Tacit vs. Overt Collusion:
Is there a « Yalta » on the French mobile phone market?

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1) Introduction

- For many years, regulatory authorities tried to show that price parallelism on the mobile phone market was an abuse of a dominant position contrary to Art. 82
- In fact, seems there was a real hardcore agreement (according to French NCAs)
  - Dec. 2005 : *Orange France*, *SFR* and *Bouygues* found guilty of collusion
    - Exchanged detailed & confidential info. on the number of new subscribers signed up in the past months + number of users who had terminated their contracts between 1997 and 2003
    - Concluded a deal not too compete too aggressively for market share between 2000 and 2002
  - Info sharing reduced “uncertainty over other players’ strategies” + “commercial independence of each business”

1) Introduction (Cont'd)

- Argument of the operators :
  - admitted exchanging confidential data but argue that this practice is of a non-competitive nature and did not cause a prejudice to consumers
  - but part of a practice encouraged by the regulator
  - so plead not guilty

- Issue at stake :
  - validate whether the decision of the French NCAs is the right one
  - determinate whether info. sharing was a determinant factor for collusion

2) The demand system

- Each consumer purchases one unit of a first good (talk plan), the type of which is chosen among N substitutable types ($i \hat{I} \{1,...,N\}$).
  - Index of quality x_i and price p_i
- The absence of consumption of the good is defined by the consumption of a type $i=0$ with $p_0=0$ and $x_0=0$.
- "Other goods" are assimilated to an aggregate good.
  - Quantity z, price normalised to 1
- Each consumer has a (potentially different) income R.
- Utility if type i is consumed: $U_i = a\, x_i + z \quad \hat{U} \quad U_i = a\, x_i + R - p_i$

2) The demand system (cont'd)

- The marginal rate of substitution a for each individual is drawn from a continuous uniform distribution on $[0, a_{max}]$
  - Mostly justified because it yields a linear demand system

- a consumer with a given marginal rate of substitution a will prefer type i to all other substitutable types if and only if

$$\frac{p_i - p_{i-}}{x_i - x_{i-}} < a < \frac{p_{i+} - p_i}{x_{i+} - x_i}$$

- i- and i+ denote substitutes of type i with an index of quality respectively just below and just above that of type i.

2) The demand system (cont'd)

- We finally obtain the following <u>linear</u> (with respect to prices p_j and to the demand parameter a_{max}) demand system:

$$q_i = \frac{Q}{a_{\max}} \left(\sum_{j=1}^{N} a_{ij}\, p_j + b_i\, a_{\max} \right)$$

- Where:
  - coefficients a_{ij} and b_i depend on the x_i and x_j (quality of the different types)
  - Q is the total number of consumers (market size)
  - a_{max} is the only demand parameter

3) Price determination (cont'd)

- We now consider the subgame of price determination for given qualities.
  - Implicit idea: the modification of types requires higher costs (advertising…) than price adjustments

- Each producer m ($m \hat{I} \{1,\ldots,M\}$) offers a set of types W_m

- Whether collusion is tacit of overt, each producer m maximises the expected sum of its own profits and its competitors profits:

$$\underset{\{p_i;\, i\in\Omega_m\}}{Max}\, p_m + \sum_{\substack{n=1 \\ n\neq m}}^{M} E_{\neq n}[p_n] \qquad \text{with} \qquad p_m = \sum_{i\in\Omega_m}\left(p_i - m\,e^{x_i}\right)q_i$$

- Where me^{xi} is the cost of providing quality x_i and E_{1n} denotes the mathematical expectation with respect to the information available to all other producers than n.

3) Price determination (cont'd)

- In order to capture this distinction between overt and tacit collusion, we consider that for each producer *m* the parameter a_{max} may be decomposed as follows:

$$a^{m}_{\max} = \tilde{a} + \tilde{a}_{m} \qquad \text{with} \qquad E_{\neq m}\left[a^{m}_{\max}\right] = \bar{a} \qquad \text{and} \qquad E_{\neq m}\left[\tilde{a}_{m}\right] = 0$$

  - $\tilde{a}$ reflects common information on the demand parameter while $\tilde{a}_{m}$ reflects an idiosyncratic information shock for firm *m*.
  - Common information is a random term which has the same realisation for each producer and has expectation $\bar{a}$
  - idiosyncratic shocks are random terms with a different realisation for each producer and a null expectation (otherwise its expected value would be part of the common information)
  - At each date, producers observe the same realisation of the common information shock and the realisation of their private information shock but not that of other producers.
  - <u>If there is overt collusion, information sharing implies that there are no more idiosyncratic shocks:</u> $\tilde{a}_{m} = 0 \quad \forall m$

3) Price determination (cont'd)

- First stage:
  - determine the reaction function for the prices p_m of the types offered by firm *m.*
  - each reaction function is a linear function of the expected prices $E_{1n}[p_n]$ of the types offered by competitors *n*
- Second stage:
  - Given the reaction function obtained at the first stage, compute the expected prices (facilitated by the fact that the reaction functions are linear)
  - Then, substitute them in the reaction function
- The vector of resulting prices may be written

$$P_m = \tilde{a}_m V_m + \tilde{a} Y_m + m Z_m$$

  - V_m, Y_m and Z_m are vectors of regressors depending only on the index of quality x_i of the different types of the good.

4) Estimation procedure (cont'd)

- An error term is added to each price equation
- We obtain a three dimensions random coefficient panel data model. Indeed the coefficients for V_m and Y_m depend respectively on the private information shock and the common information shock.
- the three dimensions are
  - time
  - operator
  - type of good
- we assume that idiosyncratic information shocks, common information shocks and error terms are uncorrelated.
- Information shocks and error terms are assumed to be normally distributed.

4) Estimation procedure (cont'd)

- We have to compute a single index of quality for each talk plan (type of good) from numerous characteristics.

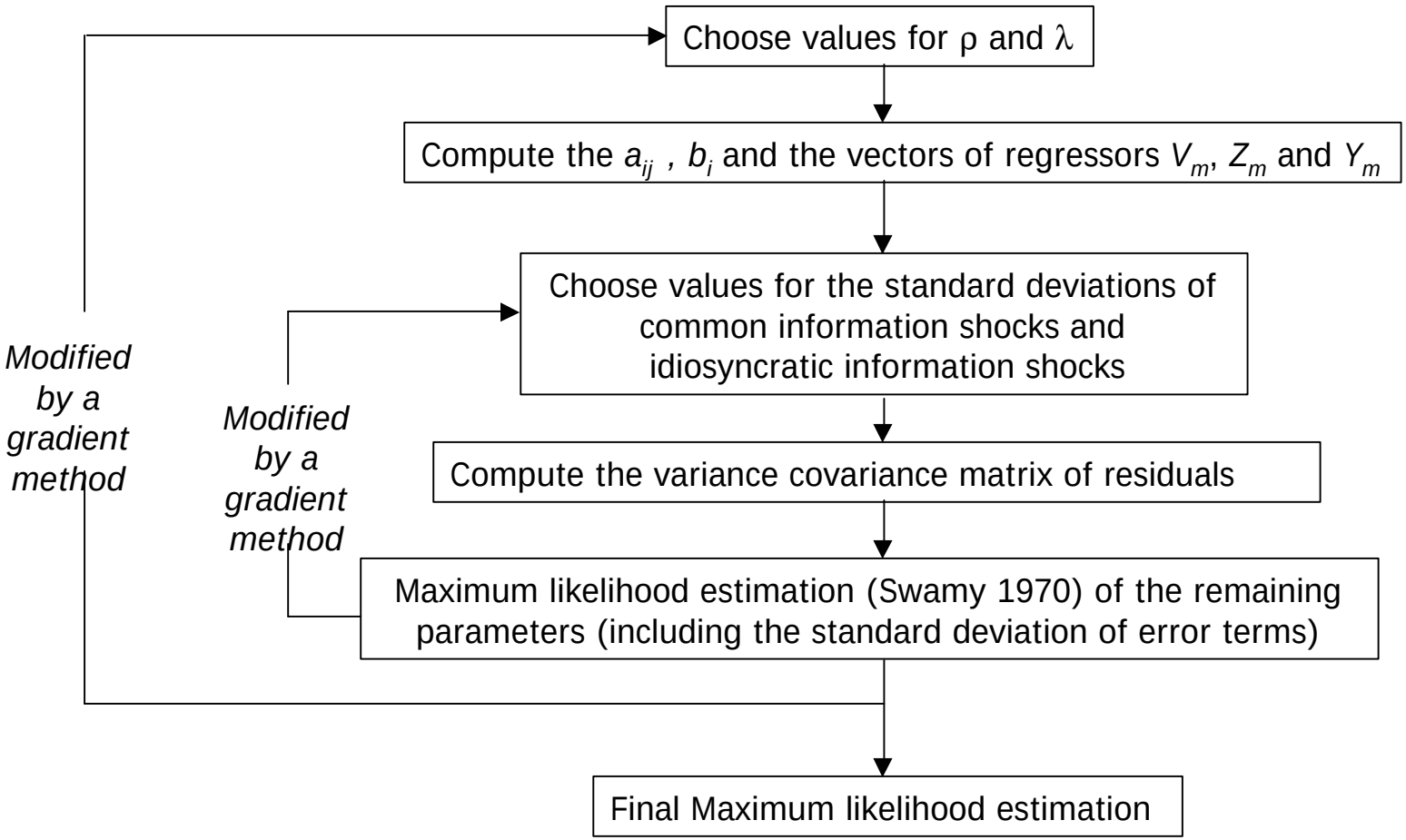
- Inclusive time of communication h_i is a major characteristic of each type i.

- Other characteristics of type i are aggregated in a single value l_i obtained as the coordinate of talk plans on the first component of a principal component analysis of these other characteristics.

- h_i and l_i are combined in a CES function (with parameters ρ and λ) to obtain the index of quality x_i:

$$x_i = \left(h_i^{-r} + l\, l_i^{-r} \right)^{-1/r}$$

4) Estimation procedure (cont'd)



5) Estimation results

Table 3: Estimation results

Coefficient:	
r	0.066005
l	0.096732
h_e (std of common information shocks)	0.00348678
h_a (std of idiosyncratic information shocks)	0.01331
$\bar{a}$ (expected value of common information shocks)	2.0555
s_u (std of error terms))	7.498
m (cost parameter)	0
Log likelihood:	-5406.36

4) Estimation results (cont'd)

- The constrained version ($h_a = 0$) of the model characterising overt collusion yields a log likelihood of –5568.3.
- The likelihood ratio test produces a statistic of 323.88 which is far above the critical value 7.89 obtained from a table of a Khi square distribution with one degree of freedom.
- The hypothesis that idiosyncratic shocks are not significant and thus, that there is overt rather than tacit collusion, is rejected by the likelihood ratio test.
- According to our data and model we are not able to conclude that over the periods considered, prices have been set following overt collusion.