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COMPETITIVE BEHAVIOUR IN THE
FRENCH SATELLITE PAY-TV MARKET**

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ABSTRACT

Monopoly Practises and Competitive Behaviour in the French Satellite Pay-TV Market*

This Paper uses monthly data from a differentiated market dominated by a duopoly to analyse the nature of interactions between competitor firms. The incumbent, Canal Satellite, and the entrant, TPS, have dominated the French satellite pay-TV market, characterized by a monopoly until the end of 1997. This Paper investigates the effects of the entry and tests for collusive behaviour by means of non-nested methods in this duopoly with differentiated products. The main findings reject collusive behaviours in favour of Stackelberg competition with the incumbent as the leader. A preliminary comparison with the UK satellite pay-TV market characterized by a monopoly indicates that prices are substantially lower in France. In view of our results, we argue that the difference can be explained by more competition between firms in the French case.

JEL Classification: L22 and L82

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1 Introduction

Since the beginning of the 1990s satellite pay-TV has played an increasingly important role in the broadcasting industry. In almost all countries consumers have now access to several hundred programs and various interactive services. This process is only accelerating with substantial progress in digital technology. While most satellite pay-TV markets in Europe are characterized by monopolies, in some cases rival firms compete with each other. French pay-TV market is an example of such competitive situation. However, even in markets with several firms, there is a risk of anti-competitive conduct. Whether the fruit of the technological progress is realized, or eliminated by anti-competitive conducts, is a question of central importance to economics. Not surprisingly, authorities such as the European Commission focus with great interest on competitive behavior in industries like pay-TV¹.

Much has been said and written on the nature and consequences of competition between firms in various industries. The merits as well as the limits of competition are relatively well documented in the economics literature. As far as pay-TV industry is concerned, however, the bulk of the literature focuses on the theoretical arguments on competition (see for example Armstrong, 1999; Harbord and Ottaviani, 2001). In addition, studies devoted to empirical verifications of day-to-day interactions between firms are quite rare. To the best of our knowledge, the existing studies focused on vertical integration in the US pay-TV market (Rubinovitz, 1993; Waterman and Weiss, 1996; Chipty, 2001).

The goal of this paper is to provide an empirical assessment of the nature of competition between two dominant (and a priori rival) firms in the French satellite pay-TV industry. The French satellite pay-TV market has been characterized by a monopoly until the end of 1997 when a second firm entered this market. Both the incumbent, CanalSatellite, and the entrant, Télévision par Satellite (TPS), organize their digital

¹See for instance, the European directive “Television without Frontiers” (89/552/EEC and 97/36/EC), which establishes the legal frame of reference for the free movement of television broadcasting services in the European Union.

offer around three main bundles containing channels relating to movies, sport and interactive services. This paper investigates the effects of the entry and tests for different (implicit or explicit) collusive behaviors by means of non-nested methods in this duopoly with differentiated products. Structural econometric models are estimated using monthly data from 1997 to 2002 on the number of subscriptions, subscription fees, advertising effort, discounts, number of channels and content as well as other exogenous variables characterizing the demand.

We find that despite the entry of a competitor the subscription price of satellite pay-TV in France did not decrease. However, the ‘quality’ (i.e. the number as well as the diversity) of programs substantially increased over time. Our empirical analysis show that an increase in the CanalSatellite price leads to a decrease in ‘quantity’ (i.e. the number of subscriptions) but for TPS an increase in price does not affect its quantity. Moreover, advertising expenses of each firm have a positive and significant impact on its own demand, but a negative (predatory) effect on its rival. Finally, the results of nonnested tests indicate that CanalSatellite is the leader and TPS the follower.

The rest of the paper is organized as follows. Section 2 provides a picture of the structure and the main actors of the French digital satellite pay-TV market. Section 3 describes the construction of the data set. Section 4 discusses the modelling strategy and presents the econometric frameworks used to estimate the model. Results of our empirical analysis and comments are provided in Section 5. Section 6 compares the French competitive situation with the British monopolistic satellite pay-TV industry. Section 7 concludes.

2 The French digital satellite Pay-TV market

With some oversimplifications the pay-TV industry can be described as having three sectors or layers (See Figure 1 in the Appendix). The production of programming constitutes the first sector (the upstream market). Producers in this sector obtains sports rights, produce movies as well as other “premium” programming. Typically, premium

programming corresponds to first run movies and major sport events. Access to these inputs are widely viewed as essential to attract new subscribers². Then comes retailing of programming to consumers (the intermediate market). In this sector programs are bought from producers at the wholesale level. And finally the distribution of programming to customers constitutes the third sector (the downstream market). The central ingredient of the industry is the encryption system and a set-top box in order to decode the scrambled signal. There are several encryption systems in the industry, and usually the system used for one encryption is not compatible with another encryption. The encryption system together with the set-top box is called the “Conditional Access System”. Naturally, there may be vertical integration, between the first and the second sectors, between the second and the third, or between the three sectors. In this paper we only focus on competitive interactions in the distribution sector in the French case.

France is the only European market where three digital satellite television platforms coexist. The two dominant firms, CanalSatellite and TPS, together with a third but minor company, ABSat, share the French digital satellite market³. In addition, the French market includes cable television or terrestrial pay-TV. Such a competitive situation can be expected to promote technological progress and benefit consumers given the increased pay-TV offer and more advantageous subscription conditions.

The pay-TV market has been identified as a separate one from the free-access television market, by the European Commission in its decisions⁴. Since pay-TV broadcasters are usually financed through subscription, the pay-TV market is distinct from free access television, which is usually financed by advertising or by State contributions⁵. Moreover, for cultural and linguistic reasons, the French geographic market can be viewed

²A second run movie will be regarded as a lower quality movie by the satellite subscribers. As a result, pay-TV broadcasters may be forced to reduce their subscription prices to differentiate accordingly.

³In December 2000, the market share of ABSat was less than 2% whereas the combined market share of the two dominant firms was over 98%.

⁴See for instance, Commission decisions 94/922/EC (IV/M 469-MSG Media Service), OJ L364, paragraph 32 and 33.

⁵The economics literature on free access television is large. Recent theoretical contributions include Anderson and Coate (2000) and Gabszewicz et al. (2002).

as a national market. In this paper a further distinction is made between digital satellite broadcasters and cable television or terrestrial pay-TV. These two types of pay-TV broadcasting channels are assumed to form separate markets. Admittedly, this assumption is a relatively strong one since cable pay-TV services are somehow substitutes to satellite pay-TV services. Nonetheless, for at least two reasons, one may consider the two markets as separate. The first reason is the geographic landscape of France, which except major urban areas is not well equipped with TV cable infrastructure⁶. The second reason rests in the differences regarding the content and the quality of the programs broadcast by these two sources. The satellite digital service is not only of a better quality but also is characterized by a larger diversity. As a result, in this analysis we confine our attention to the competitive behaviors of the two main actors, CanalSatellite and TPS⁷.

CanalSatellite launched a bouquet of analogue pay-TV channels broadcast by satellite since 1992. This service which ceased in October 1998 was replaced by a digital service launched in 1996. In 2002, Canal+, the first pay-TV firm in France since 1984, owns 66% of CanalSatellite and the remaining 34% are owned by Lagardère. 49% of Canal+ are owned by Group Canal+, fully-owned by Vivendi-Universal. TPS launched its digital platform for the distribution of satellite pay-TV programs and services in January 1997. In 2002, the ownership structure of TPS is divided into three shareholders: TF1 (50%), M6 (25%) and Lyonnaise satellite (25%).

Besides the basic bundle, each package of CanalSatellite and TPS offers a full range of specialist channels such as movies, children programs, sport events, music programs, and so on⁸. For CanalSatellite, consumers must subscribe to the basic offer or to the maximal offer in order to access to the movie offer. On the contrary, consumers can subscribe directly to TPS' movie offer. CanalSatellite and TPS do not employ the same

⁶In the MediaCabSat (2002) report, the share of subscriptions to cable-TV was about 35% for the period of January 2002 to May 2002 against 65% for Satellite pay-TV.

⁷As already mentioned, the third player, ABSat, only plays a minor role in the market given its marginal number of subscriptions.

⁸See Tables A2 and A4 for more details about the content and the number of channels.

encryption technology and do not market compatible decoder equipment. However, since the subscription and the renting of the set-top box are not expensive, and decoders compatible with both encryption technologies are more and more available, it is reasonable to assume that switching costs do not constitute a barrier for a consumer to churn⁹. As already mentioned, the quality of the movie offer depends on the number of the premium movies, considered as driver products to capture new consumers. Consequently we assume that the consumers' choice to subscribe to the movie offer is influenced by both the quality and the price. That is, on the downstream market, CanalSatellite and TPS are assumed to compete in (quality-adjusted) price. Their strategies consist of proposing to consumers a high quality movie offer at a low price.

CanalSatellite has two main advantages over its rival. First, it was the first company to offer a satellite digital bouquet. The initial investment constitutes a first mover advantage for CanalSatellite. Second, CanalSatellite also benefits from a reputational advantage, due to a substantial "catalogue" of French and American movies acquired by Canal+, which built its reputation on first transmissions of quality feature films. In addition, CanalSatellite has access to outside premium inputs, through its parent's network¹⁰. While this advantage in terms of consumers' preference should have decreased with the entry of TPS, the investments of the latter on the outside upstream market are negligible as compared to the incumbent to be taken into account as a relevant parameter. Quantitative information as regards the acquisition of exclusive pay-TV rights is not easily available. However, CanalSatellite appears to invest six more times in its programs' content as compared to TPS and in terms of the movie offer, the former has exclusive rights to broadcast 30 movies out of 32 listed on the box office (TéléSatellite, 143, p. 44). As noted by Harbord and Ottaviani (2001), acquiring exclusive rights to

⁹The rental cost of a set-top box varies from about 30% to 25% of the annual total subscription's costs at the end of the period and is the same for both firms. The entry costs (activation costs) at the end of the period represent about 11% the total subscription's costs for one year, 5.5% for two years, and so on.

¹⁰Vivendi Universal has co-financed a high number of lucrative movies with others majors Hollywood studios (Columbia, Disney, Warner, Fox and MGM).

premium programming (or sport events) gives competitive advantages over rival, which suffer a loss (negative externality).

The entry of TPS in the market was not considered by the European Commission as restricting competition. The European Commission noting the primarily pro-competitive effect of having a new operator, considered the entry of TPS on the market as not falling under Article 85(1) of the EC Treaty. However, the Commission noticed that two clauses included in the contract did restrict competition, in particular by limiting competitors' access to a certain type of contents, but that these clauses can be exempted under Article 85(3) of the EC Treaty for three years, which is the crucial period of TPS' launch¹¹.

Table A1 in the Appendix gives the market shares in terms of the number of subscriptions of CanalSatellite and TPS. The market share represents the penetration rate, which is the fraction of homes which have subscribed with a pay-TV operators. In practice, the European Commission has relied strongly on market shares in order to establish dominance. Firms are frequently declared dominant if they supply at least 40-45 per cent of the market¹². Given this definition and the market share of CanalSatellite, this firm can be considered as dominant on the French Satellite pay-TV market.

¹¹These clauses, which had originally been envisaged to remain in place for 10 years, grant to TPS: priority and the right of last refusal to broadcast channels and television services edited and controlled by its parent companies; and exclusive rights to distribute digitally the four general content channels TF1, France 2, France 3 and M6. The Commission considers in particular that the exclusive availability of these four general content channels on TPS is a differentiating feature and an appealing product which are essential for this new entrant to enter the pay-TV market.

¹²The European Court of Justice has defined the dominance in the United Brands case as : "a position of economic strength enjoyed by an undertaking which enables it to prevent effective competition being maintained on the relevant market by giving it the power to behave to an appreciable extent independently of its competitors, customers and ultimately consumers".

3 Data

The data set has been constructed for the period of January 1997 to December 2002 from raw data published by TeleSatellite, the French reference magazine for Satellite pay-TV programs and news. Each month, this magazine provides a detailed table including the subscription prices of the different options, i.e. bundles, for CanalSatellite and TPS as well as their content in terms of program channels. It is important to note that both firms frequently propose sales promotions that consist of price rebates and free subscription periods (in general one to three months for a one year subscription contract). All in all, these promotions represent about 20% of the subscription price. The variables constructed are the monthly number of subscriptions for both firms, the price of the subscription net of bonus or free periods and the number of channels for each bundle (basic option, movie option, thematic channels, pay per view movies and sport events)¹³. Furthermore, for the basic bundle, 6 groups of programs have been created on the basis of the description of each channel, and for each group the number of channels has been calculated for each month¹⁴.

Figure A2 and Table A3 in the Appendix give the evolution of the number and the net price of subscriptions over the period. Descriptive statistics for the main variables are reported in Table A4 in the Appendix. In order to take into account the level of advertising effort, a qualitative variable has been constructed. To that end, the number of advertisements for CanalSatellite and TPS has been counted and weighted by its size (1 for a full page, .5 for an half page, .25 for a quarter page, and so on) for each issue of the TeleSatellite magazine. Finally, additional macroeconomic variables such as the number of unemployed, an index of purchase power, and temporal dummies assumed to pick up seasonal effects have also been considered in the empirical analysis as additional control variables.

¹³TéléSatellite is the primary source for this information. Note that for the number of subscriptions, other sources on the internet (CanalSatellite and TPS websites, specialized reports, magazines,...) were consulted to check for consistency and to complete missing observations in a few cases.

¹⁴See Table A2 in the Appendix.

4 The Model¹⁵

4.1 Demand Functions

As already mentioned, the French digital pay-TV industry is dominated by two firms, the incumbent CanalSatellite and the entrant TPS together with a third player (ABSat) with a negligible, and declining over time, market share. Given that ABSat is clearly a competitive fringe, its market share was just slightly over 1 % during the period covered by this analysis, we focused on the two main firms.

CanalSatellite (resp. TPS) in the rest of the analysis is also denoted firm 1 (resp. firm 2). For analytical and empirical tractability, in this analysis we postulate a simple demand function. As a result, the residual demand function of firm i (resp. firm j) is assumed to have the following form (Gasmi and Vuong, 1991; Gasmi et al., 1992):

$$N_i = \gamma_{i0} + \alpha_{ii}p_i + \alpha_{ij}p_j + \gamma_{ii}A_i^{\frac{1}{2}} + \gamma_{ij}A_j^{\frac{1}{2}}, \quad i, j = 1, 2 \quad i \neq j \quad (1)$$

where N_i , p_i and A_i are firm i 's number of subscribers or "quantity", price, and advertising expenditures, respectively, and α 's and γ 's are the parameters of the model to be estimated. According to economic theory we expect $\alpha_{ii} \leq 0$, $\alpha_{ij} \geq 0$, and $\gamma_{ii} \geq 0$. Note that for simplicity advertising expenditures are assumed to be exogenous. One justification for this simplifying assumption is the limited number of observations at hand. By considering advertising as endogenous we would have two additional equations and at least six more parameters to be estimated. Since the total number of observations per firm is about 70, estimation of those additional parameters would considerably reduce the number of degrees of freedom. In addition, we do not have monthly data on the firms' precise expenditures, we only use a proxy variable. Clearly, with a larger data set and with more detailed observations it would be interesting to relax this assumption and estimate advertising as endogenous. The sign of γ_{ij} , $i \neq j$, is unclear because advertising has two opposing effects. The first is negative (predatory effect) while the

¹⁵The model is based on the one proposed by Gasmi et al. (1992).

second is positive (spillover effect). Depending on which effect is dominating the sign of this variable may be negative or positive.

The demand of the pay-TV industry, as it is often the case, is affected by a number of other exogenous variables. These exogenous variables are usually related to the economic environment such as variation in family budget and available time for leisure. As a result, the demand equation (4) contains a term, γ_{i0} , that captures the effect of outside environment on the firms' "quantity", i.e., number of subscribers,

$$\gamma_{i0} = \beta_{i0} + \beta_{i1}Y + \beta_{i2}D + \beta_{i3}U, \quad i = 1, 2 \quad (2)$$

where Y , D , and U denotes income, seasonal dummies, and unemployment, respectively. Obviously, an increase in family income will have, *ceteris paribus*, a positive effect on pay-TV demand. As a result, we expect a positive sign for β_{i1} . Also, since for a given level of income, unemployment should increase the demand for the type of leisure considered in this paper, we expect $\beta_{i3} \geq 0$. As far as the seasonal dummy is concerned, we expect lower than average demand in Summer and higher in Winter.

4.2 Cost Functions

As far as the cost functions are concerned, we assume that both firms use similar technologies. Again, following the literature (and for simplicity) we assume a constant marginal cost function $C_i(q_i) = c_i N_i$, $i = 1, 2$ where c_i is a function of input variables that are exogenous in the model.

$$c_i = \eta_{i1}B_i + \eta_{i2}F_i + \eta_{i3}S_i + \eta_{i4}O_i \quad i = 1, 2 \quad (3)$$

with B_i , F_i , S_i , and O_i denoting the number of basic channels, the number of premium movie channels, the number of sport channels and other channels such as music or shopping, respectively. Economic theory suggests $\eta_{ij} \geq 0$ $i = 1, 2$ and $j = 1, 2, 3, 4$.

Given the data set at hand, we use a simple functional form for costs. Note, however, that the cost function can, in principle, be a complicated and/or non-linear function, though it is not clear how much better results one can obtain by complicating the

analysis. Moreover, the econometric analysis of non-linear functions become very often non-tractable.

Given the demand and cost functions, firm i 's profit can be written as:

$$\pi_i(p_i, p_j) = (p_i - c_i)(\gamma_{i0} + \alpha_{ii}p_i + \alpha_{ij}p_j + \gamma_{ii}A_i^{\frac{1}{2}} + \gamma_{ij}A_j^{\frac{1}{2}}) - K_i - A_i \quad i = 1, 2 \quad i \neq j \quad (4)$$

where K_i is the fixed cost of operation for firm i . The two demand equations and the two first order conditions lead to a system of four equations to be estimated.

$$N_1 - \gamma_{10} - \alpha_{11}p_1 - \alpha_{12}p_2 - \gamma_{11}A_1^{\frac{1}{2}} - \gamma_{12}A_2^{\frac{1}{2}} = \epsilon_1 \quad (5)$$

$$N_2 - \gamma_{20} - \alpha_{21}p_1 - \alpha_{22}p_2 - \gamma_{21}A_1^{\frac{1}{2}} - \gamma_{22}A_2^{\frac{1}{2}} = \epsilon_2 \quad (6)$$

$$N_1 + v_{11}p_1 + v_{12}p_2 - \delta_{11}B_1 - \delta_{12}F_1 - \delta_{13}S_1 - \delta_{14}O_1 = \epsilon_3 \quad (7)$$

$$N_2 + v_{21}p_1 + v_{22}p_2 - \delta_{21}B_2 - \delta_{22}F_2 - \delta_{23}S_2 - \delta_{24}O_2 = \epsilon_4 \quad (8)$$

It is obvious that v 's and δ 's are functions of the structural parameters α 's, η 's.

4.3 Strategic Behaviors

To analyze the nature of competition on the French pay-TV market, we confine our attention to three types of strategic behavior: Competitive, Stackelberg and Collusive. We thus estimate three models of noncollusive behavior. The first model assumes that the two firms play Nash and compete *à la* Bertrand (on prices). The second model considers the Stackelberg model with CanalSatellite as leader and TPS as follower. The third model is similar to the second one but with TPS as leader and CanalSatellite as follower. In addition, we estimate a model of full (tacit) collusion between the two firms.

4.3.1 Competitive Model

Here, we assume that firms compete on prices. That is, each firm simultaneously chooses its price given the price of the rival. In other words firm i $\max_{p_i} \pi_i(p_i, p_j)$. The strategy thus played by the firms leads to the competitive (Nash) equilibrium. We therefore impose the following restrictions to the model: $v_{ii} = \alpha_{ii}, i = 1, 2$ and $v_{12} = v_{21} = 0$ ¹⁶.

4.3.2 Stackelberg Model

In this sequential game, first CanalSatellite chooses its strategy and then the follower, after observing the price of CanalSatellite, reacts. As usual, in this kind of games, the model is solved by backward induction. The first order condition of the follower is given as before. Firm 2 $\max_{p_2} \pi_2(p_1, p_2)$ which gives its reaction function to the leader price: $R_2 \equiv p_2 = \frac{1}{\alpha_{22}}c_2 - \frac{1}{\alpha_{22}}N_2$. The first order condition for the firm 2 (*FOC2*) is as before. On the other hand, the leader maximizes its profit which takes into account the reaction function of the follower $\max_{p_1} \pi_1(p_1, R_2(p_1))$

The first order condition for the leader (*FOC1*) is now different, and is given by $(p_1 - c_1)h_0 + h_0p_1 + h_1\gamma_0 + h_2A_1^{1/2} + h_3A_2^{1/2} + h_4c_2 = 0$, or after solving for p_1 :

$$p_1 = \frac{1}{2}c_1 - \frac{h_1}{2h_0}\gamma_0 - \frac{h_2}{2h_0}A_1^{1/2} - \frac{h_3}{2h_0}A_2^{1/2} - \frac{h_4}{2h_0}c_2 \quad (9)$$

where

$$h_0 = \alpha_{11} - \frac{\alpha_{12}\alpha_{21}}{2\alpha_{22}}$$

$$h_1 = 1 - \frac{\alpha_{12}}{2\alpha_{22}}$$

$$h_2 = \gamma_{12} - \frac{\alpha_{12}\gamma_{21}}{2\alpha_{22}}$$

$$h_3 = \gamma_{22} - \frac{\alpha_{12}\gamma_{22}}{2\alpha_{22}}$$

$$h_4 = \frac{\alpha_{12}}{2\alpha_{22}}$$

¹⁶The second order condition implies that the matrix $\begin{bmatrix} 2\alpha_{11} & \alpha_{12}\alpha_{21} \\ \alpha_{12}\alpha_{21} & 2\alpha_{22} \end{bmatrix}$ should be semi definite negative.

We thus have a system of four equations containing the two demand equations together with the two *FOC*'s. Next, we consider the Stackelberg model with firm 2 as the leader.

4.3.3 Collusive Model

In the collusive model we assume that the cartel maximizes the joint profits of the firm $\max_{p_1, p_2} \frac{1}{2}\pi_1(p_1, p_2) + \frac{1}{2}\pi_2(p_1, p_2)$. Note that for simplicity, this cartel is assumed to give equal weight to firms. The profit maximization by the cartel yield the two following *FOC*'s:

$$p_1 = \frac{1}{\alpha_{11}}c_1 - \frac{1}{\alpha_{11}}N_1 - \frac{\alpha_{21}}{\alpha_{11}}p_2 + \frac{\alpha_{21}}{\alpha_{11}}c_2 \quad (10)$$

$$p_2 = \frac{1}{\alpha_{22}}c_2 - \frac{1}{\alpha_{22}}N_2 - \frac{\alpha_{12}}{\alpha_{22}}p_1 + \frac{\alpha_{12}}{\alpha_{22}}c_1 \quad (11)$$

As before the two demand equations with these *FOC*'s gives us a system of simultaneous equation that can be estimated using a linear, e.g. two-stage least squares (2SLS) or non-linear method, e.g. Full information maximum likelihood (FIML) or three-stage least squares (3SLS). Note that given the number of equations and exogenous variables one can easily show that the system is identified.

5 Econometric results

The four systems of structural equations, where some equations contain endogenous variables among the explanatory variables have been estimated by 3SLS. The main results are reported in Table A5 in the Appendix.

The trend variable is always highly statistically significant with a positive sign. This result indicates that the prices of both rivals is increasing over time, which can be explained by the fact that firms are in an early stage of their industrial development. Indeed, CanalSatellite started its business in 1992 and TPS was launched in 1997. This

results confirms the patterns of the number of subscriptions shown in Figure A1 in the Appendix. The industrial production index is introduced as a control variable to capture the effects of business cycles. The estimated coefficients associated with this variable are never significant. Regarding seasonal dummies, only the third quarter is significant with a negative sign. Typically, this period corresponds to a lower economic activity combined with holidays and as a result the number of people subscribing to digital TV services is lower.

Interestingly, advertising variables are highly significant and have the expected sign across models and for both firms. That is, a firm's advertising effort always increases its own demand but decreases its rival's demand. More importantly, our main variable of interest, the prices of the subscription to digital programs is significant for CanalSatellite with the expected (negative) sign, that is an increase of CanalSatellite subscription fee has a negative effect on its demand of subscriptions. The subscription's price of TPS is not significant though it has the expected negative sign. This finding is not very surprising since this firm only recently entered this market and its prices have always been lower than the ones observed for CanalSatellite¹⁷.

On the whole, the results reported in Table A5 show that the estimates of the different models are highly similar. The different goodness of fit's statistics (adjusted R-squared and F-stat) for the system of demand equations and first order conditions do not allow one to reject a model against a different one. As an alternative, the four alternative competitive behaviors have been tested against each other by applying tests for nonnested hypotheses proposed in Vuong (1989). These tests depart from the log-likelihood ratio statistic LR adjusted by a correction factor ξ_n that penalizes each model for complexity in terms of the number of estimated parameters and normalized by \hat{w}_n .

Formally, the adjusted LR statistic is given by:

$$n_n^{-\frac{1}{2}} \widetilde{LR}_n \left(\hat{\beta}_n, \hat{\gamma}_n \right) / \hat{w}_n \quad (12)$$

where

¹⁷A second explanation is a statistical one, the number of observations is rather low despite the fact that montly data are available.

$$\widehat{w}_n = \sqrt{\frac{1}{n} \sum_{i=1}^n \left[\log \frac{f(y_i/x_i; \widehat{\beta})}{g(y_i/x_i; \widehat{\gamma})} \right]^2 - \left[\frac{1}{n} \sum_{i=1}^n \log \frac{f(y_i/x_i; \widehat{\beta})}{g(y_i/x_i; \widehat{\gamma})} \right]^2} \quad (13)$$

$$\widetilde{LR}_n = LR_n(\widehat{\beta}_n, \widehat{\gamma}_n) - \xi_n \quad (14)$$

$$\xi_n = - \left[\left(\frac{p}{2} \right) \log n - \left(\frac{q}{2} \right) \log n \right] \quad (15)$$

p and q are the number of parameters in models f and g and n is the number of observations¹⁸. As shown by Vuong (1989), the test statistic is asymptotically standard normal under the null hypothesis, i.e. both models are equivalent.

The results of the Vuong tests are reported in Table A6 in the Appendix. It follows from this table that the Competitive Nash behavior is rejected in favour of the two Stackelberg models. The nonnested test for these two models reject the second model, i.e. the model where TPS is the leader and CanalSatellite the follower. As regards the tacit collusion, the test statistics is inconclusive as regards models 2 and 4, but at the 5% level, the test reject the collusive behavior in favor of the Stackelberg one where CanalSatellite is the leader and TPS the follower. Hence, both firms appear to behave according to a Stackelberg leader-follower setting, the leader being CanalSatellite and the follower TPS. Here again, this result is not unexpected given that TPS is a new entrant which reached its break-even point in October 2002¹⁹.

CanalSatellite, on the other hand benefits from its longer presence in this market as an incumbent and from its reputation as well as from its parents' relationships.

¹⁸This correction factor for the number of estimated parameters is the one proposed in Schwartz (1978). Other penalty functions can be considered (Akaike, 1973 or Hannan and Quinn, 1979). These alternative correction factors have been estimated but do not change the conclusions as regards the models' selection process.

¹⁹Télé Satellite, number 155, p. 32. For CanalSatellite the break-event was reached in September 1999; source: Télé Satellite, number 118, p. 14.

6 A comparison with the British case

To have an idea about the consumers welfare one can compare the French competitive situation with a country characterized by a monopoly. Does such country exist? And if so, does a cross country static comparison make any sense? The answer to the first question is a qualified yes. Several countries in Europe has only a single digital satellite pay-TV operator. However, the answer to the second question is not that clear. The problem with a cross country comparison is that there are several factors that have an impact on the firms strategic behavior. Size for example is an important factor. A country with a large population size may benefit from higher return to scales. The benefit may be such that the consumers welfare is even larger than a small country with a high level of competition. The regulatory framework, e.g. competition policy, is another factor. Obviously the list of factors is long.

Nonetheless, we cannot resist in comparing the situation in France to that of the Great Britain. On several dimensions, the Great Britain is similar to France. But unlike France, the Great Britain is characterized by a single operator in the digital satellite pay-TV market.

The pay-TV industry in Britain started in 1989 when the two networks, Sky and British Satellite Broadcasting (BSB) were licensed.²⁰ The two companies used different satellites, and as a result, separate satellite dishes were required to receive both signals. Both companies tried to gain subscription by obtaining exclusive movie rights from Hollywood studios. In 1990 Sky merged with British Satellite Broadcasting, and the combined firm was named BskyB. BskyB had about 2.1, 3.1, and 3.4 million subscribers in 1994, 1996 and 1998, respectively.

A first comparison in Table 1 shows that the prices of basic packages are almost identical not only within a country (France) but also across countries. However, the prices of the premium packages are very different across firms. As expected the UK has the most expensive premium package. While it is true that the Sky's premium

²⁰See Armstrong (1999) for more details on satellite pay-TV in Britain.

package contains a larger number of movie channel, but that fact alone cannot justify the price difference between Sky and CanalSatellite. Probably the quality of the premium programs offered by the Sky might be so high that can justify the price differential. In view of our analysis, we argue that the competitive force that characterize the French market can explain this difference²¹.

Table 1. Comparison between France and UK

	BskyB (UK)		CS ^a (FR)		TPS (FR)	
	min ^b	Max ^c	min ^d	Max ^e	min ^f	Max ^g
Premium Movies ^h	0	12	0	11	0	7
Premium Kids ^h	0	4	0	9	0	3
Premium Sports ^h	0	4	0	7	0	7
Price (EUR)	17	54	17	35	17	33

Note : *a*CS is CanalSatellite; *b*Sky Entertainment Package; *c*Sky World;

*d*CanalSatellite Thematiques; *e* Grand Spectacle; *f*TPS Théma; *g*TPS Maximal;

*h*entries are the minimum/maximum number of channels in the beginning of 2003.

7 Concluding Remarks

The main objective of this paper is to provide an empirical assessment of the nature of competition between two dominant rival firms in the French satellite pay-TV industry, CanalSatellite, the incumbent, and TPS, the entrant. Structural econometric models are estimated using monthly data from 1997 to 2002 gathering information on the number of subscriptions, subscription fees, advertising effort, discounts, number of channels and content as well as other exogenous variables characterizing the demand. These models reflect different competitive behavior, i.e. Nash-Bertrand, Stackelberg and tacit collusion, and can be tested by means of tests for nonnested hypotheses. Such an exercise ask for a careful and modest interpretation of the main results obtained given a certain

²¹The UK may not be the best country for such a comparative exercise, mainly because of the exchange rates changes and the higher cost of living in this country. A first look at the Italian market, which is also characterized by a monopoly, Sky Italia, confirms our conclusions. In future work, it will be interesting to systemically extend the comparison with more countries and time periods.

number of assumptions on which they hinge. First, the pay-TV market in France has been assumed to form a separate one from the cable-TV market. Though the share of the latter is small as compared to the former, and both services are rather different in terms of their contents, such a hypothesis may appear as restrictive if consumers can substitute one service to the other. Second, given data constraints, it has not been possible to endogenize advertisement efforts. Such activities, however, are a main component of non-price competition. Third, the functional forms of the demand and the cost functions are rather basic. Here also, data availability constraints, in particular the number of observations, prevent investigating more general functional forms.

Despite these limitations, the main empirical findings indicate that the subscription price of satellite pay-TV in France did not decrease after the entry of TPS in this market. The substantial increase of programs suggests that competition is mainly driven by reactions in quality-adjusted quantity between the leader (CanalSatellite) and the entrant (TPS). Furthermore, advertising expenses of each firm have a positive and significant impact on its own demand, but a negative (predatory) effect on its rival. Finally the results indicate that an increase in the CanalSatellite price leads to a decrease in ‘quantity’ (i.e. the number of subscriptions) while for TPS an increase in price does not affect its quantity. We explain these findings by the history of both competitors. CanalSatellite started its business in 1992 in this industry and benefits from a reputation that allow this firm to maintain higher prices. On the other hand, TPS, through lower price and a continuous improvement of the quality and diversity of its programs, has been able to attract new subscribers and as a result to increase his market share. However, given its recent entry in this market, this firm has not yet reach its break-even point which prevent her to behave more aggressively by proposing lower prices.

In terms of welfare, a preliminary investigation of the French and the UK pay-TV markets, which is characterized by the presence of a single monopoly, clearly shows a price differential in favour of France, even after controlling for quality differences. This observation supports the idea that competitive pressures are higher in France. In our future research agenda, we will explore these results more systematically by collecting

time series data on prices and quality for the British pay-TV firm and by implementing hedonic regressions to compare price differences in both markets. Another extension of the analysis is to take into account the vertical structure of this industry. As discussed before, CanalSatellite, through its parent network, appears to benefit from lower input prices given its vertical agreements with upstream movies suppliers. Here, the welfare effects are ambiguous, lower inputs' costs could be translated into lower subscriptions' fees given the existing level of competition. On the other hand, vertical restrictions, e.g. foreclosure, could lead to exclusionary practices, i.e. full access to high premium movies or sport programs denied to competitors. It would also be interesting to examine the existing regulations, e.g. The EU Audiovisual policy, with that respect and test how they interact with these practices.

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Appendix

Table A1. Market shares of CanalSatellite and TPS

	CanalSatellite		TPS		TOTAL
	Number of subscriptions (mio)	Market share	Number of subscriptions (mio)	Market share	Number of subscriptions (mio)
1993	0.1	100%			0.10
1994	0.21	100%			0.21
1995	0.3	100%			0.30
1996	0.45	100%			0.45
1997	0.78	70.9%	0.32	29.09%	1.12
1998	1.1	64.3%	0.61	35.67%	1.71
1999	1.37	62.3%	0.83	37.73%	2.20
2000	1.62	61.8%	1.00	38.17%	2.62

Source: AVICAM/CSA – Direction des études et de la prospective (Lettre du CSA, n°146-1, Décembre 2001, p.2)

Table A2. Content by category of programs of the basic bundle, CanalSatellite and TPS as of end of 2002

CanalSatellite		TPS	
Entertainment			
13e Rue	Movies	AB Moteurs	Motors
AB 1	Movies	Bandiagara	Games
Canal Festival Dauville	US film festival	BBC Prime	Entertainment
Canal Jimmy	Children	Escales	Tourism
CanalJ	Children	Festival	Movies
Canalsat Jeux	Games	France Supervision	Sport
Cartoon Network	Children	Game one	Games
Comédie	Humor	Gourmet TV	Culinar
Fashion TV	Fashion	Histoire	History
Forum Planète	Debates	knowledge TV	Education
Fox Kids	Children	KTO	Religion
Game one	Games	La Chaîne Sud	Family
Gourmet TV	Culinar	Motors TV	Motors
Match TV	People	Odyssée	Documentary
Monte Carlo TMC	Family	Paris Première	Art
Paris Première	Art	Série Club	Series
Planète	Documentary	Télétoon	Children
Planète Future (2)	Documentary	Télétoon +1	Children
Planète Thalassa	Sea	Téva	Women
Santé	Health	TF6	Entertainment
Téva	Women	TPS Hors Série	Events
Tiji	Children		
TV Festival	Cannes Festival		
Voyage	Tourism		

Table A2. Content by category of programs of the basic bundle, CanalSatellite and TPS as of end of 2002 (con't)

News			
BBC World	British news	Arte	Cultural
Bloomberg TV France	Financial news	BBC World	British news
CNBC-NBC	US news	CNN International	US news
Cuisine.TV	Culinar	Fox News Channel	US news
Euronews	European new	France 2	Generalist
France 2	Generalist	France 3	Generalist
France 3	Generalist	I Télévision	News
Free One	Generalist	La Chaîne Parlementaire	Parliamentary
Itélévision	News	La Cinquième	Education
LCI	News	LCI	News
RFO Sat	Regional news	M6	Generalist
RTL 9	Generalist	Régions	Regional news
RTPI	Generalist	RFO Sat	Regional news
TV Breizh	Regional	RTL 9	Generalist
Zaléa TV	Citizens	RTM	Generalist
		TF1	Generalist
		TFJ	Jewish
		TV Breizh	Regional
		TV5	Generalist
		TV7	Generalist
Music			
MCM		Fun TV	
MCM 2		M6 Music	
MCM Africa		Mezzo	
MTV		MTV	
Nostalgie la Télé		VH-1	
RFM la Télé			
Zik			
Interactive services			
Allociné TV	News	Annonces et Shopping	Shopping
Auto Moto	Motors	Astrologie (Equilibre)	Astrology
Bonjour.fr	Ads	Canal Auto	Motors
Canal Club	Shopping	Chronobourse	Financial
Canalsat Boutique	Shopping	Ciné info	News
Canalsat Finances	Financial	Club Téléachat	Shopping
Club Téléachat	Shopping	Espace annonces	Ads
CTV	Ads	Fi (CATV/Vega/Echos)	Financial
Demain!	Job	France courses	Hippism
Fiches Elle	Culinar	Info Express	News
Forum Boutiques	Shopping	Infoscore	Sport news
France courses	Hippism	Le journal de chez vous	News
I.Sport	Sport news	L'oeil du hibou	Cultural
Journal de chez vous	Local news	Météo Express	Weather
La chaîne météo	Weather	Mon Shopping	Shopping
Météo interactive	Weather	Pari à domicile	Hippism
Parents	Young parents	Shopping Avenue	Shopping
Pari à domicile	Hippism	TPS Boutique	Shopping
Première	Cinema	TPS Mail	E-mail
Spectacle	Shopping		
Zoé	Job		
Sport			
AB Sports		Equidia	
Equidia		ESPN Classic Sport	
ESPN Classic Sport		Eurosport Breizh	
Eurosport France		Eurosport France	
L'équipe TV		Infosport	
Pathé Sport		Superfoot	
Sport+			

Table A3. Net subscription price (euros), CanalSatellite (CS) and TPS, 1996-2002

December of	TPS	CanalSatellite
1996	237.82	228.67
1997	256.11	246.36
1998	272.88	272.58
1999	283.56	301.85
2000	300.02	311.00
2001	300.02	311.00
2002	300.02	334.78

Source: TéléSatellite, own calculations.

Table A4. Descriptive statistics of main variables

Variable		Mean	Std. error	Min	Max
net annual subscription price (euros)	p1	288.13	29.12	228.67	334.78
	p2	269.38	37.05	158.55	300.02
# of subscribers	q1	1212789	508735	201200	1998400
	q2	726392	361634	0	1172000
advertising	a1	1069	268	447	1414
	a2	810	268	0	1083
total # of channels	nt1	73.68	19.80	29	108
	nt2	49.36	10.30	16	59
total # of channels in the basic bundle	nb1	37.83	14.00	15	56
	nb2	40.00	9.53	21	52
total # of channels in the movie bundle	nc1	6.53	1.51	5	11
	nc2	3.76	0.78	3	5
total # of bundles	o1	9.25	1.00	5	11
	o2	7.49	2.12	2	11
industrial production index (OECD)	y	112.59	4.72	101.30	118.30

Notes:

- 72 observations
- 1: CanalSatellite
- 2: TPS

Source: TéléSatellite, own calculations.

Table A5. "Parameter estimates (3SLS) of different strategic behaviours

	Model 1		Model 2		Model 3		Model 4	
	Nash		Leader TPS		Leader CanalSat		Tacit collusion	
	Q TPS	Q CS	Q TPS	Q CS	Q TPS	Q CS	Q TPS	Q CS
Constant	-205 (1.16)	-399 (2.20)**	-208 (1.18)	-429 (2.35)**	-197 (1.11)	-427 (2.35)**	-190 (1.07)	-414 (2.27)**
Qt-1	0.555 (7.80)***	0.182 (3.05)***	0.550 (7.72)***	0.186 (3.12)***	0.549 (7.69)***	0.171 (2.90)***	0.556 (7.79)***	0.182 (3.06)***
P TPS	-18.087 (1.15)	14.162 (0.81)	-16.309 (1.03)	9.192 (0.52)	-16.560 (1.05)	15.670 (0.90)	-18.644 (1.18)	13.273 (0.76)
P CS	18.773 (0.67)	-63.245 (2.01)**	18.532 (0.66)	-60.606 (1.92)*	-6.159 (0.22)	-95.005 (3.04)***	11.163 (0.40)	-69.272 (2.20)**
A TPS	515 (5.65)***	-270 (2.94)***	518 (5.68)***	-281 (3.04)***	515 (5.62)***	-291 (3.17)***	517 (5.65)***	-267 (2.90)***
A CS	-182 (2.68)***	1,214 (12.25)***	-182 (2.68)***	1,212 (12.14)***	-186 (2.73)***	1,228 (12.43)***	-183 (2.69)***	1,205 (12.13)***
S2	-9,339 (1.40)	-7,726 (1.01)	-9,411 (1.41)	-7,100 (0.92)	-10,198 (1.52)	-10,003 (1.31)	-9,082 (1.36)	-7,514 (0.98)
S3	-15,645 (2.31)**	-20,637 (2.66)***	-15,568 (2.30)**	-21,388 (2.74)***	-16,424 (2.42)**	-22,367 (2.89)***	-15,657 (2.31)**	-20,046 (2.58)**
S4	-288 (0.04)	1,785 (0.22)	-420 (0.06)	1,336 (0.17)	-298 (0.04)	1,319 (0.17)	-13.265 (0.00)	2,311 (0.29)
Y	1,779 (0.94)	1,156 (0.58)	1,785 (0.94)	1,510 (0.75)	2,109 (1.11)	1,926 (0.96)	1,762 (0.93)	1,441 (0.72)
T	3,045 (4.29)***	7,580 (10.23)***	3,082 (4.34)***	7,580 (10.19)***	3,297 (4.63)***	7,953 (10.81)***	3,087 (4.34)***	7,647 (10.33)***
Observations	69	69	69	69	69	69	69	69
R ² a	0.9278	0.8948	0.9281	0.8947	0.9274	0.8964	0.9285	0.8972
F stat	96.53	66.22	96.51	66.38	96.23	66.12	96.21	65.87

Notes:

- Absolute value of t statistics in parentheses.
- * Significant at 10%; ** significant at 5%; *** significant at 1%.
- The estimates of each model's first order conditions are not reported.
- Model 1: Nash competition; model 2: Stackelberg model with CS as leader; Model 3: Stackelberg model with TPS as leader; Model 4: Tacit collusion on prices.
- Advertising expenditures are assumed to be exogenous.
- Q is number of subscriptions; P is subscription's fee (price), A is firm's advertising expenditures; S2-S4: Quarterly dummies; Y = industrial production index; T: trend.

Table A6. Vuong nonnested tests for alternative competition models

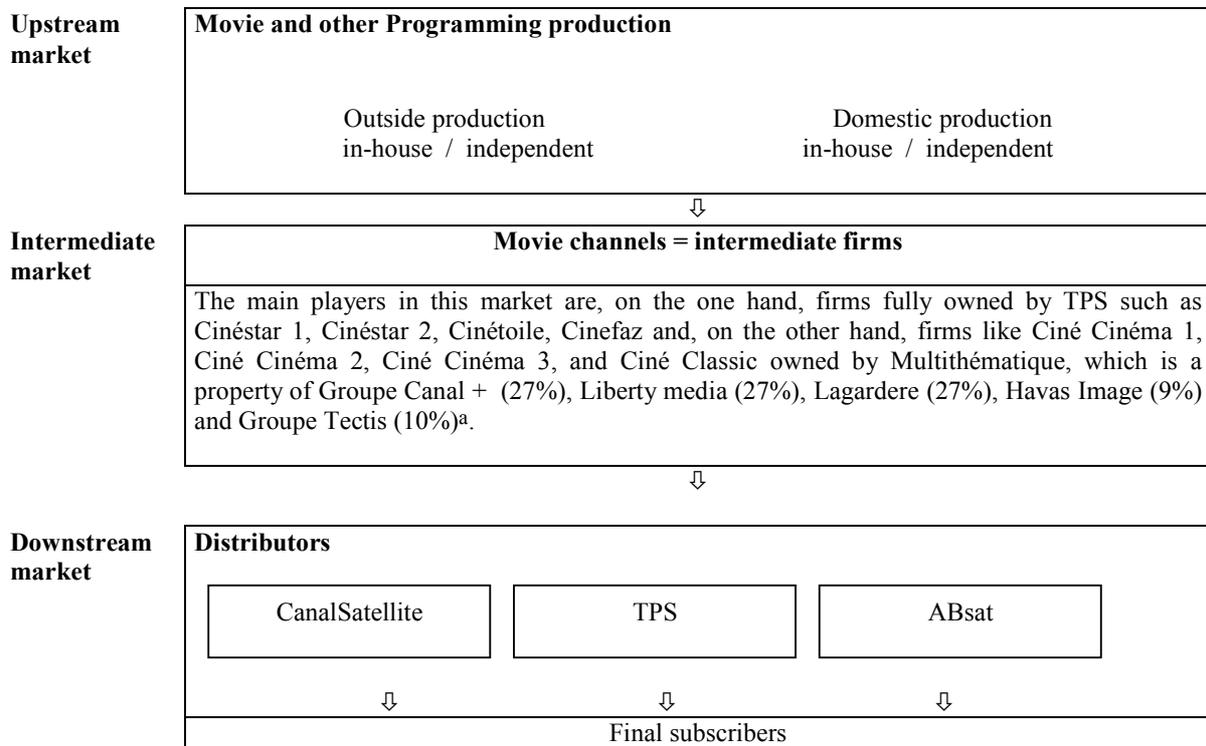
	2.	3.	4.
1.	3.98	5.12	2.57
2.		2.11	-.27
3.			-2.44

Notes:

1: Nash competition; 2: Leader TPS; 3: Leader CanaSatellite; 4: Tacit collusion.

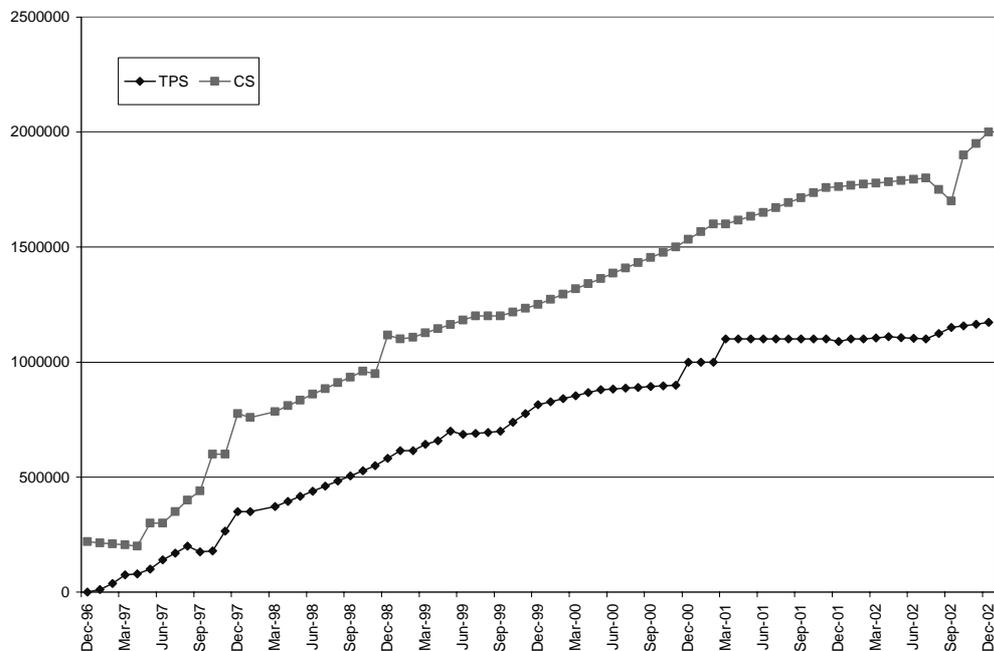
Values for the Vuong test (column j vs. line i) above 2 reject the model in line (i), and below -2 favor the model in column (j) at the 1% level.

Figure A1. The French satellite pay-TV market



Note : a) Extract from CNC Mai 2001, Liens financiers.

Figure A2. Number of subscription CanalSatellite (CS) and TPS, 1997-2002



Source: TéléSatellite, own calculations.