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Market Power and competition effect on Interconnection fees: Econometric Estimation of the Mobile Tunisian Market

Sami ALI Debbichi
Faculty of Economics and Management of Tunis el Manar, Tunisia

Abstract

Econometric analysis can be mobilized by the regulator to set cost-oriented prices. Indeed, the regulator can influence the market structure to lower interconnection prices. Our work is to estimate, econometrically, the effect of variables related to market structure and competition on mobile termination rate evolution .The variable of market power will be estimated, based on the work of Parker Roller and the assumption "Balanced Balling Pattern". The “conduct parameter” measuring the intensity of competition is not null during the period (1993-2011), in this situation operators practice full market power. Econometric model will be based on Ordinary Least Squares method during the period (1993, 2011).Results show that competition affects the interconnection prices. This issue is underlined clearly in the official report of OECD Developments in mobile interconnection fees (2012).

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Contact: Sami ALI Debbichi - samieme79@yahoo.fr.
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1. Introduction

Liberalization of the telecommunications sector consists of opening all its segments to competition and privatization Wallsten, S. J (2001). Economic issues in the telecommunications sector and regulation are very important (Flacher and Jennequin (2007)). Several economic issues are resolved, as the barriers to entry (Baranes and Flochel (1999)), interconnection networks (Bulatovic (2004), Schiff (2005), Colombier et al. (2010)), the level of pricing (Dessein (2003), Berger (2005)), privatization (Wallsten (2002)) and market structure De Donder (2005) and strategic behavior competitors (competition, collusion (Parker and Roller (1997), Souam and Pénard (2002),), agreement fusion (Artz et al. (2009)) or deviation).

Interconnection is :"The ability of each operator to access to the network infrastructure of other operator Laffont and al. (2003), otherwise, it is the connection of different networks together to enable all users of telecommunications facilities to communicate freely". Interconnection is a key factor to competition Laffont and al. (1996). Each operator must pay an interconnection charge to its competitor for routing the call on its network *(two-way interconnection).* The stability of the interconnection rate, especially, during the duopoly period (2002-2011), leads us to ask about the state of competition, firstly, on the interconnection market and secondly, on the retail market (Steve G.Parsons (2002)). In this context, collusion is one of the possibilities and strategies (Colombier et al. (2010)) that actors may adopt to control the market. Collusion is a strategic behavior chosen by economic agents when the result is better in comparison with competition. Also, telecommunications operators may even use a high access charge as an instrument of collusion (Dessein (2003)). Laffont and Tirole (2000) present a study of competition in telecommunications, much the same, competition from the United States was presented by Parsons (2002). Several studies have already highlighted the determinants of the choice of colluding (Parker and Roller (1997) and Hoffler (2009)), and especially its relationship with the level of interconnection fees.

The regulator is faced with the difficulty of judging the state of competition in the market, on the one hand, and does not know how and by what instrument he must take, on the other hand. In a first context, regulator can act on interconnection tariffs to control the structure of the market and the trend of collusion through the preference threshold for collusion Debbichi, S.and Hichri, W. (2013). Whereas in another context it can be possible to influence the market structure *(market share, market power, concentration etc. ...) t*o regulate interconnection rates. As a game theory. Econometrics is a powerful tool that can be mobilized by the regulatory agency to study the strategic behavior of firms, and the detection agreement on prices. Our work is inserted in this context and is to estimate, econometrically, the effect of variables related to market structure and competition on mobile termination rate .The variable of market power will be estimated, based on the work of Parker Roller and the assumption "Balanced Balling Pattern".

The paper is organized as follows: Section 1 presents the related literature. We present thereafter, a data and methodology (section 2). The different results obtained are discussed in Section 3. Finally, we present concluding remarks.

2. Related Literature

Our work will focus on econometric study to explore the effect of variables related to market structure on termination rate evolution. "Madden, G., and Savage, S-J. (2000)"extend the work of Ergas and Patterson by developing an econometric model of settlement rate pricing. The model is estimated on data for 27 US bilateral phone markets for the period from 1985 to 1995. Parameter estimates are used to identify settlement rate determinants, and so highlights impediments to efficient international telecommunications pricing. A new feature of the model is the inclusion of a resale market structure variable. "Edwards.and Waverman,L. (2005)" examine the effects of public ownership and regulatory agency independence on regulated interconnection rates paid by entrant operators to the incumbent. He finds that public ownership of the incumbent positively affects these interconnection rates. However, we also find that the presence of independent regulator from the government mitigate this effect. The model is estimated during the period between 1997 and 2003.

"Bolotova, Connor and Miller (2008)" propose to use Arch and Garch models to, simultaneously; estimate the mean and variance of price collusion agreements should lead to higher prices and a reduction in variance. "Harrington and Chen (2004)" explained that the low variance in prices resulted dice cartel incentives to reveal information on costs in order to reduce the probability of detection. "Balaguer, Orts and Uriel (2007)" proposed using an econometric test for the agreement based on a breakdown of prices. They propose to estimate the following equation:

$$\ln(P_{it}) = \beta + \varphi_t + \delta_i + \varepsilon_{it} \quad (1)$$

With: β a constant, φ_t fixed effect associated with period t, δ_i a fixed effect associated with the local market and ε_{it} residue. φ_t is supposed to capture the changes in the firms cost and δ_i supposed to capture the peculiarities of local demand on local market.

3. Data and Methodology

3.1. Mobile Phone Market in Tunisia

Tunisia has one of the most developed mobile markets in Africa as indicated by the high-level mobile penetration. There are three mobile phone operators in the country. The market structure of the mobile phone in Tunisia has gone through several stages, from the monopolistic structure (1992-2001), to the duopolistic one (2002-2009) until reaching a three operators structure (from 2010 until today). In addition to the market structure, there have been changes in the market shares "Fig1" of the public and the private operators. Indeed, the privatization of Tunisia Telecom (T.T.) (the historical national operator) in 2006 transformed (theoretically) the market from a mixed (Private-Public) duopoly to a private one. With the entry of Orange Tunisia in the market in 2010, one should talk about a three private operators market.

Tunisian regulatory authority establishes the method of Long-term incremental costs (LRIC) corresponding to the additional cost incurred by the incumbent, and to the request for interconnection. Operators use several formulas for determining interconnection tariffs for calls between their networks: The Calling Party Network Pays (CPNP), Bill and Keep (BAK) etc... "Degraba, P. (2000, 2002)" shows that (BAK) system is an effective interconnection

regime, unlike "Wright, J (2002)" sees this one affects the coverage of costs to consumers."Gans and King (2001)" shows that the "Bill and Keep" system could have a negative effect on the competitive pressure in the situation of cost based pricing. The (CPNP) system increases retail prices. In Tunisia, mobile phone operators practice a symmetric termination rate (CPNP system). The principle that the network of the caller pays to the operator receiving the call .This is the best-known interconnection regime. In this situation, money transfer between operators can be important factors that facilitate or inhibit collusive schemes. From the (Fig2), interconnection rates have witnessed a remarkable decrease after the year (2008), but some stability between years 2002 and 2008 (the duopoly period). Between the years (2002-2011) this reduction is about 46 percent. Indeed, at the entrance of *Tunisiana,* the decrease was about 29 percent. While, about 8 percent at the entrance of *Orange Tunisie*.This change of termination rates is related to; monopoly period which *Tunicell* operates during the years (1993-1998) with the analog technology, and between (1998-2002) with the GSM digital mobile technology, the duopoly period, with the entrance of *OTT* (2002-2010) and finally, with the third entrance of *Orange Tunisie.* In this context, can we say that said that this reduction is due to other market factors? Which is the purpose of the following econometric study?

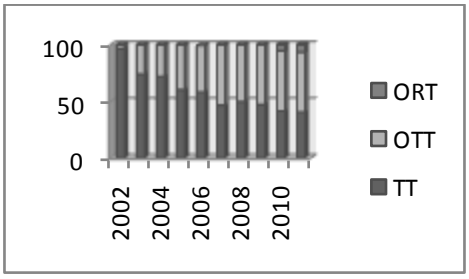


Fig 1 : Market share of three operators (In Percentage) [1]: Source INT

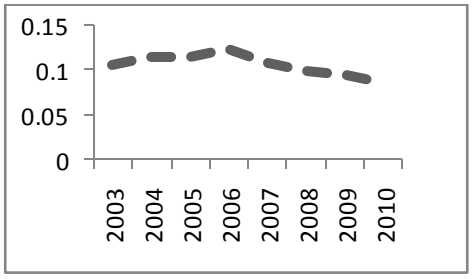


Fig 2 : Interconnection fees evolution in Tunisia (Tunisian Dinar): Source INT

3.2 Market Power

We say that an operator has the market power if it sets non-competitive prices above marginal cost. In the absence of cost accounting, the measurement of marginal cost will be more difficult and assessment of market power will become impossible. For this reason, "Parker and Roller (1997)" consider "The conduct parameter" ϑdefined by:

$$\vartheta = \left(\frac{-a}{\acute{a}\left(q_{ij}\right)q_{ij}}\right)\left(\frac{a\left(q_{ij}\right)-\theta_i}{a\left(q_{ij}\right)}\right) \Leftrightarrow eL \qquad (2)$$

With q_{ij} the quantity of interconnection exchanged between two networks, $\theta_i$the marginal cost and a the termination price, and e the demand elasticity of interconnection. The price elasticity of demand is assumed constant (8%) between the years (2002-2011) for both operators and is calculated through the following formula and based on the hypothesis "*Balanced Calling Pattern*"[1] "Debbichi, s. and Ben Khalifa, A. (2013)".

[1] ORT : Orange Tunisie (private operator)
OTT : Orascom Tunisie Telecom (private operator)
TT :Tunisie Telecom (Public Operator)
INT: Instance Nationale des Telecommunications (Regulatory Agency)

The Lerner index (margin) formalized in 1934 by Abba Lerner measures a firm's level of market power by relating price to marginal cost and is equal to its market share divided by demand elasticity (request to interconnection), given by the following equation[2]:

$$\frac{(a(q_{ij}) - \theta_i)}{a(q_{ij})} = \frac{\propto_i}{e} = L_i \quad (3)$$

Now we have already seen that the HHI is equal to the sum of the squared market shares. The average index is equal to:

$$\overline{L} = \sum_{i=1}^{n} \alpha_i L_i = \sum_{i=1}^{n} \frac{\alpha_i^2}{e} = \frac{HHI}{e} \quad (4)$$

It was shown that the average Lerner index is proportional to the HHI on the interconnection market .We are faced with two alternatives; $\to 0$; perfect competition of interconnection market, and$\vartheta \to 1$; the market is monopolistic. Generally, in the case of Cournot competition between n symmetric operator$\vartheta \to \frac{1}{n}$. The parameter ϑ measures the degree of collusion. In this case it's possible to construct an econometric test to reject or to accept the assumption that industry is competitive, monopolistic comparing the theoretical value to estimated value.

1/ If $\vartheta = 0$,$a = \theta$ prices equal to marginal costs and the industry is perfectly competitive.

2/ If $\vartheta > 0$, the price is above marginal cost, and interconnection industry in a collusive situation.

From the table1 $\vartheta \to \frac{1}{n} = \frac{1}{2} > 0$ the interconnection price is above marginal cost. This result is valid in three cases of market structure (monopoly, duopoly and triopoly), but the intensity of market power decreases with increasing the number of operators in the market. "Debbichi, S and Hichri, W. (2013)" studied a Cournot model that compares the intensity of market power by the critical threshold of collusion in Duopoly and Oligopoly Markets where the actors are private, mixed or public.

Table I: Tunisian Market Power value (1993-2011): Constructed variable

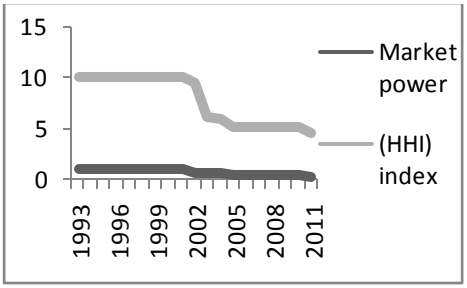
Years	Market power value	Years	Market power value
1993	1.00*[2]	**2003**	0.6058
1994	1.00*	**2004**	0.5848
1995	1.00*	**2005**	0.5103
1996	1.00*	**2006**	0.5024
1997	1.00*	**2007**	0.5014
1998	1.00*	**2008**	0.5002
1999	1.00*	**2009**	0.5018
2000	1.00*	**2010**	0.4580
2001	1.00*	**2011**	0.3333*
2002	0.6058		

We showed in the previous section, that HHI index is proportional to the Lerner index. Otherwise, there is a correlation between concentration and market power. This is shown graphically "Fig 3"and statistically "TableII". In fact, the R^2 value which is about 0.95.

Table II: Covariance Matrix

	HHI Index	Market Power Value
HHI Index	1.000000	----------
Market Power Value	0.9530454	1.000000
t-statistic	12.975599	
Proba.	0.0000	

Fig3: Market Power and HHI Index Evolution (1993-2011)/ Source : INT



3.3 Some Descriptive statistics

This Table reports summary statistics on the data employed in econometric model presented in following section.

Table III: Descriptive Statistics

Variables	Min	Mean	Max
Termination Rate	0.080	0.113	0.150
HHI	4.486	7.685	10.00
Convergence	-18.860	9.555	93.02
Competition	1.000	1.631	3.000
Market Power	1.000	0.742	0.333

With Kurtosis value equal to 3, rates presented a normal distribution. Convergence series presented a peaked distribution with Kurtosis value greater than 3. But, the distribution of HHI, (Market Power and competition) series is flatter with Kurtosis value lower than 3. The Skewenes value is from zero for all series (Appendis1).

3.4 Empirical strategy

Our primary purpose is, therefore, to measure the effect of competition (*Entry of new operator)* on call termination rates evolution, to compare to other variables of market structure . Estimation is with OLS over the period (1993-2011). We will test econometrically the assumption ("Penard (2003)") according to which any factor that increases competition between operators is more promising incentive for collusion. We will then express the effect of each retained variable on interconnection fees evolution (The interconnection rates charged and exchanged between operators represent the whole sale prices expressed in Tunisian local currency without taxes.)

$$Rat_t = \propto (Comp)_t + \beta(M.Pow)_t + \theta(HHI)_t + \vartheta(S.Conv)_t + Rat_{t-2} + \varepsilon_t \qquad (5)$$

The variables of the estimated model are related to the market structure and include competition (Comp), which is measured by the number of mobile operators. In fact, there is a relationship between the number of competitors and collusion, as shown in Selten (1973) who presents a theory that investigates "the connection between the number of competitors and the tendency to cooperate." The importance of the number of competitors as a variable is at the origin of the distinction made by "Chamberlin (1933)", "Don Bellante (2004)" between small group and the large group. Variables includes also a measure of market concentration (HHI), expressed by the HHI index. This index is established by summing the squared market shares (usually multiplied by 100) of all the operators. The more the HHI index is high, the more the market is concentrated and the more preference for collusion is strong Murakami, "H. and Asahi, R. (2011)".

The two other variables of the first kind are market shares convergence (S.Conv) measured by the difference between the market shares of operators expressed in percentage (the more market shares are converging (difference tends to zero), the more the collusion is easy and the more the interconnection fees are stabe. The Lerner index (M.Pow), as presented in "Debbichi and Ben Khalifa (2013)". This index reflects the degree of market power for operators. The more the price is far from the marginal cost, the more the market power is important, and the more preference for collusion is strong. This variable is constructed on the assumption called "Balanced Calling Pattern" "Laffont and Tirole (2000)" and according to which, the fraction of calls from the original network and ending on the other competing network is proportional to the market share of the competitor. In other words, the flows of incoming and outgoing calls are balanced, even if market shares are not. An AR (2) term is introduced in the model to correct for autocorrelation(Rat_{t-2}). All of the variables are expressed as logarithms

4. Econometric Results

Results suggest that market structure, market power, competition and market concentration are the essential determinant of the termination rate evolution. In fact, all Variables are significant at 1 % risk. The entry of new operator decreases over interconnection rates of about 2%. While the concentration has a positive effect: a 1 % increase in the ratio of HHI increases fees by about 5%. The variable of the market shares symmetry has a positive effect on increasing of termination rates. Convergence of 1%market share of the two operators is increasing rates by about 0.33%. This result proves the one of market power of the first part. Market power has a negative effect on evolution of termination fees. Overall, our estimations show that the competition has no effect on tariffs. This result allows us to suspect the presence of collusion between competitors. In fact, operators can maintain these high interconnection charges to inflate prices paid by consumers and reduce the probability of detecting collusion retail prices. The competition affects weakly the termination rate. This issue proves our results of collusion in the first part of this paper. Collusion may be the result of inadequate regulatory policy in Tunisia. In fact, the system (CPNP) may explain our results

Table IV: Results of OLS estimation (Dependent Variable: Interconnection Rate)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Competition	-0.024737	0.009097	-2.719196	0.0186
Market Power	-0.051616	0.027329	-1.888695	0.0833
Shares Convergence	0.000331	5.15E-05	6.426330	0.0000
HHI	0.048928	0.009064	5.398214	0.0002
AR(2)	-0.467032	0.317419	-1.471342	0.1669

R-squared	0.881034	**Mean dependent var**	0.112882
Adjusted R-squared	0.841378	**S.D. dependent var**	0.016109
S.E. of regression	0.006416	**Akaike info criterion**	-7.020237
Sum squared resid	0.000494	**Schwarz criterion**	-6.775175
Log likelihood	64.67202	**Hannan-Quinn criter.**	-6.995878
Durbin-Watson stat	2.381701		

5. Concluding remarks

The model we present above determines the market power of the mobile operators market in Tunisia on interconnection market, using the Lerner index. This index is a relevant indicator available for the regulator to judge the nature of competition, to keep a certain degree of competition. The regulator, as in "Flacher and Jennequin (2007)", can set the level of interconnection rate at a level that minimizes collusion. In this paper the regulator can control market structure to minimize prices. The "*conduct parameter*" measuring the intensity of competition is not null during the period (1993-2011), in this situation interconnection price is not oriented to marginal cost. Econometric results suggest that an entry of new operator decreases over interconnection rates by about 0.33%. This result proves the first and allows us to suspect the presence of collusion between competitors. In fact, operators can maintain these high interconnection charges to inflate prices paid by consumers and reduce the probability of detecting collusion retail prices. Collusion may result from the inadequate regulatory Policy in Tunisia. In fact, the system (CPNP) may explain our results.

However, we must recognize that our analysis has some weaknesses. The HHI used does not measure market concentration, since its calculation is based on market share customers of both operators, not on the quantities exchangeable between operators. A theoretical extension is to estimate the "conduct parameter" by means of variables related to market structure and prices. It is recommended that the regulator can use our results to control the status of competition, by acting on market structure and on interconnection tariffs, to prevent the reproduction of collusion behavior on the retail price. The CPNP regime, however, gives rise to market power in termination markets and is widely accepted as justification for regulatory interventions "(see Armstrong, 1998, Laffont, Rey and Tirole, 1998a)".It would be interesting to use the most sophisticated econometric models such as (Arch., and Garch) for the detection of prices agreements.

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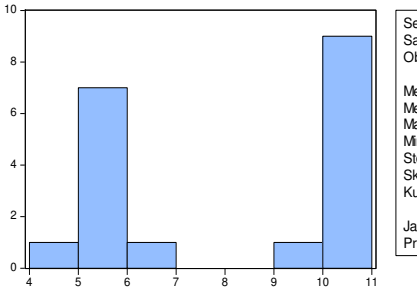
End notes:

[1]Laffont and Tirole (2000) defined this hypothesis that the fraction of calls cause of network and ends on the other competing network is proportional to the market share of the latter. In other words, the flow of incoming and outgoing calls is balanced even if market shares are not.

[2]For More details see Debbichi, S. and Ben Khalifa, A (2013) "Market conduct, interconnection costs and benchmarking in mobile phone industry: the Tunisian case," Int. J. Mobile Learning and Organisation, Vol. 7, No. 1

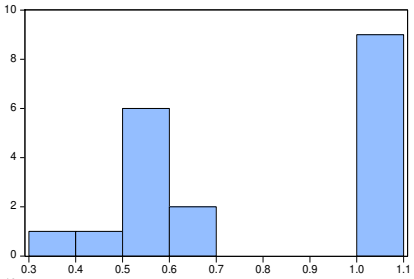
[3]values are estimated according to the equation $\vartheta = \frac{1}{n}$

[2] Appendis 1: Descriptives statistics



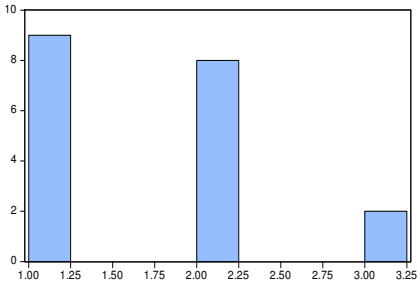
Series: HHI
Sample 1993 2011
Observations 19

Mean	7.685468
Median	9.326000
Maximum	10.00000
Minimum	4.486970
Std. Dev.	2.458844
Skewness	-0.142442
Kurtosis	1.088417
Jarque-Bera	2.957120
Probability	0.227966



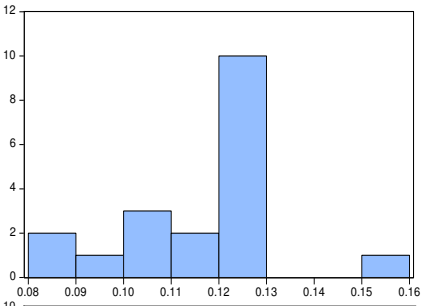
Series: PMAR
Sample 1993 2011
Observations 19

Mean	0.742305
Median	0.605800
Maximum	1.000000
Minimum	0.333300
Std. Dev.	0.257523
Skewness	-0.049333
Kurtosis	1.225029
Jarque-Bera	2.501871
Probability	0.286237



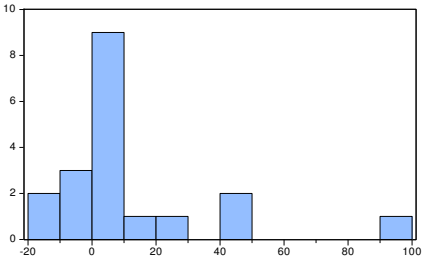
Series: CONC
Sample 1993 2011
Observations 19

Mean	1.631579
Median	2.000000
Maximum	3.000000
Minimum	1.000000
Std. Dev.	0.683986
Skewness	0.581069
Kurtosis	2.302187
Jarque-Bera	1.454691
Probability	0.483190



Series: TARIFS
Sample 1993 2011
Observations 19

Mean	0.113632
Median	0.120000
Maximum	0.150000
Minimum	0.080000
Std. Dev.	0.015352
Skewness	-0.241304
Kurtosis	3.920476
Jarque-Bera	0.855147
Probability	0.652089



Series: CONV
Sample 1993 2011
Observations 19

Mean	9.555789
Median	1.000000
Maximum	93.02000
Minimum	-18.86000
Std. Dev.	26.45146
Skewness	1.924018
Kurtosis	6.407584
Jarque-Bera	20.91505
Probability	0.000029