

Do reforms sequences matter for telecom sector performance?

Evidence from MENA countries

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Abstract

Since the late eighties, governments in developing and developed countries have designed telecommunication policies aiming at introducing competition. This implies usually new regulation framework and privatization of the State Owned Enterprises (SOEs). This paper empirically assesses the effect of the sequence of different infrastructure reforms (regulation, privatization and competition) in the telecommunications sector on the sector performance, by using a sample of 17 Middle East North African “MENA” countries for the period 1995-2010. Countries are free to choose how to proceed notably whether to establish an independent regulatory authority (IRA) before or after privatizing the State Owned Enterprises (SOEs), as well as they can create the IRA before introducing competition rather than after. In the case of MENA countries, which are significantly heterogeneous in terms of economic development and financial constraint notably, we assume that the choices of reforms sequences are affected by institutional, political and economic variables such as the democracy level, the legal origins, the natural resources rents per country and the independence year from colonization. We correct for the endogeneity of telecom reforms sequences and we use IV-2SLS estimation to analyze the outcome of reforms sequences in terms of telecommunication sectors performance (access, prices, productivity and quality). We find that the sequence of reforms matters: an IRA established before privatizing the incumbent operator improves the sector access but with an increase in the fixed prices. However, the effect of the IRA before introducing competition doesn't increase efficiency. This result can be explained by the regulatory capture and the high level of incumbent protection in MENA, which impose high constraints on new entrants.

JEL classification: L11; L14; L33; L43; L51; L96; O38; O50

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1. Introduction and overview of MENA telecom sector

Since the late eighties, telecommunication reforms took place both in developed and developing countries. The liberalization of the telecom sector contributes largely to the economic growth through the ICT development and diffusion in the economy. Specifically, with increased mobile competition in MENA, mobile revenues have contributed to economic growth, job creation, greater investment and integration in the global economy (Hakim and Neaime, 2014). Indeed, the price and quality of telecommunication services affect the capacity of businesses to compete in foreign and domestic markets (Rossotto et al., 2005). Middle East and North Africa (MENA) countries face the medium term challenges of creating employment opportunities for a rapidly growing young population, serving local markets and exports needs. This typically requires development and growth, and as such the opening up of markets in telecommunications services, holds a big promise of realizing this challenge. Market openness in telecommunications services and the quality of regulatory regimes are main drivers of ICT sector development (OECD, 2000b). As in many other infrastructure industries, technological innovation, as well as ideological and institutional changes have made possible the move away from a natural monopoly model to introduce competition where possible⁴ in the telecommunication sector through the so-called regulatory reforms (Laffont and Tirole, 1994, Noll, 1989, Laffont, 2005 and Armstrong and Sappington, 2007).

In practice, these reforms consist of various features such as vertical disintegration (unbundling) of the infrastructure activities, introduction of competition where possible through the openness to access the networks to the new actors and the fostering of new entrants into mobile/fixed telephony, data transmission and Internet services markets, the establishment of new contractual forms through license contracts, the privatization of SOEs which means organizing as far as possible the State's disengagement from production and finally the creation of new regulatory mechanisms and institutions. In telecommunication sector as in many other infrastructure industries (electricity, water, gasoline, railways), it has been argued that competition creates additional incentives to reduce costs, to innovate and to eliminate distorted (regulated) prices (Laffont and Tirole, 2001). Once that said, the question is how to proceed to efficiently introducing competition, privatizing SOEs and re-regulating the industry. Indeed, new regulatory mechanisms⁵ and institutions (notably an independent regulatory agency (IRA) and the Competition Authority⁶) are needed to create a reliable and stable institutional framework to deal with new kind of relationships based on transparency and impartiality between the State on one side, and private-owned firms and all stakeholders on the other side. Regulators have thus to carry various tasks namely detecting undesirable or non-compliance behaviors, designing and developing appropriate regulatory mechanisms tools and strategies for responding to these behaviors, enforcing those tools and

⁴ In this paper, we focus on the services-based competition rather than the network-based (facilities-based) competition, as we will explore later on.

⁵ These regulatory mechanisms include licensing rules, interconnection agreements and dispute resolution mechanisms, third party access to the networks, incentive contracts (Intven, 2000, Levy and Spiller, 1994 and Laffont and Tirole, 2001).

⁶ Obviously, the adoption of competition law is a necessary condition to introduce competition into economic activities but it is not a sufficient condition. The creation of a Competition Authority, with the adequate power, independence, and credibility also plays an important role in creating a more or less deep competition culture. As we will see, the difficulties encountered in the implementation of competition policy in developing countries have implications for the optimal sequence of reforms even if we focus more on sectoral regulatory authorities than competition authorities. As privatizations and formal liberalizations are likely to lead to private monopolies; efforts to impose these reforms before a credible set of institutions – regulation and competition policy – will yield disappointing results (Laffont, 1998).

strategies on the ground and assessing their success or failure and modifying them accordingly (Baldwin, Cave, Lodge, 2012). Regulatory reforms consist in fact in “reregulating” the sector (Ménard and Ghertman, 2009) through different type of reforms.

A crucial question for policy makers is what should be the optimal sequence of the reforms considering that privatization, liberalization and the creation of an IRA might occur simultaneously or sequentially. More precisely, the question is whether a country should create an IRA before the privatization of its incumbent operator and/ or the introduction of market competition or whether it is better to liberalize and privatize before creating an IRA as it has been done typically in Germany (Glachant *et al.*, 2008). This paper deals with this specific aspect. Up to now, no single way to proceed has emerged; countries have followed quite heterogeneous and changing policies regarding the sequence. Still, for most MENA countries as for all countries, liberalization is typically done in two steps. First step consists of the enactment of a telecom law and the establishment of an independent regulatory authority. In the second step, dependent on the success of the first one, the telecom authority starts to liberalize the telecom market (Hakim and Neaime, 2014). But as we will see, that is not always the case, or in the case of MENA countries, we can suspect that it is just theoretical or “on paper”; in practice, the power given to the IRA, or the number of effective entries doesn’t correspond to real liberalization standards.

Intuitively, the reforms sequences should determine the behaviors of both public and private actors and consequently the performance of the industry. Typically, an independent regulatory agency is supposed to create the conditions for new entrants to have a reasonable expectation of obtaining a return for their investments (Richardson, 1960) and the insurance not to be expropriate (Levy, Spiller 1994). On the top of that, the recent Arab Spring comes on the heels of the region’s recovery from the global economic crisis in the late 2000s, with a dampening effect on foreign investment in the region. Still, while socio-political and institutional factors help explaining the differences in the pace of economic reforms among MENA countries, the main explanation of the heterogeneity of MENA countries at the general regional level are the distinguishing structural features of the economies in the region (Karshenas, 2001). As argued by the World Bank (2013), MENA countries may find themselves in a resource trap unless they succeed in strengthening institutions and improve the investment climate, especially political and macroeconomic stability. Furthermore, the state of FDI in MENA shows differences from the rest of the world (World Bank, 2013); although the region attracted more FDI in the 2000s relative to the 1990s, the majority of MENA countries are still below potential. Thus, assessing the economic reforms in MENA region, and notably the telecommunication sector reforms which may strongly impact other economic outcomes, is crucial to be able to make an assessment – conditional on data availability – after such political transitions. As argued by the World Bank (2013), *the absence of significant economic reforms, combined with persistent political and macroeconomic instability, is likely to keep investment and growth below potential in developing MENA, not only in the short run but in coming years, unless there is a break with past practices.*

This can be explained by the fact that when public and administrative power is still heavily centralized and when public authorities keep a strong influence on both public and private firms as it is the case in most MENA countries (the so-called “administrative regulation” as opposed to the “neo-liberal regulation” (Mezouaghi, 2008), it is not surprising that the same sequence applied in less centralized countries gives different results in term of performance. In addition, the reforms process in MENA countries remains far from complete in spite of international pressures from the IMF, WTO or the WB to

implement these reforms (Worldbank, 2013)⁷. Market liberalization in telecom sector has been slower in MENA than elsewhere in the developing world and above all, it has resulted in lower performances. In terms of access, as of 2010, every market in MENA region has at least two mobile operators; however, this is not the case in the fixed-line market. Although fixed-line markets are competitive in Bahrain, Jordan, Morocco, Oman, Saudi Arabia, Sudan and United Arab Emirates, some countries still have a monopolist in their fixed-line services as Algeria, Djibouti, Egypt, Kuwait, Lebanon, Libya, Qatar, Syria, Tunisia and Yemen. Moreover, the monopolist incumbent operator remains a state-owned operator in Algeria, Djibouti, Kuwait, Lebanon, Libya, Syria and Yemen.

Surprisingly, there are relatively few studies addressing the impact of telecom reforms in MENA countries on performances (Rossotto et al., 2005) as compared to other developing countries like Latin America (Wallsten et al., 2001, Fink et al., 2003, Estache et al., 2006,...). MENA countries share many features with other countries regarding the motives and the implications of the liberalization of telecommunication industry as it has been theoretically and empirically analyzed based on the different experiences in developed and developing countries. The same reasons why regulation based on monopolies has failed as analyzed by Laffont and Tirole (2001) applies in MENA countries.

Concerning our research question, this is particularly acute since to our knowledge; only two studies explore the impact of reforms sequences in telecom sector (Wallsten, 2003; Fink et al, 2003). This lack of empirical analysis is all the more regrettable that liberalization in MENA region should be taken for granted (Cankorel and Aryani, 2009). For instance, Algeria has repeatedly postponed the privatization of the incumbent operator it committed to in the Telecommunications Sector Policy Statement in 2000⁸. Even Lebanon, among other countries, still has a monopolist state-owned incumbent operator. Although the formation and privatization of Liban Telecom is defined in the Telecommunications Law 2002, it doesn't take place up to now due to political conflicts. The telecommunications markets in MENA region remain less open to competition than elsewhere in the developing world – on average, the level of telecom restrictive policies affecting the developing world (in a sample of 79 countries including countries from Asia, Africa, Latin America, MENA...) is 0.35⁹ compared to 0.46 in MENA countries – therefore denying the region the benefits of increased participation into global trade, with stronger export and growth performance (Rossotto et al., 2005)¹⁰. In addition, in the case of some MENA countries, the relatively low performance of the telecom sectors should be analyzed taking into account all institutional factors since there is no obvious reason why the reforms shouldn't be successful except in some segments

⁷ Typically, telecom liberalization is a requirement for accession to the WTO (Hakim and Neaime, 2014). As the conditions to become a WTO member imply that each country should engage in multilateral and bilateral negotiations (WTO, 2015) and before it can join the WTO, it has to establish binding limits on the taxes, or tariffs it charges on imports. This encourages freer trade, but it also leaves the country's domestic producers more exposed to foreign competition (The guardian, 2012). Such conditions apply to the telecom sector, among services sectors.

⁸ This policy Statement called for the gradual liberalization of the sector including the privatization of the public telecommunications operator. The Algerian government initially planned to sell off 35% of the operator in an initial public offering (IPO) at the end of 2006, the tender was then rescheduled for 2008. In 2008, the company's CEO announced another delay from two to three years to improve its services and become more competitive.

⁹ It is the value of an index constructed by the WB to reflect the level of market restrictions; it varies from 0 (an open market) to 1 (a closed market), these averages are calculated in Ahmed Ezzat and Aboushady (2015).

¹⁰ As in Rossotto et al. (2005), in 1998-1999, MENA countries with restricted market access include Kuwait, Tunisia, Yemen, Algeria, Iran, Libya, Oman, Qatar, Saudi Arabia and Syria. Countries with limited degree of market openness as Bahrain, Egypt, Jordan and Lebanon. Moderate market openness are present at Morocco and Israel. No country is with full market openness. Openness indicator is based on competition in fixed and mobile markets, openness to foreign ownership and pro-competitive regulation.

of the industry (notably mobile- services compared to fixed-services) given the specificities of the telecom sector in the MENA countries.

In some MENA countries, the introduction of additional network-based operators may not be a feasible option since investors may be reluctant to enter markets with high entry-costs in a highly uncertain environment¹¹. Thus, the introduction of service-based competition – by relying on the existing infrastructure of network operators¹², – would enable them to recover their initial investments relatively quickly and thus, the services-based competition may be the primary enabler for better market development. The sector that is most reluctant to such a competition is the fixed voice market¹³ (El-Darwiche et al., 2008). Facilities-based would be therefore encouraged to invest in improving their infrastructure. In this case, having a regulator in place before the introduction of competition is crucial to ensure that operators would allow access to their networks through unbundling or resellers access, in a non-discriminatory manner. Although the significant positive effects of services-based competition, facilities-based markets should not be neglected (El-Darwiche et al., 2008). The fixed market is still with importance for the region; most of the region access the internet through dial-up connections and rural areas are disconnected from the world (Cankorel and Aryani, 2009). But, they also access the internet through broadband internet services accessible mostly via a fixed line service.

As a result, the range of competition varies across MENA region. It is possible to propose a typology of MENA countries depending on their competitiveness and their openness to FDI. The first group is composed of most GCC. Although not all GCC countries are opened for competition and for foreign investments, they still have the capital – except Yemen – allowing them to invest domestically in the telecom sector. For instance, although Kuwait and Yemen have the same level of telecom reforms – only the mobile market is opened for competition – the level of performance in both countries are far from comparable in terms of telecom performance (the level of fixed penetration is 20.7 % in Kuwait compared to 4.35% in Yemen in 2010). Moreover, the mobile penetration is 160.8% in Kuwait in 2010 compared to 46.1% in Yemen. The other exception among GCC is Oman in the sense that even if it is a completely closed country to foreign equity share it has a competitive fixed and mobile market, as well as a partially private incumbent operator. The other group of countries – mostly oil importing countries which contrary to GCC don't have enough domestic capital – is facing external financing constraints and fiscal pressures. North-African countries know moderate level of competition compared to GCC countries, with the exception of Morocco. Lebanon and Libya are crippled and struggled with high service tariffs or entry barriers with a state-owned monopoly in the fixed sector and a government owned-duopoly in the mobile sector.

As such, it is not easy to characterize MENA countries according to their competitiveness and openness to FDI. Too many differences are among them. The analysis of the telecom sector in the MENA region suggests that the level of performance and the number of operators in each market are more likely to be explained by differentials in income levels rather than regulatory policies and commitments to open the market (Ahmed Ezzat and Aboushady, 2015). There are countries in the region that are quite

¹¹ Due to the reluctance of investors to enter markets, either due to market limitations (such as high level of saturation, small size and decreasing returns) or technical limitations (scarce resources and spectrum availabilities) (El-Darwiche et al., 2008).

¹² Investments in telecom infrastructures in MENA are limited compared to other regions. Moreover, they are much below their peak in 2006 when the region attracted \$9.47 billion of investments, compared to \$2.9 billion in 2012. Egypt and Morocco are the 'largest market in MENA'; both received 29% of investments in this region, which was a little over \$800 million each. Smaller investments occurred in Syria, Jordan, Algeria, West Bank and Gaza (Jett & Verink, 2013).

¹³ The competition took place with carrier selection regulation in Bahrain, Jordan, Morocco and the UAE; and fixed-voice resale in Bahrain, Jordan, Egypt and Morocco.

advanced and have ICT levels quite comparable with developed countries, as UAE, Bahrain, Kuwait and Qatar. All these countries are oil producers and are small compared to North African countries as Egypt.

Although the overall increase in landline penetration in MENA region between 1995 and 2010 from 11.49 to 15.26 lines per 100 inhabitants, MENA fixed penetration has two trends. In 1995, higher income GCC countries know penetration rates of over 20%. However, the remaining MENA countries suffer from significantly lower landline penetration due to large geographical size and relatively lower income levels. In 2010, most middle-income MENA countries (Egypt, Morocco and Tunisia) witness an increase in landline penetration. Second, with the exception of Oman and Saudi Arabia, GCC countries witness a decrease in landline penetration to about an average of 20 lines per 100 inhabitants. Concerning the mobile market in MENA, it is oversaturated with 10 out of 17 countries have a mobile penetration rate of over 100%. Moreover, MENA region knows a mobile penetration higher on average than low- and middle-income countries and OECD countries. Increased mobile penetration is not only specific to GCC countries, but also to middle-income countries such as Egypt, Jordan and Morocco.

Hence, the telecom reforms sequence – a neglected issue in MENA agenda – is very crucial for MENA reforms policies. We need to assess what is the miracle recipe for reforms sequences in MENA region. Reaching a consensus on economic reforms for MENA region becomes a pre-requisite for high economic growth in developing MENA countries, specifically structural reforms that have long-term effects on the provision of backbone infrastructure services as the telecommunications sector.

In this paper, we will investigate empirically the effect of various reforms sequences on the telecom sector performance for MENA countries, in order to derive policy implications for reforms sequences in the region. The paper is organized as followed. Section 1 introduces the issues at stake regarding the sequences of reforms in the telecommunication in the specific context of MENA countries. We insist on the fact that even if MENA countries differ among each other's, they share some characteristics that justify to consider them together in the empirical strategy to test the impact of the sequence of reforms on the telecommunication performance. In the second section, we review the literature on the dynamics of reforms and derive testable propositions. In the third section, we present our empirical strategy and results. Section 4 discusses the results and we conclude in section 5.

2. Related literature and testable hypotheses

The debate on telecom reforms sequences has already been explored empirically notably by Wallsten (2003) and Fink et al. (2003). This gap is largely the result of a lack of data. Our objective, in this section, is to find a relationship between telecom reforms sequences and telecom performance. Telecom reforms sequences explored in our paper are: Regulation-Privatization and Regulation-Competition sequences. Concerning telecom performance, it has four dimensions: access, affordability, productivity and quality. In the section, we will present previous empirical studies and we derive our testable hypotheses.

2.1. Does the establishment of a separate regulator prior to the incumbent privatization help reducing the privatization drawbacks?

Large monopolies firms were often privatized with no regulatory authorities in place that could help facilitate competition (Wallsten, 2003). Moreover, governments sometimes give exclusivity periods to the privatized monopolies, so they can make higher profits before introducing competition. Thus, by

regulating the sector, the government would retain its interests in the operator publicly owned to maintain its monopoly profits rather than promoting market efficiency. As a result, a separate regulator appears as a way to eliminate inefficiencies occurring in the public operator functioning, as well as inefficiencies in regulating the sector. Therefore, it is better for countries to create an IRA before the privatization of their incumbent operator. The OECD stated that *one core element in any reform package is the introduction of fair rules of the game in a newly privatized market for public services including the establishment of independent, competent and credible ad hoc institutions* (Goldstein, 2002). However, while privatization can bring about great improvements, it must be combined with effective regulation (Wallsten, 2001). More specifically, it is recommended to have a regulatory framework prior to privatization (Wallsten, 2003). Spiller (1993) confirmed that the prior or simultaneous development of the required institutions is crucial when the privatization takes place. This would serve to avoid opportunistic behavior and give a guarantee for investors against the risk of expropriation (Shapiro and Willig, 1990).

Therefore, the presence of an IRA prior to the privatization of the incumbent operator matters to ensure market efficiencies. In our sample of MENA countries, introducing privatization before the establishment of IRA took place only in: Bahrain, Qatar, Sudan and United Arab Emirates. In all other countries with a separate regulatory authority, the privatization process took place after the establishment of IRA. However, we should take into account other dimensions, as stated by Wallsten (2003); it is likely that a quick privatization process is due to a bad sector performance, that governments want to be rid of. However, countries with a better sector performance may have more time to establish their separate regulators prior to the privatization. .

Wallsten (2003) tests the effect of the sequence of introducing different reforms; he finds that establishing a regulator prior to the privatization process is correlated with improvements in telephone penetration and incumbent's investment. Consequently, investors pay more for telecom firms in countries that established a regulator prior to the privatization process.

Hypothesis 1. The establishment of a separate regulatory authority prior to the privatization of the incumbent operator helps increasing the telecom penetration and productivity and helps decreasing prices.

2.2. Does a regulator in place prior to the introduction of market competition affect the telecom sector performance?

The presence of a separate regulatory authority before the introduction of market competition is crucial. An IRA should put in place the rules required to introduce market competition and to efficiently regulate *the residual monopoly elements* in the sector (Estache et al., 2006). Such rules concern: licensing conditions, interconnection agreements, technical standards and management of scarce resources in non-discriminatory way. The presence of a separate regulator in place prior to the entry of new competitors is thus of great importance. Pro-competitive measures taken in this phase should result largely in higher penetration and lower prices. Consequently, the establishment of a regulatory authority before the entry of new competitors is a priority, in order to oversee the incumbent behavior and to serve as guarantee for new competitors.

Hypothesis 2. The establishment of a separate regulatory authority, before the introduction of market competition, helps increasing the telecom penetration and helps decreasing prices.

2.3. Institutional, economic and political factors as instruments for the reforms variables

The institutional and political framework for MENA countries is of great importance since it affects the decision to adopt different reforms. In their study, Levy and Spiller (1994) find that the credibility and effectiveness of a regulatory framework and its ability to facilitate private investment vary with the country political and social institutions. Furthermore, they find that the privatization in countries that lack the formal and informal institutions will require the development of alternative safeguards. Unless the required institutions develop as the privatization process progresses, investors will be reluctant to invest. In this subsection, we argue that institutional, economic and political factors explain the reform process adopted by MENA countries.

Consequently, we argue that the reform process is affected by the level of democracy established in each country. The intensity of the democracy indicator would thus affect different reforms adopted by MENA countries such as; the adoption of IRA, the attractiveness of private investments and the market competition. According to Giuliano et al. (2012), the democracy has a positive and significant impact on the adoption of economic reforms, but there is no evidence that economic reforms foster democracy. Theoretically, *economic theory does not give clear answer on whether political liberalizations favor or hinder economic reforms or if the relationship could go both ways* (Giuliano et al., 2012). Empirically, only a few papers study the relationship between democracy and reforms¹⁴. This indicator appears thus to be a valid instrument for telecom reforms; overall democracy is not likely to have a direct effect on telecom market performance other than through different reforms. Moreover, telecom reforms are sufficiently micro-measured; hence it is not possible that such reforms would alter the level of democracy.

The legal origins were introduced in many countries through colonization. As considered by La Porta et al. (2008) in their study, the legal origin of a country is a style of social control of economic life, and such styles have developed, survived over the years and continued to have substantial economic consequences. Legal origins prove their persistency in different countries and are very difficult to be altered. Furthermore, the historical origin of a country's laws is highly correlated with a broad range of its legal rules and regulations, as well as with economic outcomes (La Porta et al., 2008). With a focus on the effect of legal origins on government regulation, La Porta et al. (2008) find that civil law countries are qualified by government ownerships, while common law countries are more likely to use private contracts. They conclude that common law countries have better investor protection, lighter government ownership and regulation and more independent judicial systems, which are associated to more secure property rights. Hence, we argue that the historical legal origin of each country is likely to affect the reform adoption, specifically in terms of privatization and market competition. Finally, legal origins seem to be a valid instrument for telecom reforms, since they are considered as historical facts difficult to be altered. Therefore, it is far from real to consider that telecom market performance could shape the legal origins of each country.

Another factor that is likely to affect the reform adoption is the natural resources in MENA countries, considered as an important source of rents. MENA countries are known by their abundant natural resources, including oil, natural gas, coal, mineral resources and forest. According to the World Development Indicators (2013), Arab World and MENA countries lead the World in the natural resources rents. In fact, the motive for public ownership of incumbent operators has been the government desire to keep control on the rents produced in order to exploit oil and other non-renewable natural resources (Goldstein, 2002). Moreover, major reforms are introduced under the pressure of the IMF and the WB in

¹⁴ As in Giavazzi and Tabellini (2005), Djankov and Amin (2009) and Quinn (2000).

order to reschedule debt service payments or to resort for new loans. Thus, countries independent in their resources are less forced to adopt reforms under such pressures.

Finally, we need to control for the independence year from colonization for each country, which is also considered as a historical factor that would affect the lags in the establishment of a separate regulator. Thus, later the independence year, lower the time available for the country to develop its national requisite institutions and get rid of the pre-independence institutions.

To sum up, it would be interesting to test the interplay between the institutional, economic and political variables and the adoption of telecom market reform, as well as their sequences, to explain different factors leading to faster reform adoption.

Hypothesis 3.

3.a. A more democratic country is likely to have a high level of reform adoption.

3.b. A civil law country is less likely to adopt reforms, specifically in terms of privatization and market competition.

3.c. Countries are more reluctant to adopt different reforms when they have abundant natural resources.

3.d. Latter is the independence year from colonization, more are the lags in reform adoption.

3. Empirical strategy

3.1. Empirical model

Our aim is to develop an empirical analysis on 17 MENA countries from 1995-2010 to explore the impact of the sequences of different reforms – namely the Regulation-Privatization sequence and the Regulation-Competition sequence – on the telecom sector performance in the voice market for fixed and mobile segments. We estimate the following model by using Instrumental Variable-Two Stages Least Squares (IV-2SLS) estimation¹⁵ while accounting for the endogeneity of reforms and while including year dummies¹⁶. We adopt a log-linear specification to transform different variables into a normal distribution. The regression takes the form:

$$Y_{it} = \beta_0 + \beta_1 R_{it} + \beta_2 X_{it} + Z_t + u_{it} \quad (1)$$

Where Y_{it} is one of the four performance indicators we have chosen to consider. R_{it} is a vector of reforms and reforms sequences dummies. X_{it} is a vector of control variables (GDP per capita and Population

¹⁵ Even if our endogenous variables are discrete variables, the consistency of IV-2SLS does not require the endogenous variables to be continuous (Heckman and Robb, 1985). Using the logit model in the first stage is unnecessary since in 2SLS estimation, the consistency of the estimates in the second stage are not dependent on the correct functional form in the first stage. Moreover, performing the 2SLS step by step procedure leads to inconsistent standard errors, since it does not take into account in the second stage that the endogenous variables were predicted in a previous step.

¹⁶ We don't use fixed effect estimation, since they don't allow for the estimation of time invariant effects, such variables would be dropped from the estimation process. In our sample, we have some time invariant variables, whose effects would be lost in the fixed effects estimation. Fixed effects methods are useless for estimating the effects of variables that don't change over time. Fixed effects and first-differencing methods can lead to imprecise estimates in cases where the key variables in X_t do not vary much over time (Wooldridge 2010).

density), Z_i are year dummies and u_{it} is the disturbance term. Each equation is estimated for each of the dependent variables we consider here.

To get the first stage results, we test the effect of institutional, economic and political variables, used as instruments, on different reforms variables. Specifically, we model the decision to have an independent regulator, privatize and foster competition, using an OLS model. The regressors are mainly the democracy indicator, the legal origin, natural resources rents as % of GDP and the independence year, plus the exogenous variables we used in the second stage equation (such as population, GDP per capita and year dummies).

3.2. Data¹⁷

The previous hypotheses, mentioned in section (1), will be tested using a panel dataset of 17 MENA countries from 1995 to 2010¹⁸. We construct our original database from various sources, as detailed in this section. Moreover, we are focusing only on voice market in the fixed and mobile segments.

To assess the performance, we use four different dimensions: access rates, productivity, prices and quality, as used by Estache et al. (2006). We use different proxy variables to reflect those dimensions. To reflect access rates, we use as dependent variables, fixed and mobile penetration (the number of fixed and mobile telephone lines in a country per 100 inhabitants in natural log).¹⁹ The productivity is measured by the number of telephone subscribers in fixed and mobile telephone per employee (employed by total full-time telecommunication employee)²⁰. To measure affordability, we use prices indicators²¹ as the monthly subscription for residential telephone service in US\$ as in Estache et al. (2006) and Gasmi et al. (2013), and the price of a 3-minute fixed telephone local call (at peak and off-peak rates) in US\$ as in Wallsten (2001), Li and Xu (2004) and Estache et al. (2006). We use also mobile price of 3-minute local call (at peak and at off-peak rates) in US\$ to reflect mobile affordability as in Gasmi et al. (2013). As suggested by the ITU (2012), we construct price baskets; a price basket for landline services and a price basket for mobile services, to better reflect affordability. The landline price basket includes monthly subscription fees in addition to the rate for 30 three-minute local calls to the same network (15 minutes at peak rate and 15 at off-peak rate). As in ITU (2012), the mobile basket is equivalent to 50.87 minutes, we calculate it as $10 * (\text{mobile price of 3-minute local call (at peak)} + \text{mobile price of 3-minute local call (at off-peak)})$ due to the lack of some prices indicators²². The data on prices are available at the ITU database.

¹⁷ See Table 1 for the variables list and Table 2 for the summary statistics.

¹⁸ Countries included: Algeria, Bahrain, Djibouti, Egypt, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Sudan, Syria, Tunisia, United Arab Emirates, and Yemen. We eliminate Iraq, Iran and Palestine due to the lack of consistent data for many variables over the whole period. Also, we eliminate Israel and Turkey since they are considered as developed countries (OECD countries).

¹⁹ This measure is used by different authors (Ros 1999; Ros 2003; Fink et al. 2001; Fink et al. 2003; Wallsten 2001; Li and Xu 2004; Gual and Trillas 2006; Gasmi et al. 2013; Trillas and Montoya 2011).

²⁰ This measure is used in different studies (Ros 1999; Ros 2003; Gutiérrez 2003; Li and Xu 2004; Gual and Trillas 2006; Gasmi et al. 2013). We use this method to measure productivity since we don't have the number of telecom employees per segment. We find that dividing the number of mainlines by the number of staff employed by telecom operators is not reliable, as used in (Ros 1999; Ros 2003; Fink et al. 2001; Fink et al. 2003; Wallsten 2001; Li and Xu 2004; Gual and Trillas 2006; Gasmi et al. 2013; Trillas and Montoya 2011).

²¹ Given by ITU Database (2011).

²² The monthly mobile price basket includes the price of 30 outgoing calls (on-net, off-net and to a fixed line, for peak, off-peak and weekend periods), plus 100 SMS messages (50 on-net and 50 off-net).

Quality indicators are the least reported variables. To measure fixed quality, we use the waiting list for fixed lines, the faults per 100 fixed lines per year and the percent of fixed telephone faults cleared by next working day. So, the data we use are the best data available up till now. The data on the performance indicators come from the ITU database.

Tracking evolution in the dynamics of reforms in MENA countries is very complex. One of the steps taken by each country to reflect its commitments to adopt telecom reforms is the establishment of an IRA. To measure the effect of regulation, we use a dummy variable that equals 1 if an independent regulatory authority exists in a country in a specific year. The creation of IRA per country is documented in the ITU World Telecommunication Regulatory Reports 2012, “*Does a separate Regulatory Authority exist for Telecommunication or Information and Communication Technology (ICT) in your country?*”²³ This measure doesn’t reflect the degree of independence, but it is the only measure available we can rely on due to the lack of detailed information on the regulatory functions for a long period of time²⁴. As a consequence, interpreting its effect in a regression is related to attempts at regulatory reform rather than the effect of being an independent entity (Wallsten, 2001). We collect data for regulation from ITU database and different regulators websites. Another dummy variable is constructed for privatization²⁵. This variable takes the value of 1 starting from the year when any part of the fixed incumbent operator was privatized. If it is only transformed into a Joint Stock company, this doesn’t imply its privatization; since in most of the cases in MENA countries it remains a state-owned company. Data are collected from ITU website, incumbents operators’ websites and Ministries of communications websites per country. To measure the effect of competition, we collect data about the number of fixed operators, as well as the number of mobile operators per country. Those numbers are based on the date in which the company started operating in the market, which is more reliable and reflects effective competition rather than the number of licenses in a particular segment. We construct dummy variables for the competition in the fixed and the mobile segment. Then, to reflect the state of competition in the telecom market, we construct an index as in Li and Xu (2004), it is constructed as follows; it equals 0 if monopoly exists in both segments (fixed and mobile), equals 1 if at least one segment operates with more than one operator and equals 2 if both segments become competitive. Data for competition come from ITU, different regulators and operators’ websites and Ministries of communications websites per country.

To test the effect of the sequences in telecom reforms, we construct two variables for the two sequences we account for. The first dummy variable equals one when the country established an IRA before the incumbent privatization, starting from the first year in which the privatization took place²⁶. Then, we construct another variable as a cumulative variable that takes the value of 1 starting from the first year of the sequence, and it increases by one for each subsequent year. Concerning the second sequence, we construct another variable that equals 1 when an IRA is in place before the introduction of market competition starting from the first year in which the competition dummy variable or the competition index equals 1²⁷. Then, we construct another variable as a cumulative variable that takes the value of 1 starting from the first year of the sequence, and it increases by one for each subsequent year.

²³ In this survey, ITU defined separate as “independent” in terms of finance, structure, and decision making from the operator(s) and the sector Ministry.

²⁴ We prefer to construct an index to reflect regulatory powers and functions but limited published information for the whole period prevent us; since we only have a one year per country data. As stated by Wallsten (2001), “*acquiring such information – especially for developing countries – is a Herculean task*”. We will correct for this limitation by having two stages estimation.

²⁵ We use a dummy variable due to lack of data on the percentage of privatization of the incumbent operator.

²⁶ Countries which didn’t privatized till 2010 are considered as missed data.

²⁷ Countries with a competition index equal to zero till 2010 are considered as missed data.

Concerning the third sequence of privatization and competition²⁸, no country in our sample introduced competition in the fixed segment before the privatization of its incumbent operator. Thus, the effect of such variable could not be statistically tested.

In our model, we control for demographic and macroeconomic variables, such as GDP per capita based on purchasing power parity (PPP) in constant US dollars as a determinant of demand and population density as a determinant of the market size. These data come from the World Development Indicators “WDI” database, the World Bank. Also, we include year dummies to measure time fixed effects.

Finally, to correct for possible endogeneity of reforms variables, we use the Polity IV Project’s political regime indicator for democracy as a political variable. It ranges from -10, fully institutionalized autocracy, to +10, fully institutionalized democracy. These data are available at the Center for Systemic Peace Web site “Polity IV”. Then, we normalize the variable to be in the range from 0 to 1. Then, to take into account the legal origin for each country – either it is civil law or common law country –, we collect data from the CIA World Factbook on the legal origin. We construct a dummy variable that equals 1 if the country has a civil legal origin, zero otherwise. Moreover, we use the total natural resources rents (% of GDP) to reflect the country natural resources potentially leading to rents. These data come from the WDI database created by the World Bank. Finally, we collect data about the independence year from colonization for each MENA country from the CIA World Factbook data.

3.3. Descriptive statistics

Table 2 provides basic analysis of the data, allowing for a number of observations. Focusing on the effect of sequences, a separate regulator prior to the privatization of the incumbent leads to lower fixed access and higher prices. However, an IRA prior to the privatization process leads to higher productivity and better quality. Concerning the establishment of IRA prior to the introduction of competition in the market, it leads also to lower fixed access, but to higher mobile access, higher productivity and better quality. However, the effect of this sequence on prices is not clear-cut. Definitely, descriptive statistics do not necessarily hold for the econometric specification. We therefore conduct an econometric analysis to validate or nuance these previous conclusions.

3.4. Results²⁹ and robustness checks: IV-2SLS estimation findings³⁰

Table 5 shows the estimation for the regressions of different performance indicators on our three reforms variables. Then, it shows the sequences results. We focus on the effect of the sequences between the presence of a separate regulator and the privatization of the incumbent operator. Then, we focus on the establishment of a separate regulator before the introduction of competition. In table 5, the results show that the regulation, when tested without sequences, is statistically insignificant for some performance variables, mainly fixed prices indicators. However, establishing a separate regulator has a positive effect on fixed and mobile access and it helps increasing productivity. The effect of a separate regulator on quality measures is ambiguous; while its establishment helps decreasing the number of faults per 100 fixed lines per year, it increases the fixed waiting lists. The privatization has a negative significant effect

²⁸ Fink et al. (2003) studies only the implications of alternative sequences between privatization and competition.

²⁹ The OLS estimations are available in Table 3.

³⁰ The results are robust but with lower coefficients when we use the variables for sequences as cumulative variables that start with 1 from the first year of the sequence, and they increase by one for each subsequent year. See table 6.

on fixed access. Indeed, it has no effect on productivity measure but it increases prices indicators in terms of the fixed monthly subscription and the price of 3 minutes fixed call, as well as for the fixed price basket. However, privatization helps improving the quality measures, in terms of the fixed waiting lists and the percent of telephone faults cleared by next working day. Concerning the third reform variable, the competition has no effect on telecom access and it helps reducing different indicators of fixed and mobile prices. However, competition has no effect on telecom productivity with a positive effect on telecom quality in term of the fixed waiting list. Overall, it is noteworthy that different reforms variables: the privatization of the incumbent operator and the entrance of new competitors, have no effect on telecom productivity in our sample of MENA countries.

The regulation-privatization sequence leads to higher fixed access and higher prices mainly in terms of the 3 minutes fixed local call. However, from the other side, having a regulator prior to the incumbent privatization increases the fixed prices which become higher due to privatizing the incumbent operator. Finally, this sequence doesn't affect the productivity and it is with an ambiguous effect on the quality measures; it leads to a decrease in the number of waiting lists and in the percent of faults cleared by next working day, and to an increase in the faults per 100 fixed lines per year. This is not the case when we test the effect of the privatization without taking the sequence into account.

The sequence between regulation and competition has a negative effect on the fixed access, with no effect on the mobile access. Furthermore, the prior presence of a regulator decreases the telecom productivity. Moreover, establishing a regulator before introducing competition in the market leads to higher fixed prices. Concerning the quality indicators, this sequence improves quality by reducing the number of waiting lists of fixed lines, but from the other side, it increases the number of faults per 100 fixed lines per year and reduces the number of faults cleared by next working day. Thus, this sequence has an ambiguous effect on telecom quality.

4. Discussions

Focusing on the Regulation-Privatization sequence, we find that, although the privatization alone has a negative effect on the fixed access, this sequence helps improving fixed access since this provides investors with credibility and confidence before entering the market and new investors would ensure they will not be abused by the incumbent operator. After the privatization process, the objectives of the firm changes from the maximization of the social welfare to the maximization of the firm's profits. Thus, the prior establishment of a regulator helps eliminating the negative effect of privatization on the fixed access, which means also that an IRA mitigates the harmful effects of exclusivity periods. This result is important since a regulator in place serves as a guarantee that the privatized incumbent would not restrict output and reduces the fixed access; a privatized firm has no incentives to offer services if this would not be profitable for it. However, the prior establishment of a regulator leads to an increase in fixed prices, which implies that they would remain high due to privatizing the incumbent operator. This effect has a negative impact on consumers; however it would give incentives for investors to enter the market. Finally, although the privatization alone leads to a decrease in the number of fixed waiting lists, the effect of the sequence is not clear-cut on the quality indicators. The Regulation-Privatization sequence helps decreasing the number of fixed waiting lists, but it leads to higher number of faults in fixed lines and lower percent of fixed faults cleared.

The sequence between regulation and competition has a negative significant effect on the fixed access. Therefore, the regulator – supposed to put in place the rules that would facilitate the operation of

new competitors in the market in terms of interconnection agreements, the licensing conditions – hinders competition in the market. Moreover, the prior establishment of a regulator reduces telecom productivity. This negative effect could only be explained by the regulatory capture by the incumbent operator. Thus, this reflects the importance of institutions to set the market rules since the incumbent can represent a high barrier for new entrants by preventing interconnection (which is the most important element for new entrants in the telecommunication sector), even by adopting vertical price squeezing or by capturing the regulator in place. It is obvious that without an IRA, no incumbent operator would allow competition, since it would not be profitable for it³¹; however, its role needs to be more efficient. Also, this sequence increases the fixed prices, due to tariff rebalancing system. This might be a way to attract investors since this would be profitable for them to have higher prices and to avoid any uncompetitive behavior by excessively reducing fixed prices by the incumbent operator – as a way to deter entry in the fixed market. Concerning the effect of this sequence on quality indicators, we find that it helps decreasing the number of fixed waiting lists, but it leads to higher number of faults in fixed lines and lower percent of fixed faults cleared.

5. Conclusion

This paper is a first attempt to test the effect of sequences in telecom reform on sector performance in MENA countries, as a group of developing countries. Also, it reduces the gap in the literature about this research question.

It is noteworthy that the establishment of IRA appears more valuable when we test for its sequence; the prior presence of IRA before other reforms, such as privatization and competition, matters. Such results are of great importance for policy makers in MENA countries, since it implies that setting rules for the regulatory framework is a priority; and the main concern for policy makers should be the guarantee of its credibility and effectiveness. Thus, an independent regulator would be able to encourage investors and new entrants to improve sector performance. Moreover, we should ensure that good rules would be implemented; if the regulator fails to find an incentive contract scheme that encourages investors to realize productivity gains while maintaining a certain level of quality, such contract would be inefficient. New rules are needed to ensure effective telecom market, effective competition in fixed segments and better monitoring for newly privatized incumbents.

The results imply that the progress made towards pro-investment reforms has been minor. Since the investments in the telecom sector are highly specific, so, contracts between governments and investors must guarantee that the investor would be able to cover such sunk investments. But, in fact, in MENA countries, the contracts are mostly incomplete which may reduce the incentives to invest and to expand the network. Therefore, it would be interesting in further researches to test the effect of different reforms on telecom sector investment and to explore the contract scheme that will fit the regulatory nature in MENA countries, principally the incentive contracts. Finally, the results would be interesting for prospective investors, as well as for policy makers, who are concerned by encouraging investments in the country and increasing country competitiveness in the telecom sector.

³¹ The MENA competition authorities are not completely established yet. The MENA countries that have competition laws include Jordan, Lebanon, Oman, Saudi Arabia, Algeria, Egypt, Morocco, and Tunisia. The countries that do not have competition laws include Syria, Yemen, and Libya.

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Table 1: Variables List

Dependent variables	Description	Source of the data
Access	Log (the number of fixed lines in a country for each 100 inhabitants)	The ITU database
	Log (the number of mobile lines in a country for each 100 inhabitants)	The ITU database
Productivity	Log {the number of telephone subscribers in fixed and mobile telephone per employee (Total full-time Telecommunication employee)}	The ITU database
Prices	Log (the monthly subscription for residential telephone service)	The ITU database
	Log (the price of a 3-minute fixed telephone local call (off-peak rate) in US \$)	The ITU database
	Log (the mobile cellular prepaid price of 3 minute local call (off-peak, on-net) in US \$)	The ITU database
Quality	Log (the waiting list for fixed lines)	The ITU database
	Log (Faults per 100 fixed lines per year)	The ITU database
	Log (the percent of fixed telephone faults cleared by next working day)	The ITU database
Reform variables		
	Regulation dummy variable	ITU database and different regulators websites
	Privatization dummy variable	By the author from ITU, incumbents operators' websites and Ministries of communications websites per country
	Competition index	By the author from ITU, different regulators and operators' websites and Ministries of communications websites per country
	The sequence (Regulation before privatization)	By the author
	The sequence (Regulation before competition)	By the author
Control variables		
	Log (GDP per capita)	WDI (World Development Indicators), the World Bank
	Log (population density)	WDI (World Development Indicators), the World Bank
Instrumental Variables		
	Polity IV Project's political regime indicator for democracy	The Center for Systemic Peace Web site ("Polity IV")
	Legal origins - civil law or common - dummy variable	The CIA World Factbook
	Total natural resources rents (% of GDP)	WDI (World Development Indicators), the World Bank
	The Independence year	The CIA World Factbook

Table 2. Summary statistics

Variable	Mean (Standard Deviation, Number of observations)						
	For the whole sample	When IRA = 0	When IRA = 1	When Privatization = 0	When Privatization =1	When Competition n = 0	When Competition >= 1
Access indicators							
Fixed per 100 inhabitants	12.84 (8.68, 272)	13.34 (9.45, 148)	12.24 (7.67, 124)	10.7 (6.77, 166)	16.20 (10.19, 106)	13.13 (9.51, 164)	12.4 (7.26, 108)
Mobile per 100 inhabitants	37.31 (45.24, 272)	20.71 (34.27, 148)	57.14 (48.76, 124)	20.8 (34.4, 166)	63.18 (48.18, 106)	18.65 (30.6, 164)	65.66 (49.12, 108)
Productivity indicator							
Total Lines (Fixed and Mobile) per Employee	367.47 (429.4, 217)	155.94 (193.28, 116)	610.42 (493.78, 101)	171.26 (203.51, 125)	634.07 (506.47, 92)	92.16 (51.81, 137)	687.82 (514.78, 80)
Affordability indicators							
Monthly subscription for residential telephone service	5.96 (4.41, 235)	6.24 (5.06, 127)	5.64 (3.53, 108)	5.87 (4.87, 137)	6.089 (3.71, 98)	6.21 (4.67, 146)	5.56 (3.93, 89)
Price of a 3-minute fixed telephone local call (off-peak rate) in US \$	0.06 (0.09, 243)	0.047 (0.054, 123)	0.08 (0.12, 120)	0.05 (0.06, 142)	0.08 (0.12, 101)	0.055 (0.058, 142)	0.078 (0.12, 101)
Fixed Basket	7.94 (6.29, 212)	7.7 (6.52, 110)	8.19 (6.05, 102)	7.54 (6.4, 120)	8.46 (6.13, 92)	7.88 (6.09, 125)	8.03 (6.61, 87)
Mobile cellular prepaid- price of 3-minute local call (peak) in US \$	0.49 (0.45, 226)	0.53 (0.5, 123)	0.44 (0.34, 103)	.55 (0.53, 136)	0.4 (0.29, 90)	0.51 (0.42, 142)	0.46 (0.5, 84)
Mobile cellular prepaid- price of 3-minute local call (off-peak) in US \$	0.39 (0.42, 213)	.42 (0.51, 111)	.37 (0.29, 102)	.43 (0.5, 123)	.34 (0.27, 90)	.39 (0.37, 129)	.41 (0.49, 84)
Mobile Basket	8.69 (8.64, 211)	9.22 (10.34, 111)	8.09 (6.24, 100)	9.57 (10.23, 123)	7.46 (5.57, 88)	8.66 (7.77, 128)	8.74 (9.88, 83)
Quality indicators							
Waiting list for fixed lines	397652 (768667, 150)	619083 (974601, 80)	144589 (258007, 70)	590904 (902189, 96)	54093 (119165, 54)	541719 (893905, 99)	117994 (271460, 51)
Faults per 100 fixed lines per year	23.07 (27.63, 154)	30.88 (33.15, 80)	14.64 (16.49, 74)	32.63 (33.22, 86)	10.99 (8.84, 68)	30.44 (31.91, 97)	10.54 (9.27, 57)
Percent of fixed telephone faults cleared by next working day	83.42 (12.8, 116)	79.28 (15.58, 55)	87.16 (8.09, 61)	78.51 (14.22, 61)	88.88 (8.17, 55)	80.89 (14.57, 73)	87.7 (7.38, 43)

Note. Source: Own calculations from ITU database and collected data.

(Continues)

Table 2. (Continued) Summary statistics

Variable	Mean (Standard Deviation, Number of observations)			
	IRA before Privatization =0	IRA before Privatization =1	IRA before Competition =0	IRA before Competition =1
Access indicators				
Fixed per 100 inhabitants	13.14 (9.35, 227)	11.33 (3.59, 45)	13.1 (9.2, 200)	12.13 (7.06, 72)
Mobile per 100 inhabitants	30.12 (42.14, 227)	73.6 (43.27, 45)	22.97 (34.79, 200)	77.15 (47.24, 72)
Productivity indicator				
Total Lines (Fixed and Mobile) per Employee	246.82 (296.61, 179)	935.8 (501.06, 38)	207.61 (229.3, 162)	838.36 (527.5, 55)
Affordability indicators				
Monthly subscription for residential telephone service	5.54 (4.42, 196)	8.11 (3.71, 39)	5.96 (4.64, 166)	5.98 (3.83, 69)
Price of a 3-minute fixed telephone local call (off-peak rate) in US \$	0.05 (0.06, 199)	0.12 (0.16, 44)	0.48 (0.05, 174)	0.11 (0.14, 69)
Fixed Basket	7.04 (5.63, 174)	12.02 (7.51, 38)	7.43 (5.95, 144)	9.02 (6.88, 68)
Mobile cellular prepaid- price of 3-minute local call (peak) in US \$	0.48 (0.46, 189)	0.52 (0.39, 37)	0.5 (0.49, 170)	0.46 (0.33, 56)
Mobile cellular prepaid- price of 3-minute local call (off-peak) in US \$	0.38 (0.43, 176)	0.44 (0.37, 37)	0.39 (0.46, 157)	0.398 (0.31, 56)
Mobile Basket	8.48 (8.88, 174)	9.66 (7.47, 37)	8.7 (9.33, 156)	8.65 (6.37, 55)
Quality indicators				
Waiting list for fixed lines	460608 (814933, 128)	19726 (232645, 22)	487424 (848808, 115)	102689 (238283, 35)
Faults per 100 fixed lines per year	25.08 (29.66, 128)	13.18 (9.05, 26)	26.24 (30.66, 117)	13.06 (8.84, 37)
Percent of fixed telephone faults cleared by next working day	82.88 (13.87, 92)	85.52 (7.21, 24)	82.9 (14.17, 88)	84.79 (6.95, 28)

Note. Source: Own calculations from ITU database and collected data.

Table 3. OLS estimation

VARIABLES	ACCESS		PRODUCTIVITY		AFFORDABILITY				QUALITY				
	Fixed per 100 inhabitants (in log)	Mobile per 100 inhabitants (in log)	Total number of Lines per employee (in log)	Monthly subscription for residential telephone service	Price of a 3-minute fixed telephone local call (peak rate) in US \$ (in log)	Price of a 3-minute fixed telephone local call (off-peak rate) in US \$ (in log)	Fixed – Price Basket	Mobile cellular prepaid price of 3minute local call (peak) in US \$ (in log)	Mobile cellular prepaid price of 3minute local call (off-peak) in US \$ (in log)	Mobile-Price Basket	Waiting list for fixed lines (in log)	Faults per 100 fixed lines per year (in log)	Percent of fixed telephone faults cleared by next working day (in log)
Effect of Regualtion-Competition Sequence													
Separate regulator	-0.09 (0.11)	-0.38 (0.42)	0.301 (0.22)	-0.186 (0.19)	0.027 (0.17)	0.08 (0.298)	-0.05 (0.19)	-0.137 (0.24)	-0.199 (0.26)	-0.15 (0.26)	0.39 (1.45)	0.27 (0.78)	0.068 (0.08)
Privatization	-0.027 (0.09)	0.31 (0.38)	0.319** (0.13)	0.22* (0.12)	0.23 (0.25)	0.45** (0.18)	0.20 (0.15)	-0.295 (0.24)	-0.26 (0.27)	-0.28 (0.25)	-2.54*** (0.82)	-0.18 (0.81)	0.07 (0.05)
Competition Index	-0.09 (0.06)	0.24 (0.31)	0.211 (0.14)	0.077 (0.14)	0.071 (0.13)	-0.145 (0.175)	0.027 (0.13)	-0.14 (0.19)	-0.069 (0.195)	-0.11 (0.19)	-0.63 (0.698)	-0.08 (0.66)	0.11 (0.073)
Population density	0.09 (0.077)	0.16* (0.09)	-0.03 (0.06)	0.004 (0.12)	-0.18 (0.14)	-0.059 (0.11)	-0.007 (0.12)	0.09 (0.06)	0.068 (0.05)	0.09 (0.06)	-0.41 (0.61)	0.22 (0.29)	0.013 (0.022)
GDP per capita	0.709*** (0.12)	1.042*** (0.15)	0.198* (0.103)	0.296*** (0.11)	0.315 (0.22)	0.18 (0.21)	0.26*** (0.09)	-4.08e-05 (0.11)	-0.02 (0.11)	-0.004 (0.11)	-0.81 (0.57)	-0.42 (0.33)	0.04 (0.037)
Observations	260	255	207	225	205	193	211	212	202	200	128	149	111
Number of countries	17	17	17	16	14	14	16	17	17	17	16	15	13
R-squared	0.73	0.84	0.80	0.102	0.097	0.18	0.101	0.10	0.12	0.097	0.38	0.25	0.32

Robust standard errors in parentheses. Estimations include year dummies (coefficients estimates not reported). *** p<0.01, ** p<0.05, * p<0.1.

(Continues)

Table 3. (Continued) OLS estimation

VARIABLES	ACCESS		PRODUCTIVITY		AFFORDABILITY			QUALITY		
	Fixed per 100 inhabitants (in log)	Mobile per 100 inhabitants (in log)	Total number of Lines per employee (in log)	Monthly subscription for residential telephone service	Price of a 3- minute fixed telephone local call (peak rate) in US \$ (in log)	Price of a 3- minute fixed telephone local call (off-peak rate) in US \$ (in log)	Fixed price basket	Waiting list for fixed lines (in log)	Faults per 100 fixed lines per year (in log)	Percent of fixed telephone faults cleared by next working day (in log)
Effect of Regualtion-Privatization Sequence										
Separate regulator	-0.10 (0.12)		0.35 (0.26)	-0.16 (0.195)	0.04 (0.175)	0.004 (0.33)	-0.04 (0.199)	0.17 (1.66)	0.16 (0.80)	0.12 (0.11)
Privatization	-0.65*** (0.206)		0.14 (0.17)	-0.24 (0.36)	0.39 (0.34)	0.44** (0.21)	-0.23 (0.37)	-2.32** (1.12)	-0.47 (0.94)	0.13*** (0.046)
Regulation- Privatization	0.65*** (0.18)		0.47* (0.26)	0.53 (0.44)	-0.15 (0.44)	0.006 (0.395)	0.46 (0.44)	-0.699 (1.43)	0.85 (0.93)	-0.07 (0.058)
Population density	0.16*** (0.06)		0.008 (0.05)	0.049 (0.11)	-0.17 (0.14)	-0.06 (0.11)	0.036 (0.12)	-0.45 (0.596)	0.23 (0.28)	0.009 (0.02)
GDP per capita in	0.77*** (0.098)		0.22** (0.11)	0.31** (0.14)	0.29 (0.21)	0.19 (0.22)	0.29** (0.12)	-0.80 (0.58)	-0.35 (0.299)	0.018 (0.03)
Observations	260		207	225	205	193	211	128	149	111
Number of countries	17		17	16	14	14	16	16	15	13
R-squared	0.8		0.8	0.16	0.1	0.15	0.14	0.37	0.26	0.28

Robust standard errors in parentheses. Estimations include year dummies (coefficients estimates not reported). *** p<0.01, ** p<0.05, * p<0.1.

(Continues)

Table 3. (Continued) OLS estimation

VARIABLES	ACCESS		PRODUCTIVITY	AFFORDABILITY							QUALITY		
	Fixed per 100 inhabitants (in log)	Mobile per 100 inhabitants (in log)	Total number of Lines per employee (in log)	Monthly subscription for residential telephone service	Price of a 3-minute fixed telephone local call (peak rate) in US \$ (in log)	Price of a 3-minute fixed telephone local call (off-peak rate) in US \$ (in log)	Fixed – Price Basket	Mobile cellular prepaid price of 3minute local call (peak) in US \$ (in log)	Mobile cellular prepaid price of 3minute local call (off-peak) in US \$ (in log)	Mobile-Price Basket	Waiting list for fixed lines (in log)	Faults per 100 fixed lines per year (in log)	Percent of fixed telephone faults cleared by next working day (in log)
Effect of Regualtion-Competition Sequence													
Separate regulator	-0.06 (0.087)	-0.46 (0.41)	0.404* (0.23)	-0.21 (0.196)	-0.07 (0.14)	0.003 (0.18)	-0.08 (0.20)	-0.25 (0.25)	-0.25 (0.24)	-0.25 (0.27)	-0.398 (1.48)	-0.27 (0.75)	0.105 (0.08)
Competition Index	0.007 (0.12)	-0.046 (0.39)	0.09 (0.18)	0.005 (0.18)	-0.198 (0.23)	-0.36 (0.23)	-0.08 (0.19)	-0.24 (0.26)	-0.16 (0.26)	-0.18 (0.26)	-0.11 (1.06)	-1.39 (0.96)	0.22** (0.09)
Regulation-Competition	-0.21 (0.21)	0.66 (0.66)	0.22 (0.199)	0.204 (0.17)	0.59 (0.39)	0.597* (0.35)	0.26 (0.23)	0.15 (0.29)	0.13 (0.34)	0.09 (0.31)	-1.16 (0.90)	2.95** (1.23)	-0.17** (0.08)
Population density	0.032 (0.102)	0.18* (0.09)	-0.01 (0.06)	-0.014 (0.12)	-0.17 (0.14)	-0.08 (0.11)	-0.02 (0.13)	0.06 (0.06)	0.09 (0.06)	0.056 (0.06)	-0.47 (0.65)	0.32* (0.18)	0.008 (0.02)
GDP per capita	0.74*** (0.13)	1.07*** (0.13)	0.23** (0.11)	0.33*** (0.11)	0.33 (0.24)	0.25 (0.196)	0.29*** (0.098)	-0.04 (0.096)	-0.07 (0.099)	-0.04 (0.10)	-1.13* (0.64)	-0.48 (0.40)	0.066** (0.03)
Observations	260	255	207	225	205	193	211	212	202	200	128	149	111
Number of countries	17	17	17	16	14	14	16	17	17	17	16	15	13
R-squared	0.7	0.83	0.79	0.11	0.13	0.17	0.11	0.09	0.14	0.09	0.27	0.39	0.36

Robust standard errors in parentheses. Estimations include year dummies (coefficients estimates not reported). *** p<0.01, ** p<0.05, * p<0.1.

Table 4. First stage estimation

First stage estimation for reform variables			
VARIABLES	Parameters' estimates for reform variables using OLS estimation		
	Establishment of a separate regulator	Privatization of the incumbent operator	Competition index
Polity IV indicator	-0.387* (0.23)	-1.518*** (0.14)	-0.633* (0.34)
Civil law	--- ---	-0.229*** (0.07)	-0.165* (0.09)
Total natural resources rents of (% of GDP)	-0.015*** (0.002)	-0.0199*** (0.003)	-0.006 (0.004)
Independence year	-0.007*** (0.002)	--- ---	--- ---
Population density in log	-0.02 (0.027)	-0.011 (0.02)	0.048 (0.03)
GDP per capita in constant 2000 US\$ (PPP) in log	0.066* (0.04)	0.129*** (0.03)	-0.05 (0.05)
Observations	218	250	250
R-squared	0.37	0.46	0.43

Robust standard errors in parentheses, including year dummies (not reported), *** p<0.01, ** p<0.05, * p<0.1. Our results are robust when we eliminate the control variables (Population density and GDP per capita) from the estimation.

Table 5. IV-2SLS estimation

VARIABLES	ACCESS		PRODUCTIVITY	AFFORDABILITY						QUALITY			
	Fixed per 100 inhabitants (in log)	Mobile per 100 inhabitants (in log)	Total number of Lines per employee (in log)	Monthly subscription for residential telephone service	Price of a 3-minute fixed telephone local call (peak rate) in US \$ (in log)	Price of a 3-minute fixed telephone local call (off-peak rate) in US \$ (in log)	Fixed-Price Basket	Mobile cellular prepaid price of 3minute local call (peak) in US \$ (in log)	Mobile cellular prepaid price of 3minute local call (off-peak) in US \$ (in log)	Mobile-Price basket	Waiting list for fixed lines (in log)	Faults per 100 fixed lines per year (in log)	Percent of fixed telephone faults cleared by next working day (in log)
Separate regulator	1.58*** (0.37)	0.67* (0.39)	1.09*** (0.35)	0.49 (0.83)	-0.606 (0.91)	-0.52 (1.12)	0.157 (1.06)	0.86* (0.46)	0.49 (0.39)	0.63 (0.44)	22.91** (10.88)	-4.16*** (1.07)	0.15 (0.196)
Privatization	-1.399*** (0.38)	-0.095 (0.42)	0.204 (0.22)	1.297* (0.77)	2.169** (0.997)	2.56** (1.14)	1.48 (0.91)	0.06 (0.40)	0.006 (0.33)	0.03 (0.38)	- 11.54** (5.19)	0.96 (0.75)	0.145** (0.07)
Competition Index	1.04 (0.86)	1.02 (0.95)	0.099 (0.31)	-2.88** (1.33)	-4.06** (1.599)	-4.537*** (1.76)	-3.15** (1.36)	-1.86*** (0.71)	-1.424** (0.57)	-1.68** (0.7)	-18.85* (10.61)	0.02 (0.88)	0.11 (0.15)
Population density	0.11 (0.09)	0.19* (0.099)	-0.01 (0.07)	0.045 (0.13)	-0.407 (0.27)	-0.379 (0.31)	0.06 (0.16)	0.309*** (0.088)	0.259*** (0.07)	0.279** * (0.08)	-0.203 (1.08)	-0.05 (0.19)	0.02 (0.03)
GDP per capita	0.93*** (0.09)	1.03*** (0.11)	0.215*** (0.05)	0.002 (0.17)	0.42 (0.32)	0.42 (0.38)	-0.038 (0.18)	-0.128 (0.099)	-0.15* (0.09)	-0.112 (0.09)	0.62 (1.27)	-0.94*** (0.24)	0.03 (0.03)
Observations	218	213	173	184	164	153	171	175	165	163	105	134	98

Robust standard errors in parentheses. Estimations include year dummies (coefficients estimates not reported). Variables used as instruments are: "The Polity IV democracy indicator", "Legal origin dummy variable", "total natural resources rents (% of GDP)" and "independence year from colonization". *** p<0.01, ** p<0.05, * p<0.1. (...) means not reported.

(Continues)

Table 5. (Continued) IV-2SLS estimation

VARIABLES	ACCESS		PRODUCTIVITY		AFFORDABILITY			QUALITY		
	Fixed per 100 inhabitants (in log)	Mobile per 100 inhabitants (in log)	Total number of Lines per employee (in log)	Monthly subscription for residential telephone service	Price of a 3-minute fixed telephone local call (peak rate) in US \$ (in log)	Price of a 3-minute fixed telephone local call (off-peak rate) in US \$ (in log)	Fixed Price basket	Waiting list for fixed lines (in log)	Faults per 100 fixed lines per year (in log)	Percent of fixed telephone faults cleared by next working day (in log)
Effect of Regulation-Privatization Sequence										
Separate regulator	-2.35 (2.15)		3.25** (1.45)	-1.014 (1.31)	-2.01*** (0.69)	-2.06*** (0.74)	-0.597 (1.09)	9.58** (3.97)	-10.32*** (3.78)	0.587*** (0.21)
Privatization_incumbent	-0.996** (0.47)		-0.265 (0.55)	0.24 (0.32)	0.64 (0.39)	0.78* (0.45)	0.23 (0.31)	-4.34** (1.897)	1.859 (1.67)	0.029 (0.12)
Regulation-Privatization	5.326* (2.84)		-2.51 (1.696)	2.12 (1.32)	2.135*** (0.71)	2.51*** (0.7)	1.40 (0.98)	-21.42*** (7.44)	7.614* (4.01)	-0.53*** (0.199)
Population density	0.197*** (0.07)		0.054 (0.12)	-0.05 (0.08)	-0.34** (0.14)	-0.302** (0.15)	-0.02 (0.07)	0.77 (0.74)	-0.84 (0.59)	0.088** (0.04)
GDP per capita	0.96*** (0.12)		0.22* (0.11)	0.27*** (0.09)	0.599*** (0.159)	0.62*** (0.175)	0.196*** (0.07)	-0.60 (0.51)	-1.007** (0.46)	0.015 (0.04)
Observations	218		173	184	164	153	171	105	134	98

Robust standard errors in parentheses. Estimations include year dummies (coefficients estimates not reported). Variables used as instruments are: "The Polity IV democracy indicator", "Legal origin dummy variable", "total natural resources rents (% of GDP)" and "independence year from colonization". *** p<0.01, ** p<0.05, * p<0.1. (...) means not reported.

(Continues)

Table 5. (Continued) IV-2SLS estimation

VARIABLES	ACCESS		PRODUCTIVITY		AFFORDABILITY					QUALITY			
	Fixed per 100 inhabitants (in log)	Mobile per 100 inhabitants (in log)	Total number of Lines per employee (in log)	Monthly subscription for residential telephone service	Price of a 3-minute fixed telephone local call (peak rate) in US \$ (in log)	Price of a 3-minute fixed telephone local call (off-peak rate) in US \$ (in log)	Fixed-Price Basket	Mobile cellular prepaid price of 3minute local call (peak) in US \$ (in log)	Mobile cellular prepaid price of 3minute local call (off-peak) in US \$ (in log)	Mobile-Price basket	Waiting list for fixed lines (in log)	Faults per 100 fixed lines per year (in log)	Percent of fixed telephone faults cleared by next working day (in log)
Effect of Regualtion-Competition Sequence													
Separate regulator	2.099*** (0.59)	0.569 (0.45)	1.678*** (0.37)	-0.69 (1.34)	0.144 (0.37)	0.449 (0.42)	0.333 (0.85)	0.775 (0.52)	0.45 (0.48)	0.59 (0.53)	-2.735 (4.13)	-4.86*** (0.93)	0.25 (0.19)
Competition Index	-0.97 (0.98)	0.87 (0.65)	0.005 (0.35)	-1.22** (0.55)	-2.45*** (0.45)	-2.57*** (0.53)	-1.54*** (0.36)	-1.75** (0.69)	-1.395** (0.54)	-1.61** (0.69)	6.46 (4.13)	-0.64 (0.81)	0.226* (0.13)
Regulation-Competition	-2.62*** (0.80)	0.14 (0.70)	-1.07* (0.59)	3.71* (2.13)	4.37*** (0.91)	4.919*** (1.06)	1.82 (1.41)	0.26 (0.89)	0.087 (0.795)	0.125 (0.87)	-17.81*** (6.71)	4.67*** (1.06)	-0.258*** (0.09)
Population density	0.235** (0.11)	0.195** (0.09)	0.05 (0.06)	0.006 (0.09)	0.059 (0.099)	0.17 (0.12)	0.06 (0.05)	0.303*** (0.09)	0.26*** (0.07)	0.28*** (0.08)	-1.128* (0.63)	0.006 (0.197)	0.013 (0.03)
GDP per capita	0.65*** (0.08)	1.015*** (0.08)	0.225*** (0.05)	0.22*** (0.06)	-0.088 (0.16)	-0.23 (0.19)	0.148*** (0.05)	-0.12 (0.08)	-0.15** (0.07)	-0.107 (0.08)	-1.478*** (0.33)	-0.61** (0.26)	0.068*** (0.02)
	218	213	173	184	164	153	171	175	165	163	105	134	98

Robust standard errors in parentheses. Estimations include year dummies (coefficients estimates not reported). Variables used as instruments are: "The Polity IV democracy indicator", "Legal origin dummy variable", "total natural resources rents (% of GDP)" and "independence year from colonization". *** p<0.01, ** p<0.05, * p<0.1. (...) means not reported.

Table 6. IV-2SLS estimation with cumulative sequence variables

VARIABLES	ACCESS		PRODUCTIVITY	AFFORDABILITY			QUALITY			
	Fixed per 100 inhabitants (in log)	Mobile per 100 inhabitants (in log)	Total number of Lines per employee (in log)	Monthly subscription for residential telephone service	Price of a 3-minute fixed telephone local call (peak rate) in US \$ (in log)	Price of a 3-minute fixed telephone local call (off-peak rate) in US \$ (in log)	Fixed Price basket	Waiting list for fixed lines (in log)	Faults per 100 fixed lines per year (in log)	Percent of fixed telephone faults cleared by next working day (in log)
Effect of Regulation-Privatization Sequence										
Separate regulator	-0.798 (1.29)		2.865*** (1.08)	0.175 (1.08)	-1.69*** (0.53)	-1.64*** (0.57)	0.44 (0.94)	9.04** (3.78)	-9.59*** (2.86)	0.54*** (0.20)
Privatization_incumbent	-1.38*** (0.32)		-0.02 (0.45)	0.157 (0.25)	0.37 (0.33)	0.43 (0.39)	0.14 (0.25)	-3.365* (1.98)	1.42 (1.38)	0.07 (0.12)
Regulation-Privatization	0.724* (0.385)		-0.510 (0.33)	0.15 (0.22)	0.403*** (0.12)	0.48*** (0.13)	0.06 (0.17)	-5.76** (2.31)	1.73* (0.89)	-0.13** (0.06)
Population density	0.224*** (0.05)		0.017 (0.11)	0.006 (0.06)	-0.28** (0.12)	-0.225* (0.13)	0.03 (0.05)	0.66 (0.68)	-0.76 (0.49)	0.08** (0.04)
GDP per capita	0.96*** (0.09)		0.19* (0.11)	0.212*** (0.08)	0.58*** (0.14)	0.59*** (0.15)	0.14** (0.07)	-0.86* (0.49)	-0.97** (0.42)	0.009 (0.04)
Observations	218		173	184	164	153	171	105	134	98

Robust standard errors in parentheses. Estimations include year dummies (coefficients estimates not reported). Variables used as instruments are: "The Polity IV democracy indicator", "Legal origin dummy variable", "total natural resources rents (% of GDP)" and "independence year from colonization". *** p<0.01, ** p<0.05, * p<0.1. (...) means not reported.

(Continues)

Table 6. (Continued) IV-2SLS estimation with cumulative sequence variables

VARIABLES	ACCESS		PRODUCTIVITY	AFFORDABILITY			QUALITY						
	Fixed per 100 inhabitants (in log)	Mobile per 100 inhabitants (in log)	Total number of Lines per employee (in log)	Monthly subscription for residential telephone service	Price of a 3-minute fixed telephone local call (peak rate) in US \$ (in log)	Price of a 3-minute fixed telephone local call (off-peak rate) in US \$ (in log)	Fixed-Price Basket	Mobile cellular prepaid price of 3minute local call (peak) in US \$ (in log)	Mobile cellular prepaid price of 3minute local call (off-peak) in US \$ (in log)	Mobile-Price basket	Waiting list for fixed lines (in log)	Faults per 100 fixed lines per year (in log)	Percent of fixed telephone faults cleared by next working day (in log)
Effect of Regulation-Competition Sequence													
Separate regulator	2.37*** (0.87)	0.59 (0.50)	1.84*** (0.43)	0.825 (1.11)	0.17 (0.38)	0.47 (0.41)	1.735 (1.47)	0.76 (0.64)	0.46 (0.56)	0.60 (0.60)	-3.55 (3.35)	-6.31*** (1.18)	0.33 (0.21)
Competition Index	-1.21 (1.16)	0.88 (0.64)	-0.004 (0.42)	-1.34*** (0.46)	-2.29*** (0.50)	-2.345*** (0.56)	-1.76** (0.81)	-1.73** (0.76)	-1.398** (0.58)	-1.62** (0.73)	7.67** (3.65)	-0.07 (1.07)	0.21 (0.14)
Regulation-Competition	-0.568** (0.24)	0.014 (0.155)	-0.27* (0.14)	0.21 (0.36)	0.64*** (0.14)	0.74*** (0.15)	-0.08 (0.38)	0.05 (0.22)	0.01 (0.195)	0.019 (0.21)	-4.29*** (1.33)	1.13*** (0.32)	-0.09*** (0.03)
Population density	0.23* (0.13)	0.195** (0.09)	0.06 (0.06)	0.06 (0.06)	-0.02 (0.11)	0.09 (0.11)	0.10 (0.11)	0.302*** (0.09)	0.257*** (0.07)	0.28*** (0.09)	-0.59 (0.46)	-0.25 (0.24)	0.025 (0.03)
GDP per capita	0.59*** (0.11)	1.02*** (0.08)	0.21*** (0.06)	0.216*** (0.07)	0.19 (0.166)	0.08 (0.180)	0.12 (0.11)	-0.11 (0.09)	-0.15* (0.08)	-0.11 (0.08)	-1.42*** (0.30)	-0.68** (0.29)	0.062** (0.02)
Observations	218	213	173	184	164	153	171	175	165	163	105	134	98

Robust standard errors in parentheses. Estimations include year dummies (coefficients estimates not reported). Variables used as instruments are: "The Polity IV democracy indicator", "Legal origin dummy variable", "total natural resources rents (% of GDP)" and "independence year from colonization". *** p<0.01, ** p<0.05, * p<0.1. (...) means not reported.