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Impact of Regulatory process on Telecommunications Market Performance: Evidence from Parametric and non parametric approach

(First Draft)

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Abstract:

In this paper we explore the impact of regulation; privatization and competition on the both mobile and fixed phone performance, in terms of service quality (network faults) and tariffs in both fix and mobile telecommunication services, using the technique of tow econometric approaches. A parametric approach (Panel Data) and non parametric approach (Matching method). The first, analyze the effect of regulation, privatization and competition on mobile networks performance in terms of quality and tariffs using the interaction effect method in linear model. Our aim is to study the nature of interaction effect between indicators: independence, regulation, competition and privatization on the market performance. The second approach is to correct the inefficiencies of the first estimation and based on propensity score matching (Difference-in-Differences estimations (*Heckman et al., 1997, Meyer, 1995*)), from 1990 to 2008. Overall, our estimations show a positive relationship between the presence of regulator and tariffs and quality. However, competition has no effect on tariffs. This result allows us to suspect the presence of collusion between competitors and found using the tow approaches.

**Keywords: Telecommunications' Market – Tariffs and Quality Performance
- Regulation – Difference-in-Differences**

**JEL Codes : L56 – L96 -
C14**

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1-Introduction:

The main reason why countries have established a regulatory authority is because the opening of telecommunication sector to competition *Souam and Pénard (2002)*. However, it is also clear that the transition from monopolies to competitive markets, there was a need for regulation to prevent abuses from the incumbent operator and to facilitate the entrance of new carriers *Hubert (2004) and Shelanski (2006)*, and encourage the privatization of incumbents. Studies conducted by the International Telecommunications Union, shows that countries that have achieved better performance in the telecommunications in terms of quality , prices and services are the first who adopt this regulatory process. *Wallsten (2003) explores* the effects of privatization, competition, and regulation on telecommunications performance in 30 African and Latin American countries from 1984 through 1997. The results show that competition has a positive effect on per capita number of mainlines, payphones, and connection capacity, and with decreases in the price of local calls. This study also suggests that the effects of privatization is positively correlated with telecom performance, when it's combined with an independent regulator. Privatization alone is negatively correlated with connection capacity. *Zheng and Ward (2011)* studied how liberalization and privatization have affected the performance of Chinese telecommunications industry, in terms of price and subscription levels, for both fixed and mobile networks, based on the techniques of panel data from 1998 through 2007. The results show a high level of performance will coincide with a decrease in the concentration and the capital share held by the State to improve the level of competition. This is most notable for the mobile network for the fixed network. *Baranes, Benzoni and Vuong (2011)* have studied the effect of the regulation of call termination on the mobile operator's performance in Europe. They examined the effect of asymmetric regulation on the entry of new operators using a dynamic model that explains the internal performance of the company. The results clearly prove the theoretical prediction. . *Cambini and Rondi (2009)* analyzed qualitatively and quantitatively the relationship between access regulation, financial structure and investment decisions in the networking industry, analyzing if financial variables can be used strategically to influence the regulator's decisions in terms of price. This study is based on more technical panel data of 15 public operators in the European Union during the period (1994-2005).

The results show that higher debt also leads to higher access charges and an increase in debt, which will be followed by a decrease in the number of competitors and by increasing market share of the incumbent. This suggests that the strategic use of debt can influence the regulator

delaying some competition in the retail sector, but has a favorable counterpart in mitigating the underinvestment problem.

Another approach recently used: the econometric method of assessment (Matching Model) which had a considerable success in recent years in several disciplines and fields. including statistics (*Holland 1986; Rubin 2006, 1974; Rosenbaum 2002*), economics (*Abadie and Imbens 2006; Galiani, Gertler, and Schargrodsky 2005; Dehejia and Wahba 2002, 1999*), medicine (*Christakis and Iwashyna 2003; Rubin 1997*), sociology (*Morgan and Harding 2006; Diprete and Engelhardt 2004; Winship and Morgan 1999; Smith 1997*) political science (*Bowers and Hansen 2005; Imai 2005; Sekhon 2004b*), and even law (*Rubin 2001*).

Indeed, *Chaouani (2010)* used econometric evaluation approach and propensity score based on a unique firm-level panel data set of more than 3950 French firms from several industries. This approach is to measure the effect of treatment of public structure (Treated) and private (non-treated) on the firm's performance. The results shows that choose to be public coincide with a higher level of performance.

In this paper we will explore the impact of regulation; privatization and competition on the both mobile and fixed phone performance, in terms of service quality, interconnection fees and subscription levels, using the technique of panel data in linear model in the first step and in a second step the propensity score and. Nonparametric model DID differences-in-differences *Heckman and al. (1997)*, (*Meyer, 1995*), is an extension of the econometric evaluation method and will be our basic estimation model. Thus, this paper is organized as follows: We expose in the first section an introduction of the tow approach with a literature review. In the second section we expose parametric approach. In a third section, we present the non parametric Approach. And in a final section we present the estimation results, and comments. Finally we conclude.

2) Analysis with parametric Approach: Estimation with Panel Data

2-1) the model:

In this section we attempt to explore the effect of regulation when following privatization and the opening up to competition on rates of fixed and mobile termination. Our objective is to study the nature of the interaction effects between indicators: regulation, competition and

privatization. Using the technique of interactive variables (*First and second level*). A question arises: Why are these interactions? Indeed, the regulator seeks to promote the process of dynamic development that gradually settles genuine competition, fighting against anti-competitive practices. In addition, the regulator aims to encourage the privatization of the incumbent operator, to strengthen its independence. So, it is very logical that regulation improves the impact of competition and privatization. Our econometric study will involve a sample of 18 Arab countries during the period (1992-2008). The estimate is with Generalized Least Squares of panel data with fixed effects by referring to *Hsiao Hausman test* (2003).

Model variables can be cited as follows:

The dependent variable is the termination rates in fixed and mobile phone, it can be considered as a variable that reflects the performance of the both sector. **(MTR)**: Prices of mobile communication as measured by the call cost per three minutes (MT/3mn) in U.S. Dollar is expressed in logarithm. **(FTR)**: Price of fixed communication measured by the call cost per three minutes (FT/3mn) in U.S. Dollar and expressed in logarithm. For the explanatory variables are two-fold: one is institutional variables and other demand factors. The first group range: **(Regulation)**: This is a dummy variable that takes the value 1 from the year he has been creating a regulatory agency "separate" from ministry.. **(Competition)**: The number of mobile operators other incumbent who installed their networks and sell their services. This variable indicates the degree of liberalization of the telecommunications sector. Admittedly, it is not an ideal indicator of competition, but it provides a reference for comparison of the openness of the area between the countries in the sample. **(Privatization)**: This is a dummy variable that takes the value 1 from the year in which there has been privatization of the incumbent and 0 otherwise. This indicator does not present an ideal indicator because it takes no account of the extent or conditions such as privatization, the share of capital privatized, and the selling price.

While the second group arranges the control variables **(GDP / capita)**, expressed in U.S. Dollar **(urban)**, **(total population)** and **(Exports / GDP)**. These macroeconomic variables denote the demand factors in the both sector.

The model includes three regressions. Each regression is estimated twice to explain termination rates in fixed and mobile phone. From this first regression we seek to understand the impact of regulation, competition and privatization separately on (MTR), (FTR) and (Qual). It is given by the following equation:

$$Y_{it} = \delta_i + \gamma_t + \beta_1 regul_{it} + \beta_2 comp + \beta_3 priv_{it} + \vartheta Z_{it} + \varepsilon_{it}$$

Then, our goal will evaluate the impact of regulation, competition, and when it accompanies privatization jointly on (MTR) and (FTR). It is given by the following equation:

$$Y_{it} = \delta_i + \gamma_t + \beta_1 regul_{it} + \beta_2 comp_{it} * regul_{it} + \beta_3 priv_{it} * regul_{it} + \vartheta Z_{it} + \varepsilon_{it}$$

In what follows we will analyze and interpret the results:

2-2) Results and interpretations:

a) Call termination rates for mobile phone:

In the first regression, the variables associated with the regulation and competition coefficients express a positive sign, single regulation has a significant effect. Privatization has a negative and insignificant effect on rates of mobile termination rate(MTR). Macroeconomic variables in demand have negative effects except the variable associated with the urban population has a positive effect. One can also say that the variable associated with the export / GDP expresses a negative effect of the price level of international mobile is higher than international communications by landline in Arab countries. In these countries the mobile roaming is still limited and more expensive; the mobile has no interest in exporting companies. When combined with the variable regulation, competition and privatization will have a negative but not significant. Only control maintains a positive and more significant than the first regression.

b) Call termination rates for fixed phone:

In the first regression, the variables associated with the regulation and competition coefficients express positive sign and significant at the 5% and 1% respectively. Privatization has a negative and insignificant effect on rates of fixed call termination. Macroeconomic variables in demand have negative effects except the variable associated with the total population has a negative and significant. When combined with the variable regulation, competition expresses a negative and significant effect. Regulation only expresses a positive sign and not significant in the second regression. An important result, also obtained in the addition of variable; independence.

Indeed, the regulation expresses a positive effect higher than estimated when only the same thing for the competition when it is considered with regulation and independence. Privatization expresses a negative effect when combined with the regulation and

independence index in the third regression. This is a negative correlation between the index of independence and the variable associated with privatization, that:

First privatization is a criterion for independence of the regulator, "In addition, the incumbent is privatized more pressure on the regulator decreases and more independence to strengthen." This indicator is not taken into consideration during the construction of the index of independence and secondly, little experience of privatization in the countries of the sample has a negative effect on the independence of the regulator.

The inefficiency of the estimation can be noticed due to the fact that termination rates in Arab countries are not regulated unlike the rates fixed call termination. Indeed, the mobile operators are most often set their interconnection tariffs through negotiations and trade agreements, the regulatory authority exercising the function of arbitrator only when the parties could not get agreement. Things are very different with regard to the regulation of interconnection tariffs for fixed phone.

Several variables can be introduced to correct the inefficiency of the estimate, such as those relating to the characteristics of regulation (price caps, cost of service principle), the risk of expropriation, aid projects and international organizations in the telecom sector, the performance of the regulator (number of employees, organization, financial resources), and the share of each operator. We can also introduce a variable that indicates whether the introduction of regulation before privatization or not. The introduction of this variable can help us to quantify the effort of the regulatory authorities in the privatization of the incumbent and its impact on the sector's performance.

c) Service quality

In the first regression, the variables associated with the regulation, privatization and competition coefficients express a negative sign, ie positive effect on quality, single privatization has a significant effect and positive effect on quality, this result is conform to theory that suggest privatization is the cause of innovation . Macroeconomic variables in demand have negative effects except the variable associated with the urban population has a positive effect, ie a negative effect on quality. This is logical since the increase in the number of subscribers in urban areas reduces the quality of service.

	<i>Mobile Termination</i>		<i>Fixed Termination</i>		<i>Quality Of service</i>	
	<i>Regression1</i>	<i>Regression2</i>	<i>Regression1</i>	<i>Regression2</i>	<i>Regression1</i>	<i>Regression2</i>
<i>Variables explicatives</i>						
<i>C</i>	18.09 (3.11)	16.42 (2.74)	15.00 (2.89)	12.6 (2.34)	12.67 (1.16)	13.40 (1.24)
<i>log (GDP)</i>	-0.032 (-0.72)	-0.01 (-0.22)	-0.005 (-0.05)	0.006 (0.06)	-0.013(-0.41)	-0.009(-0.27)
<i>log (UR)</i>	0.589 (1.60)	0.639 (1.50)	0.409 (1.17)	0.515 (1.40)	0.763(1.48)	0.72 (1.44)
<i>log (EXP)</i>	-0.168 (-0.45)	-0.14 (-0.38)	0.089 (0.49)	0.045 (0.24)	-0.166(-1.28)	-0.15 (-1.22)
<i>log (POP)</i>	-2.876 (-3.25)	-2.65 (-2.87)	-2.54 (-3.25)	-2.2 (-2.71)	-1.86 (-1.17)	-1.97 (-1.24)
<i>Regulation</i>	0.166 (2.02)	0.226 (2.31)	0.102 (1.75)	0.058 (0.81)	-0.024(-0.75)	0.007(0.21)
<i>Privatisation</i>	-0.028 (-0.37)		-0.04 (-0.53)		-0.092(-1.99)	
<i>Competition</i>	0.027 (0.66)		0.108 (3.58)		-0.032(-1.46)	
<i>Comp * Reg</i>		-0.03 (-0.31)		-0.04 (2.50)		-0.03 (-1.62)
<i>Priv * Reg</i>		-0.03 (-0.88)		0.09 (-0.41)		-0.155(-1.96)
<i>AR(1)</i>	0.691 (9.71)	0.687 (9.31)	0.66 (15.15)	0.68 (15.75)	0.90 (21.08)	0.89 (21.39)
<i>R²</i>	0.92	0.92	0.94	0.93	0.94	0.94
<i>R² adjusted</i>	0.92	0.92	0.93	0.93	0.94	0.94
<i>Fisher</i>	109.1427	109.2266	176.8798	172.5273	183.48	184.17
<i>D.W</i>	2.233	2.214	2.162224	2.176	1.97	1.97

2-3) Inefficiencies of last Method and solutions:

In the last section we analyzed the effect of regulation process on mobile networks performance using the interaction effect method. Our aim was studying the nature of interaction effect between indicators: regulation, competition and privatization on the market performance. Quite dummy variables[0,1] were used in the econometric model for the privatization, regulation and competition. In this context we are faced with two groups, one group or one is in the presence of a regulator $R = 1$ and another group that does not benefit from the presence of a regulator $R = 0$. In this case, the net effect of regulation on the mobile phone performance is ambiguous. If we do not take into account this ambiguity, which is similar to a self-selection, it may produce biased estimates of the effects of regulation by directly comparing the situations of the two groups, beneficiaries and non-beneficiaries. The same for the other cases of privatization and independence.

To limit the impact of selection bias, statisticians have invented an econometric method known; econometric evaluation methods or "Matching Model." This method has in recent years experienced a significant achievement for estimating the effects of public interventions in health, education and employment; it involves comparing the performance of two groups who receive treatment and those who do not benefit.

3) Analyses with non parametric Approach

3-1) Neyman-Rubin Causal Model

To evaluate the impact of regulation, privatization and regulatory independence on the performance of the telecommunications sector, requires making an inference about the performance that would have been observed in the absence of the creation of a regulatory authority (independent). As we cannot observe the performance of the sector of mobile phone in the case or control had not occurred, or before it is created, the establishment of causal inference becomes a problem with a lack of data. The Causal Model was introduced by *Rubin* in 1974.

More specifically, the Rubin model based on the existence of two latent variables of outcome. Let Y_{i1} denote the potential outcome for country i if the unit receives treatment $D_i = 1$ (regulation or privatization), and let Y_{i0} denote the potential outcome for country i in the control regime $D_i = 0$. The treatment effect for observation i is defined by $\Delta_i = Y_{i1} - Y_{i0}$. Causal inference is a missing data problem because Y_{i1} and Y_{i0} are never both observed. Thus for a country i that has established a regulatory authority, Y_{i1} is observed, Y_{i0} while is unknown. The same thing for a country i that has not established a regulatory authority Y_{i0} is observed while Y_{i1} is unknown. The fact remains that we cannot observe both potential outcomes at the same time. For a country "untreated" Y_{i0} is known the result Counter-factual. Finally, the observed outcome variable (performance) can be deduced from the potential variables and the variable "treatment" by the relation:

$$Y_i = Y_{i0} + D_i(Y_{i1} - Y_{i0}) \quad (1)$$

For each country only torque (Y_i, D_i) is observed.

The causal effect is done by the following equation:

$$\Delta_i = Y_{i1} - Y_{i0} \quad (2)$$

Δ_i : The difference between the performance of telecommunication sector in country i with presence of regulatory authority and the performance of the sector in absence of regulation. This causal effect is unobservable, since only one of the two potential variables is observed for each individual. It is also individual, and thus there is a distribution of the causal effect in the population studied. Finally, let X_i denote the control variables for each country i that will be exposed later.

Since the causal effect is unobservable, it is also not identifiable. In contrast, with assumptions about the joint distribution of the triplet (Y_{i1}, Y_{i0}, D_i) , we can identify some parameters of the distribution of the causal effect from the density of the observable variables (Y_i, D_i) . Two parameters are identifiable:

- 1) The average treatment effect (ATE) can be estimated:

$$\Delta^{ATE} = E(Y_{i1} - Y_{i0}) \quad (3)$$

- 2) The average treatment effect in the population of treated countries:

$$\Delta^{ATT} = E(Y_{i1} - Y_{i0} / D_i = 1, X_i) \quad (4)$$

So that, $\Delta^{ATE} = \Delta^{ATT}$ should that the outcome variables are independent of the treatment variable, i.e. if $(Y_{i1}, Y_{i0}) \perp\!\!\!\perp D_i$, it is possible to identify the two parameters of interest Δ^{ATE} and Δ^{ATT} .

$$\begin{aligned} \Delta^{ATE} &= E(Y_{i1}) - E(Y_{i0}) = E(Y_{i1} / D_i = 1) - E(Y_{i0} / D_i = 0) \\ &= E(Y_i / D_i = 1) - E(Y_i / D_i = 0) \end{aligned} \quad (5)$$

And

$$\begin{aligned} \Delta^{ATT} &= E(Y_{i1} / D_i = 1) - E(Y_{i0} / D_i = 1) = E(Y_{i1} / D_i = 1) - E(Y_{i0} / D_i = 0) \\ &= E(Y_i / D_i = 1) - E(Y_i / D_i = 0) \end{aligned} \quad (6)$$

In this case, we obtain, $\Delta^{ATE} = \Delta^{ATT}$, that can be estimated by the difference of average variables results in the treated and untreated group. It may be noted that the identification of the second parameter requires a weaker assumption. In this case, it is sufficient that $Y_{i0} \perp\!\!\!\perp D_i$. Suppose now that the condition of independence is not satisfied previous, the

natural estimator formed by the difference in means of the outcome variables is affected by a *selection bias*. In fact,

$$E(Y_i/D_i = 1) - E(Y_i/D_i = 0) = E(Y_{i1}/D_i = 1,) - E(Y_{i0}/D_i = 0,)$$

$$= E(Y_{i1}/D_i = 1,) - E(Y_{i0}/D_i = 1) + E(Y_{i0}/D_i = 1) - E(Y_{i0}/D_i = 0) \quad (7)$$

$$= \Delta^{ATT} + \Delta^{BTT} \quad (8)$$

With;

$\Delta^{BTT} = E(Y_{i0}/D_i = 1) - E(Y_{i0}/D_i = 0)$: The selection bias. This bias can be explained by the fact that the average situation of countries which have received treatment (regulator creation) is not the same countries that do not benefit. And also because the two population groups are not identical (Treated and untreated).

Several solutions are implemented by researchers to fight against this selection bias. The principle of social experiments and the matching method are the best known.

The first is to assign randomly countries potentially interested in a regulation, a privatization reform etc., a treatment group that will benefit from the reform program, or a group of control that will not benefit. While the second is to develop a propensity score.

This score measures the probability of access to the treatment program for each individual, beneficial or not, and independently of program (regulation) results. Other two methods do not have these characteristics and are based on the analysis of results such as: regression discontinuity and differences-in- differences (DID) method are all outlined in the following.

3-2) Difference in difference model:

The method of *DID* is a simple and deducted from the part of individual fixed effects models and time, used in panel data method. The general form of the model is as follows:

$$Y_{it} = \alpha D_{it} + \beta_i + \gamma_t + \varepsilon_{it}; i = 1..N \text{ et } t = 1 \dots, T \quad (9)$$

Where

Y_{it} : The outcome variable (Performance) for country i at time t .

D_{it} : is the dummy treatment (control) for country i at time t .

$$D_{it} = \begin{cases} 1 & \text{if treated} \\ 0 & \text{if not} \end{cases}$$

α : Is a parameter to be estimated, which represents the effect of the treatment (here assumed constant)

β_i : Is an individual fixed effect.

γ_t : Is a common time effect common to all countries.

The terms, D_{it} , β_i and γ_t are potentially correlated, then ε_{it} is a random centered, homoscedastic, and uncorrelated to D_{it} , β_i et γ_t .

We then face two groups: One group of countries on treated (presence of regulator: $D_{it} = 1$ from a time $t = \tau$, and a second control group for non-treated (absence of regulator: $D_{it} = 0$) at $t < \tau$. The same for the other dummy variables relating to privatization and competition.

The idea is to eliminate the fixed effects by first difference and time effects by a second difference:

$$\Delta Y_{it} = \alpha \Delta D_{it} + \Delta \gamma_t + \Delta \varepsilon_{it}; i = 1..N \text{ et } t = 1 \dots, T \quad (10)$$

Where

$$\Delta Y_{it} = Y_{it} - Y_{it-1}; \Delta \gamma_t = \gamma_t - \gamma_{t-1}; \Delta \varepsilon_{it} = \varepsilon_{it} - \varepsilon_{it-1} \quad (11)$$

Now if we put $t = \tau$ and $t - 1 = \tau - 1$ (or $t \geq \tau$ and $t - 1 \leq \tau - 1$)

If $i \in \mathbf{Treatment}$, then: $\Delta D_{it} = 1$ which implies that $\Delta Y_{it}^{Tr} = \alpha + \Delta \gamma_t^{Tr} + \Delta \varepsilon_{it}^{Tr}$

If $i \in \mathbf{Control}$, $\Delta D_{it} = 0$ which implies that $\Delta Y_{it}^C = \Delta \gamma_t^C + \Delta \varepsilon_{it}^C$.

The second difference eliminates common time effects.

$$\alpha = E(\Delta Y_{it}^{Tr}) - E(\Delta Y_{it}^C) \quad (12)$$

$$\text{Since, } \Delta \gamma_t^{Tr} = \Delta \gamma_t^C \text{ and } E(\Delta Y_{it}^{Tr}) = E(\Delta Y_{it}^C) = 0 \quad (13)$$

The DID estimator is then given by:

$$\hat{\alpha} = (\overline{\Delta Y_{it}^{Tr}}) - (\overline{\Delta Y_{it}^C}) \quad (14)$$

$$\text{With } (\overline{\Delta Y_{it}^k}) = \frac{1}{N_k} \sum_{i=1}^{N_k} (Y_{it}^k - Y_{it-1}^k), k \in \{Tr, C\} \quad (15)$$

In a multiple regression model this becomes:

$$Y_{it} = \alpha D_{it} + \mu Z_{it} + \beta_i + \gamma_t + \varepsilon_{it}; i = 1..N \text{ et } t = 1 \dots, T \quad (16)$$

The estimator of the *DID* is equivalent to the estimator "within" the projected pattern on the space orthogonal to the fixed effects and time.

$$WY = WX\beta + W\varepsilon \quad (17)$$

Where $X_{it} = [D_{it}, Z_{it}]$ and $\beta = (\alpha, \mu)$. The estimator "within" of the parameter vector is given by:

$$\hat{\beta}_{cov} = (\sum WX)^{-1}(\sum WY) \quad (18)$$

$$V(\hat{\beta}_{cov}) = \sigma^2(\sum WX)^{-1} \quad (19)$$

Assumptions of the implementation of the *DID* estimator are four and are:

H_1 : The temporal effects are assumed to be common to the both treatment groups and the control group $\gamma_t^{Tr} = \gamma_t^C$, at least $t = \tau$ and $t - 1 = \tau - 1$.

H_2 : There can be no attrition or endogenous selection between $\tau - 1$ and τ .

H_3 : The error terms are assumed not auto correlated; otherwise, the standard deviation of the treatment effect is systematically underestimated, *Bertrand, Duflo and Mullainathan (2004)*. In this case, the null hypothesis of no treatment effect $H_0: \alpha = 0$ is rejected too.

Model variables can be cited as follows:

The outcome variables are the termination rates in fixed and mobile phone and quality of service, it can be considered as a variable that reflects the performance of the both sector. **(MTR):** Prices of mobile communication as measured by the call cost per three minutes (MT/3mn) in U.S. Dollar is expressed in logarithm. **(FTR):** Price of fixed communication measured by the call cost per three minutes (FT/3mn) in U.S. Dollar and expressed in logarithm. **(Faults):** number of connection error or failure to call 100 mainlines. This is a variable of the quality of fixed service phone.

For the treatment variables are three: **(Regulation):** This is a dummy variable that takes the value 1 from the year he has been creating a regulatory agency "separate" from ministry.. **(Competition):** The number of mobile operators other incumbent who installed their networks and sell their services. **(Privatization):** This is a dummy variable that takes the value 1 from the year in which there has been privatization of the incumbent and 0 otherwise. While another group arranges the control variables **(GDP / capita)**, expressed in U.S. Dollar

(urban), and (total population) .These macroeconomic variables denote the demand factors in the both sector. **(TLPSE)**: Total capacity of local public switching exchanges (total exchange capacity of the service provider for fixed number). **(RMT)**: Residential telephone monthly subscription in US Dollar. **(MCM)**: Mobile cellular subscription in US Dollar. **(MCC)**: Mobile connection charge in US Dollar. In order to find consistent results, we chose to expand the sample of 18 countries to 40 countries with homogeneous characteristics. This sample besides the Arab countries was adding other countries of Europe and Latin America from 1992 to 2008.

3-3) Results and comments:

The difference-in-difference method measures the difference in an outcome (performance in terms of Tariffs and quality) between the treatment and control groups over the period (1992-2008):

- 1/The first difference should eliminate individual systematic effects;
- 2/The second difference should eliminate eliminates time effects (common to both groups) in the absence of the program.

This estimator is used to identify the causal effect, causal, measurement needs to be evaluated under the assumption that the performance of the two groups would have actually evolved in the same way in the absence of regulation.

For example, with the treatment variable "Privatization" we are faced with two situations. The presence of two groups: one affected by a privatization program (treated group) and the other no-affected (control group). And two other groups (before and after) starting privatization program. Both situations are summarized in the following table









	<i>Treated group</i>	<i>Untreated group</i>	<i>Difference</i>
After privatisation program	9685.007 - - 	9723.879  - 	(-38,872) -
Before privatisation program	9680.169  - =	9719.067  = 	(-38,898) 
Difference	4,838 -	4,812 	=0.026

Table 1 : Causal effect of privatization on mobile termination rate

The specific causal effect of privatization on interconnection rates for mobile phone (IMR) is positive and equal to 0,026. This score is obtained by the following double difference:

$$\begin{aligned} \text{Difference} - \text{in} - \text{difference} &= \text{Impact of privatisation} \\ &= (MTR_{t1} - MTR_{t0}) - (MTR_{c1} - MTR_{c0}) \end{aligned}$$

Or: $\text{Difference} - \text{in} - \text{difference} = \text{Impact of privatisation} = (MTR_{t1} - MTR_{c1}) - (MTR_{t0} - MTR_{c0})$

With $MTR_{t1}, MTR_{t0}, MTR_{c1}$ and MTR_{c0} , are, respectively, the performance of the sector (in terms of prices); for the treatment group before and after starting the privatization program and the comparison group before and after starting program.

The estimation results (*see table 2*) are as follows: regulation has a negative effect on the interconnection rates of mobile and fixed networks, but negative on the level of service quality. While privatization has a positive effect only on the interconnection tariffs of mobile phones and a negative effect on the other two performance variables. The same effects of competition. These various results of the estimation of the previous model with simple linear panel with interaction variables (first and second level). The difference lies in the importance of the use of econometric evaluation method.

4) Conclusion:

In this paper we was explored the impact of regulation; privatization and competition on the both mobile and fixed phone performance, in terms of service quality (network faults) and tariffs in both fix and mobile telecommunication services, using the tow different techniques (parametric approach and non parametric approach) of propensity score matching and based on panel data Difference-in-Differences estimations from 1990 to 2008.. Overall, our estimations show a positive relationship between the presence of regulator and tariffs and quality. However, competition has no effect on tariffs. This result allows us to suspect the presence of collusion between competitors. The results of estimation model are generally consistent with various hypotheses in economic theories of regulation. Indeed, the establishment of a regulatory authority is a critical component in reforming sector of mobile phone. Indeed, we found a strong positive correlation between regulation and two indicators of mobile performance. This correlation is quite remarkable especially when done jointly estimate the competition with regulation, and privatization with regulation. This result is quite

logical since the regulation is actually a one of competition, and the regulator on its part to encourage the privatization of the incumbent to increase its independence. Several variables can be introduced to correct the inefficiency of the estimate, such as those relating to the characteristics of regulation (price caps, cost of service...) of performance (number of employees, organization, financial resources), and privatized share of each operator. We can also introduce a variable that indicates whether the establishment of regulatory authority before privatization or the introduction of this variable may help us to evaluate the effort of regulatory authorities in the privatization of incumbent operators and its impact on performance sector.

The matching estimation, moreover DID method, it ranks various types of estimators namely the matching estimator stratified (Stratification Matching) by matching with the nearest neighbor (Nearest Neighbor Matching) by matching a given threshold (Caliper Matching) by matching a given radius (Radius matching) by matching with kernel (Kernel matching) and exact matching with group (coarsened exact matching): purpose of futures scientific productions.

	Treatment variables								
	Regulation			Privatisation			Competition		
variables	Mobile.T.R	Fixed.T.R	Quality	Mobile.T.R	Fixed.T.R	Quality	Mobile.T.R	Fixed.T.R	Quality
GDP	7349.987	2.4e+04	2.1e+04	-1.0e+04	9895.966	1.9e+04	-1.2e+03	2.2e+04	2.0e+04
Population	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Urb. population	0.889	-0.242	0.370	1.099	-0.140	0.412	1.056	-0.220	0.405
TLPSE	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000	-0.000
RMT	1.976	1.890	1.893	1.673	1.273	1.757	2.334	1.246	2.095
M.C.M.S	0.591	0.690	0.176	0.182	0.432	0.081	0.443	0.643	0.141
M.C.C	-0.080	-0.016	-0.007	-0.068	-0.006	-0.003	-0.081	-0.017	-0.007

Treatment variables														
(Performance)	Regulation							Privatisation						
	Base line			Follow-up				Base line			Follow-up			
	Control	Treatment	Différence (BL)	Control	Treatment	Différence (FU)	D.Différence	Control	Treatment	Difference (BL)	Contrôle	Treatment	Difference (FU)	D.Différence
Mobile.T.R	-7.8e+03	1.7e+04	2.5e+04	-7.8e+03	1.7e+04	2.5e+04	-12.574	9685.007	9723.879	38.872	9680.169	9719.067	38.898	0.026
Fixed.T.R	-1.0e+04	-284.633	9857.275	-1.0e+04	-284.447	9852.357	-4.918	-1.5e+03	1250.079	2721.350	-1.5e+03	1249.526	2720.034	-1.315
Quality	1567.339	7102.003	5534.665	1566.549	7098.446	5531.897	-2.767	6085.333	7751.485	1666.153	6082.280	7747.613	1665.333	-0.819
Competition														
	Base line			Follow-up										
(Performance)	Control	Treatment	Différence (BL)	Control	Treatment	Différence (FU)	D.Différence							
Mobile.T.R	988.136	-2.5e+03	-3.5e+03	987.652	-2.5e+03	-3.5e+03	1.709							
Fixed.T.R	-7.9e+03	-252.317	7623.321	-7.9e+03	-252.116	7619.549	3.772							
Quality	4166.591	4566.257	399.666	4164.499	4563.958	399.459	-0.208							

Table 2 : Estimation results of Difference-difference method

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