternative models doesn't explain the success or not of a website. In particular, we show something like a random walk associated with the audience of online press websites. The audience shares are somewhat unpredictable so that there is no past dependence. Some similarities with efficient market hypothesis seem to prevail here. It is not possible to significantly outperform the market by using any innovation or information that the market already knows, except through some random events.

Two extensions are envisaged. First, we will apply another method to categorise distribution models consisting in (1) highlighting archetypal efficient models from literature and (2) assessing their empirical significance (their "representativeness"). Two criteria will be used: The first one is to measure the statistical distribution of cases according to each archetypal model. But given that this criterion requires very general models to capture all the samples, a second criterion will be applied to calculate the statistical distance between each surveyed case and each archetypal model. This method will permit not only to weight the importance of each theoretical model but also to highlight new potential models if coherent groups clearly stand out from ideal models. Secondly, we will estimate an

econometric model for multiple choices (Greene, 1993) to identify the key features of firms that determine their choice of strategies among the two set of strategies previously defined.

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Appendix

Table 1: Business models derived from literature (preliminary version)

Appropriability	Source of revenue	DRM/rights	Pricing and marketing		Cases/literature
Direct	Per unit sales ("a la carte")	- Strong and robust protection (trusted computing) - Usage limited to private consumption	- Prices are set according to the elasticity of demand - Strong link between payment, distribution and access to the content.		VOD
		- Less robust protection - Scope of uses>the sole private consumption - Perhaps some tolerance for copying	- Limit-pricing: the price is fixed by taking into account of (1) demand elasticity (2) the cost of getting contents from illegal networks		iTunes MS Varian, 2004 Regner, 2004
			Superdistribution - Viral marketing/pyramidal selling (payment can stimulate the circulation of a given title)		Weed Rosenblatt, 2004
		- No anti-copying protection - Scope of uses maximum - Perhaps watermarking (tracing)	Limit-pricing according to the demand elasticity		eMusic iTunes MS-EMI
	Subscription	Ex ante exclusion (filtering)	- payment of a yearly/monthly fee to access freely to the catalogue of content - fixed price not linked to the actual consumption		SVOD Online press
	Voluntary contributions	Weak or no DRM systems	Purely voluntary gift - online tipping - Sponsoring		Jamendo
	Hybrid	- Exclusion - Perhaps some tolerance for copying	- Mix: Fixed price plus variable pricing - voluntary payment according or not to a given price range (the preferences of consumers determine the actual price) - sampling		Magnatune (label) Regner and Barria (2005)
Indirect	(Tying) sales of complementary/ancillary goods to end users	- Tracing uses - ex post exclusion or not (restricting or preventing redistribution in some cases)	- Sales of ancillary goods or services (concerts, hardware, software, subscription to services directly linked or not to the delivered contents…) - Digital contents serve to stimulate the sales of other product. - Tolerance for copying and sharing (all the more since the sales of the complementary good or service are positively correlated with a large circulation of contents.		Online press Grateful Dead (copying+concerts) Gayer & Shy (2004) Connolly & Krueger (2005) Einhorn & Rosenblatt (2005)
	Muti-sided markets - Sales of Web traffic (audience) - Sales of personal information	- Tracing uses - Restricting or preventing redistribution according to the models (for instance, targeted ads need to eliminate redistribution)	- Revenue from agents different from end users		- AOL In2TV, Joost, Pplive… - Microsoft/Google - Online press - Spiralfrog - YouTube, Dailymotion… - Moby (advertising) Gee & Lubomira (2006) Einhorn & Rosenblatt (2005)
	Search for reputation (new artists)	Open access with no or weak conditions (for instance, a form to fill in)	- Increase wages or better job		Online music: independents Online press: Blogs ?

Variables

Table 2 : Variables

"Services & Rights" variables	
Way to delivery contents	
Streaming	0 if yes, 1 if no
Downloadable	0 if yes, 1 if no
Physical media (CD, DVD, etc.)	0 if yes, 1 if no
Other (Podcast…)	0 if yes, 1 if no
Usability of contents	
Usable once	0 if yes, 1 if no
Limited usage	0 if yes, 1 if no
Unlimited usage	0 if yes, 1 if no
Limited duration	0 if yes, 1 if no
Unlimited duration ("permanent download")	0 if yes, 1 if no
Legally Reusable (as an input)	0 if yes, 1 if no
Legally shareable	0 if yes, 1 if no
Modifiable independently of content provider's will	0 if yes, 1 if no
Consumer implication	
Communication interactivity	0 if yes, 1 if no
Interactivity / personalized service	0 if yes, 1 if no
Loss leader (sampling, front page…)	0 if yes, 1 if no
Access time to contents	
immediate access (< 1 minute)	0 if yes, 1 if no
< 1 hour	0 if yes, 1 if no
< 24 hours	0 if yes, 1 if no
> 24 hours	0 if yes, 1 if no
high-speed constraint	0 if yes, 1 if no
Supply features	
Exclusive contents/ premium contents	0 if yes, 1 if no
Catalogue size (importance with regard to competitors)	0 if yes, 1 if no
General-interest (versus Thematic)	0 if yes, 1 if no
Obsolescence of contents	0 if yes, 1 if no
Diversified content providers	0 if yes, 1 if no
New titles	0 if yes, 1 if no
Digital multi-products	0 if yes, 1 if no
Not digital Multi-products	0 if yes, 1 if no
Terminal / mono-platform (vs. multi-platform) (TV/PC/mobile/portable device)	0 if yes, 1 if no
Proprietary format (Itunes-Ipod, Atrac Sony…)	0 if yes, 1 if no
Specific application (to access/consume contents)	0 if yes, 1 if no
Forwarding charges	0 if yes, 1 if no
Secondhand market	0 if yes, 1 if no

"Commercialisation & Financing" variables	
Financing	
Income for sales to consumers	0 if yes, 1 if no
Ads linked to contents/service	0 if yes, 1 if no
Ads not linked to contents/service	0 if yes, 1 if no
Targeted ads	0 if yes, 1 if no
Personal data (exploitation of)	0 if yes, 1 if no
Sales of complementary/ancillary goods and services (hardware, press subscriptions…)	0 if yes, 1 if no
Other	0 if yes, 1 if no
Marketing strategies	
Unit sale	0 if yes, 1 if no
Package	0 if yes, 1 if no
Included in billing (ISPs, mobile phone…)	0 if yes, 1 if no
Gift formula	0 if yes, 1 if no
Subscription	0 if yes, 1 if no
Viral model	0 if yes, 1 if no
Pricing	
2nd degree discrimination	0 if yes, 1 if no
3rd degree discrimination	0 if yes, 1 if no

Firm characteristics	
General features of the service provider	
Subsidiary	0 if yes, 1 if no
International activity	0 if yes, 1 if no
Outsourcing (distribution platform)	0 if yes, 1 if no
Key resources	
Catalogue of copyrights	0 if yes, 1 if no
Production competences	0 if yes, 1 if no
Trademark / Reputation	0 if yes, 1 if no
Distribution competences	0 if yes, 1 if no
Customers' portfolio / Installed base	0 if yes, 1 if no
Other	0 if yes, 1 if no

Data analysis

Table 3: Distribution of cases according to S&R models

	S&R1 model
Over-represented variables:	**Physical media, access time: >24h, forwarding charges, secondhand market**
Under-represented variables:	**Streaming, download, immediate access, new titles**
Typical cases:	boutique mk2, ultradisc
Video:	boutique mk2
Music:	ultradisc
Press:	-
	S&R2 model
Over-represented variables:	**Limited usage, limited duration, access<1hour, high-speed constraint, Proprietary format**
Under-represented variables:	**Unrestricted usages, unlimited duration, modifiable**
Typical cases:	document tv
Video:	free, canalplay, document tv
Music:	-
Press:	-
	S&R 3 model
Over-represented variables:	**Physical media, limited duration, access<1hour, Catalogue size, Diversified content providers, mono-platform, Specific application**
Under-represented variables:	**Legally Reusable, legally shareable, modifiable, Interactivity/personalized service, immediate access, premium content, general-interest catalogue, non-digital multi-products**
Typical cases:	cora music, systemeU
Video:	orange, ina, tf1 vision, France tvod, vodeo, virgin, glowria dvd, glowria vod, skouk, universcine, imineo, cinezime
Music:	e-compil, i-tunes, sony connect, fnac, virginmega, vitaminic, od2, neomusic, msn musiclub, tiscali musicclub, alapage, cora music, France loisir, orange jukebox, mtsonicselector, m6 musiclub, packardbell, systemeU
Press:	relay
	S&R 4 model
Over-represented variables:	**Other ways to get contents, legally reusable, access<1hour, high-speed constraint, Specific application**
Under-represented variables:	**Download, unlimited duration, modifiable, Communication interactivity, Loss leader, Non-Digital multi-products**
Typical cases:	dailymotion
Video:	arte, aol warner, youtube, dailymotion, mega upload, rapidshare, google video, myspace, m6 video, yahoo video, wat tv, noos net, alice vod, tps vod, paris premiere, abc, lesite tv, club internet, neuf vod
Music:	ratatium
Press:	lhumanite
	S&R 5 model
Over-represented variables:	**Download, unlimited duration, legally shareable, modifiable, Loss leader, immediate access, premium/exclusive contents, General-interest, obsolescence, Non-Digital multi-products**
Under-represented variables:	**Physical media, limited duration, Interactivity / personalized service, access<1hour, high-speed constraint, Diversified content providers, mono-platform, Specific application**
Typical cases:	lentreprise
Video:	-
Music:	starzik, klicktrack, e-music, e-classical, boxsonnet, musique harmonie, weedfrance, dogmazic
Press:	lefigaro, liberation, lemonde, lacroix, lesechos, latribune, lepoint, lenouvelobs, lavie, lexpansion, leparisien, historia, ouestfrance, lavoixdunord, lecanardechaine, lejournaldunet, linternaute, lejournaldesfemmes, infosciences, laviefinanciere, alternativeseco, aufeminin, letudiant, evene, caminteresse, capital, agoravox, googlenews, afp, eurosport, pleinchamp, actuenvironnement, 20minutes, agefi, argusauto, newsweb, automoto, boursier, challenge, cotemaison, culturefemme, football, geo, goal, journalauto, ladepechedumidi, lamontagne, largeur, lautojournal, lemague, lemondediplo, lentreprise, lestrepublicain, lexpress, lire, nautilus, nicematin, sport24, technoscience, telerama, terraeconomica, virginmega, votreargent

Table 4: Distribution of cases according to C&F models

	C&F1 model
Over-represented variables:	**Viral model**
Under-represented variables:	**-**
Typical cases:	skouk,weedfrance
Video:	skouk
Music:	weedfrance
Press:	
	C&F2 model
Over-represented variables:	**Unit sale, subscription, 2nd degree discrimination, 3rd degree discrimination**
Under-represented variables:	**-**
Typical cases:	leparisien
Video:	-
Music:	-
Press:	lemonde,lesechos,leparisien
	C&F3 model
Over-represented variables:	**Income from sales to consumers, Unit sale, package, Included in billing (phone,Internet…), gift formula, subscription, 2nd degree discrimination**
Under-represented variables:	**Ads not linked to contents, other financing methods**
Typical cases:	msn musiclub, tiscali musicclub, alapage, cora music, France loisir, m6 musiclub, systemeU
Video:	orange, France tvod, vodeo, canalplay, virgin
Music:	starzik, e-compil, fnac, virginmega, od2,neomusic, msn musiclub, tiscali musicclub, alapage, cora music, France loisir, orange jukebox, mtsonicselector, m6 musiclub, packardbell, systemeU
Press:	virginmega
	C&F4 model
Over-represented variables:	**Income for sales to consumers, personal data exploitation, package, subscription, 2nd degree discrimination**
Under-represented variables:	**Gift formula**
Typical cases:	sony connect
Video:	ina, free, glowria dvd, glowria vod, mega upload, rapidshare, m6 video, boutique mk2, noos net, alice vod, universcine, tps vod, imineo, cinezime, lesite tv, club internet
Music:	klicktrack, i-tunes, sony connect, e-music, vitaminic, ultradisc, e-classical
Press:	lefigaro, relay, liberation, lacroix, latribune, lepoint, lenouvelobs, ouestfrance, lavoixdunord, alternativeseco, capital, agefi, boursier, ladepechedumidi, lamontagne, lestrepublicain, lexpress, terraeconomica
	C&F5 model
Over-represented variables:	**Other financing methods**
Under-represented variables:	**Income from sales to consumers, personal data exploitation, Unit sale, package, Included in billing (phone,Internet…), gift formula, subscription, 2nd degree discrimination**
Typical cases:	aol warner, lejournaldesfemmes, 20minutes, largeur, lemague
Video:	arte, tf1 vision, aol warner, youtube, dailymotion, google video, document tv, myspace, yahoo video, wat tv, paris premiere, abc,neuf vod,
Music:	boxsonnet, ratatium, musique harmonie, dogmazic,
Press:	lhumanite, lavie, lexpansion, historia, lecanardechaine, lejournaldunet, linternaute, lejournaldesfemmes, infosciences, laviefinanciere, aufeminin, letudiant, evene, caminteresse, agoravox, googlenews, afp,eurosport, pleinchamp, actuenvironnement, 20minutes, argusauto, newsweb, automoto, challenge, cotemaison, culturefemme, football, geo, goal, journalauto, largeur, lautojournal, lemague, lemondediplo, lentreprise, lire, nautilus, nicematin,sport24,technoscience, telerama, votreargent

Table 5: Distribution of cases according to global models

	G1 model
Over-represented submodels:	**S&R1, C&F4**
Under-represented submodels:	
Typical cases:	boutique mk2, ultradisc
Video:	boutique mk2
Music:	ultradisc
Press:	-
	G2 model
Over-represented submodels:	**C&F1**
Under-represented submodels:	
Typical cases:	
Video:	skouk, weedfrance
Music:	skouk
Press:	weedfrance
	G3 model
Over-represented submodels:	**C&F2**
Under-represented submodels:	
Typical cases:	lemonde, lesechos, leparisien
Video:	-
Music:	-
Press:	lemonde, lesechos, leparisien
	G4 model
Over-represented submodels:	**S&R3, C&F3**
Under-represented submodels:	**S&R4, S&R5, C&F5**
Typical cases:	orange, France tvod, vodeo, virgin, e-compil, fnac, virginmega, od2, neomusic, msn musiclub, tiscali musicclub, alapage, cora music, France loisir, orange jukebox, mt sonicselector, m6 musiclub, packardbell, systemeU
Video:	orange, ina, tf1 vision, France tvod, vodeo, canalplay, virgin, glowria dvd, glowria vod, universcine, imineo, cinezime
Music:	starzik, e-compil, i-tunes, sony connect, fnac, virginmega, vitaminic, od2, neomusic, msn musiclub, tiscali musicclub, alapage, cora music, France loisir, orange jukebox, mt sonicselector, m6 musiclub, packardbell, systemeU
Press:	relay, virginmega
	G5 model
Over-represented submodels:	**S&R5, C&F5**
Under-represented submodels:	**S&R3, C&F3**
Typical cases:	boxsonnet, musique harmonie, dogmazic, lavie, lexpansion, historia, lecanardechaine, lejournaldunet, linternaute, lejournaldesfemmes, infosciences, laviefinanciere, aufeminin, letudiant, evene, caminteresse, agoravox, googlenews, afp, eurosport, pleinchamp, actuenvironnement, 20minutes, argusauto, newsweb, automoto, challenge, cotemaison, culturefemme, football, geo, goal, journalauto, largeur, lautojournal, lemague, lemondediplo, lentreprise, lire, nautilus, nicematin, sport24, technoscience, telerama, votreargent
Video:	arte, aol warner, free, youtube, dailymotion, mega upload, rapidshare, google video, document tv, myspace, m6 video, yahoo video, wat tv, noos net, alice vod, tps vod, paris premiere, abc, lesite tv, club internet, neuf vod
Music:	klicktrack, e-music, e-classical, boxsonnet, ratatium, musique harmonie, dogmazic
Press:	lhumanite, lefigaro, liberation, lacroix, latribune, lepoint, lenouvelobs, lavie, lexpansion, historia, ouestfrance, lavoixdunord, lecanardechaine, lejournaldunet, linternaute, lejournaldesfemmes, infosciences, laviefinanciere, alternativeseco, aufeminin, letudiant, evene, caminteresse, capital, agoravox, googlenews, afp, eurosport, pleinchamp, actuenvironnement, 20minutes, agefi, argusauto, newsweb, automoto, boursier, challenge, cotemaison, culturefemme, football, geo, goal, journalauto, ladepechedumidi, lamontagne, largeur, lautojournal, lemague, lemondediplo, lentreprise, lestrepublicain, lexpress, lire, nautilus, nicematin, sport24, technoscience, telerama, terraeconomica, votreargent

Table 6: Distribution of cases according to global model G1

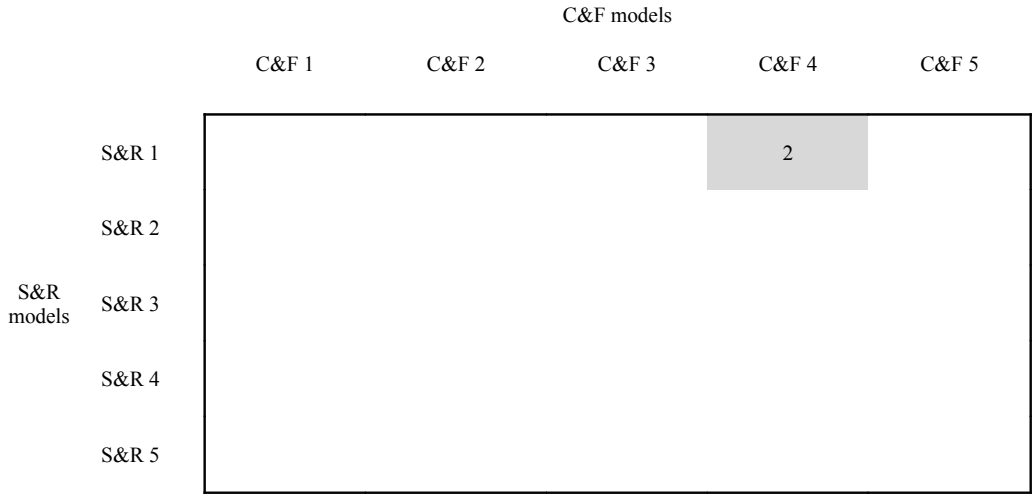

Table 7: Distribution of cases according to global model G2

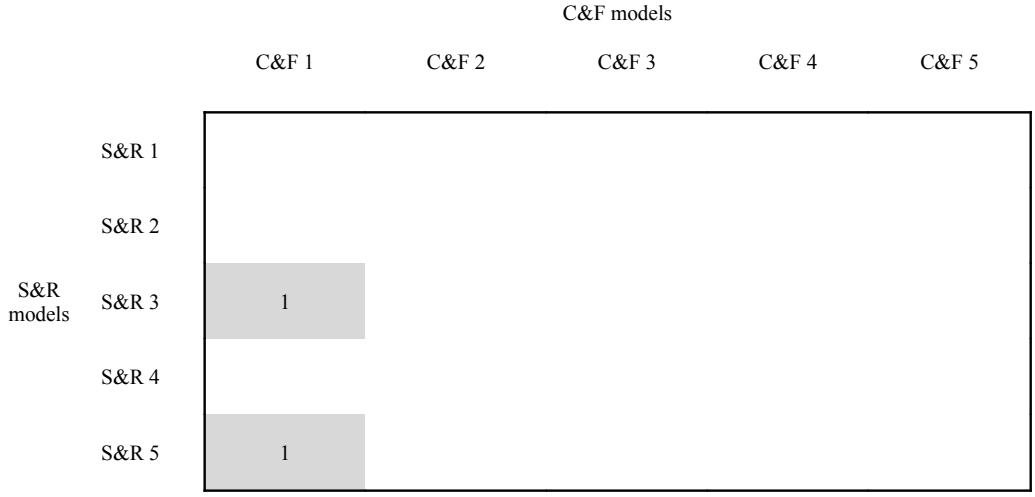

Table 8: Distribution of cases according to global model G3

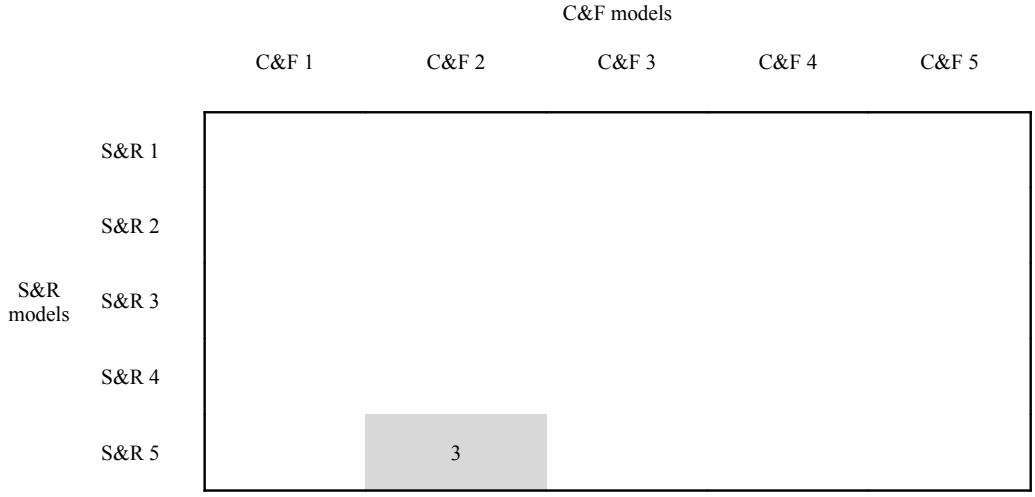

Table 9: Distribution of cases according to global model G4

S&R models \ C&F models	C&F 1	C&F 2	C&F 3	C&F 4	C&F 5
S&R 1					
S&R 2			1		
S&R 3			19	10	1
S&R 4					
S&R 5			2		

Table 10: Distribution of cases according to global model G5

S&R models \ C&F models	C&F 1	C&F 2	C&F 3	C&F 4	C&F 5
S&R 1					
S&R 2				1	1
S&R 3					
S&R 4				8	13
S&R 5				20	45

Table 11: Distribution of all cases

S&R models \ C&F models	C&F 1	C&F 2	C&F 3	C&F 4	C&F 5
S&R 1				2	
S&R 2			1	1	1
S&R 3	1		19	10	1
S&R 4				8	13
S&R 5	1	3	2	20	45

Econometric results

Table 12: Basic model

Explanatory variable	Estimated coefficient and standard deviation (in brackets)
Previously observed audience share	1.01133* # (0.01035)
Standard deviation of random shocks	0.620292
Log-likelihood	-56.9238

*: significantly different from zero at 5%
#: not significantly different from one at 5%

Table 13: Intermediate model

Explanatory variable	Estimated coefficient and standard deviation (in brackets)
Previously observed audience share	0.920398* # (0.01035)
Dummy "belongs to a group"	-0.121251 (0.160269)
Dummy "international activities"	0.163604 (0.225727)
Dummy "outsourcing"	0.137945 (0.684024)
Dummy "own rights"	-0.344866 (0.186224)
Dummy "know how for production"	0.126073 (0.273316)
Dummy "trade mark"	0.062759 (0.222483)
Dummy "know how for distribution"	0.065123 (0.366131)
Dummy "portfolio of costumers"	-0.000213 (0.181356)
Dummy "other competences"	0.381206 (0.309664)
Standard deviation of random shocks	0.613518
Log-likelihood	-51.7539

*: significantly different from zero at 5%
#: not significantly different from one at 5%

Table 14: Extended model (1)

(dummy variables for non standard models of commercialisation and financing)

Explanatory variable	Estimated coefficient and standard deviation (in brackets)
Previously observed audience share	0.914794* # (0.0471984)
Dummy "belongs to a group"	-0.123639 (0.163709)
Dummy "international activities"	0.169946 (0.239498)
Dummy "outsourcing"	0.147919 (0.698244)
Dummy "own rights"	-0.356986 (0.197271)
Dummy "know how for production"	0.131419 (0.282297)
Dummy "trade mark"	0.0503008 (0.237055)
Dummy "know how for distribution"	0.0940797 (0.383728)
Dummy "portfolio of costumers"	-0.00836788 (0.191239)
Dummy "other competences"	0.40622 (0.32678)
Dummy "business models C&F2"	0.167329 (0.421761)
Dummy "business models C&F4"	0.0138432 (0.215213)
Standard deviation of random shocks	0.624881
Log-likelihood	-51.8734

*: significantly different from zero at 5%

#: not significantly different from one at 5%

Table 15: Extended model (2)

(dummy variables for non standard global models)

Explanatory variable	Estimated coefficient and standard deviation (in brackets)
Previously observed audience share	0.920634* # (0.0523794)
Dummy "belongs to a group"	-0.134279 (0.171884)
Dummy "international activities"	0.161475 (0.230713)
Dummy "outsourcing"	0.154414 (0.698013)
Dummy "own rights"	-0.355451 (0.191083)
Dummy "know how for production"	0.153014 (0.301628)
Dummy "trade mark"	0.0488245 (0.229064)
Dummy "know how for distribution"	0.0724421 (0.386783)
Dummy "portfolio of costumers"	-0.0119307 (0.187724)
Dummy "other competences"	0.403757 (0.319646)
Dummy "business models G3"	0.147254 (0.402348)
Dummy "business models G4"	0.11997 (0.567269)
Standard deviation of random shocks	0.624622
Log-likelihood	-51.8482

*: significantly different from zero at 5%

#: not significantly different from one at 5%