

Regulation, ownership and competition in the telecommunication sector: Evidence from MENA countries

Riham AHMED EZZAT¹

Abstract

In the 1980s, the institutional and regulatory framework of the telecommunication industry has changed radically but a lot still remains to be done notably in developing countries. MENA developing countries are presently experiencing a significant transformation in their telecommunication sectors due to the regulatory reform, the privatization, and the introduction of competition. Under the pressure of International Institutions (World Bank, IMF), the liberalization, deregulation and re-regulation of the telecom industries are at the political agenda of MENA governments. This paper empirically assesses the effect of regulation, privatization and competition reforms, as well as the interactions between different reforms in the telecommunication sector using a sample of 17 MENA developing countries for the period 1995-2010. We assume that different reform variables are affected by institutional, political and economic variables and we use IV-2SLS estimation to analyze the outcome of reforms in terms of telecom performance: access, prices and productivity. As a main result, we find that institutional, political and economic variables matter and affect telecom reforms, which in turn affect different performance indicators.

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

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¹ Centre d'Economie de la Sorbonne (Université Paris 1 Panthéon Sorbonne). riham.ahmedezzat@gmail.com

1. Introduction

The telecommunications sector all over the world had largely developed since the 1980s thanks to technological, institutional, regulatory and demand side evolutions. After 1990, technological shocks had occurred; the regulatory framework had largely evolved and with lower barriers to entry, many countries opened their sector to competition. Also, the evolution of mobile network has a crucial role behind the growth of an improved telecommunication industry specifically with the increasing subscriptions, the explosion in data usage and the continuous technological evolution of different generations, such as the case of 4G and 4.5G, among others. Moreover, the privatization of the main operator took place in different countries in order to increase its effectiveness to be able to compete with new entrants. It is noteworthy that the most economically significant and politically sensitive industry being privatized in the world today is the national telecommunication monopoly (Bortolotti et al. 2002).

At this stage of development of the telecommunication sector, the telecom sector is still concerned with issues related with the triptych regulation (re-regulation), privatization and competition. Although since the 80s, the institutional and regulatory framework of the telecommunication industry has changed radically, a lot still remains to be done notably in developing countries. Due to pressures from International Institutions, mainly from the International Monetary Fund (IMF) and the World Bank (WB), developing countries are privatizing their state owned incumbent operators, allowing entry of foreign and domestic operators to increase competition and establishing separate regulatory institutions, as a way to alleviate the existing poor performance. For such developing countries, although there is a large movement towards regulatory reform, from a comparative perspective it is worth noting that the timing and aspects of reforms differ across countries. Some Latin American countries created their Independent Regulatory Authority “IRA” in the 1980s, such as Argentina and Brazil, among others. For MENA countries, they lagged in adopting reforms; the first regulatory separation took place in Jordan in 1995.

The case of **Middle East and North Africa region** (MENA) countries can be distinguished from two perspectives, first, they were late in implementing reforms, since the adoption of telecom reform took place mostly after their participation in international trade agreements (GATS). Second, MENA countries are known by specific institutional aspects as: lack of commitment power, weakness of the rule of law, low control of corruption, low level of political stability² and low government accountability. More importantly, the specificity for MENA countries arises from its historical, institutional and political nature that shapes their decisions regarding the adoption of different reforms; such as the level of democracy, the legal origin established in each country, the colonization history, the economic wealth, among other factors; therefore, given such specificities, it is crucial to understand what is the best state of reform such countries should reach?

As in many developing countries, the MENA telecom sector had started with an underdeveloped wired infrastructure that resulted notably in low penetration levels for fixed telephony services³, which was not the case with the introduction of the mobile service. It is also surprising that in comparisons to other regions (e.g., Latin America and Caribbean or East Asia and Pacific), in 2010, MENA countries have the highest mobile penetration, although the evolution of the fixed penetration is limited when compared to the same regions. Is this due to the slow reform adoption by MENA countries, or is this due to the specificity of MENA fixed telecom sector?

During this last decade, telecommunication reform in developing countries has been largely explored (Boylaud and Nicoletti 2000; Fink et al. 2001; Wallsten 2001; Fink et al. 2003; Estache et al. 2006; Maingard et al. 2011; Gasmi et al. 2013), but exploring such issues in MENA countries is clearly overlooked. Although, studies for other sectors in MENA are done like the energy sector (Cambini and Franzi 2013), no econometric study explored the impact of telecom reforms on the

² The rule of law, the control of corruption and the political stability ranks for MENA countries, according to World Governance Indicators, didn't witness any evolution during the past decade. Such ranks are only high if compared to South Asia region or Sub Saharan Africa region.

³ By the beginning of the nineties, most MENA countries averaged less than 5 telephones per 100 people compared to about 43 in OECD countries. By the 2000s, it became 10 telephones per 100 people in MENA compared to 56 in OECD countries (WDI database, 2013).

sector performance in MENA countries⁴. Moreover, various studies have been dedicated to Asian or Latin American countries that started reforming their sector a bit before MENA countries. Still the case of MENA countries is very interesting since the results would be important 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. However, this absence of studies was somehow understandable for two reasons; principally, due to lack of data for those countries and since time had to pass after introducing reforms, so more data would be available for empirical analysis. Moreover, according to our knowledge, most of the first generation studies didn't take into account the institutional aspect of the countries studied, we find only Gual and Trillas Jané (2004)⁵ that take into account the institutional endowment for a cross section data of 37 countries (3 MENA countries included).

Thus, this paper aims at developing an empirical analysis for MENA countries (17 developing countries) from 1995-2010 to explore the impact of such reforms and their interactions on telecom performance. We deal with different dimensions of reform as follows:

1. The establishment of an Independent Regulatory Authority "IRA",
2. The privatization of the state owned incumbent operator and
3. The competition between different telecom operators,

and their effect on the telecom sector performance in the voice market for fixed and mobile segments. Due to the importance of the institutional aspect of MENA countries, we will study MENA telecom reform given their level of democracy, their historical legal origin, their economic independence in terms of natural resources rents and finally given their year of independence from colonization.

The telecom performance measures include: access, productivity and affordability. In other words, we are concerned by the linkages between ownership, regulation, market structure and performance. More specifically, the focus of the paper would rather be: does the simultaneous existence of different reforms matter? Does an IRA in place help reducing the drawbacks induced by a privatized incumbent when it exists simultaneously while privatizing the incumbent operator? Are investors more incited to enter the market when there is an IRA in place? Is the simultaneous existence of an IRA with other telecom reform efficient in the context of MENA developing countries? Finally, does the simultaneous presence of the three telecom reforms help improving MENA telecom performance? Discussing regulatory design in detail is a complex task due to lack of data on the type of regulation the country adopts (price cap, rate of return...) and on the regulatory authority itself (its annual budget, number of employees, regulator enforcement powers...), so, up till now, we are focusing on the previous questions.

Moreover, this study aims at discussing the opportunity to introduce liberalization depending on the institutional, political and economic nature of each country, finding empirical support for adopting such policies in those countries since 1995 and helping to address policy recommendations. In other words, we need to assess whether imposing reform and entry liberalization depends on the institutional, political and economic nature of such countries, or it is only taking into account international political considerations regardless the country characteristics. Thus, we are looking forward to focusing on original and non-traditional determinants for introducing reforms that tended somehow to be overlooked in previous studies; such determinants will be used as instruments for policy reforms. We use mainly the democracy indicator, country resources independency "Total natural resources rents (% of GDP)", the legal origin "civil law or common law origin" and finally, we control for the independence year of each country.

The paper is organized as follows. **Section 2** presents background on telecom and on MENA region to emphasize the issues at stake. Literature review and testable hypotheses derived from the literature are presented in **Section 3**. **Section 4** provides the data and the empirical model we adopt to test the

⁴ The only study (Rossotto, Sekkat, and Varoudakis 2005) states that the market liberalization in MENA telecom has been slower than elsewhere in developing countries. They develop an indicator of market openness that encompasses elements of competition, openness to FDI, and regulatory independence for MENA. However, the empirical evidence they conduct is not specific for MENA countries.

⁵ They collected a number of political variables on the general quality of the government, interest groups, ideology, institutions and the tradition of each country with regards to the state's involvement in the economy.

hypotheses. **Section 5** presents the discussions for the different results. We end by concluding remarks in **Section 6**.

2. Background and MENA telecom liberalization

In this section, we aim to introduce MENA region and its telecom reform evolution. Then, we introduce each telecom reform: regulation, privatization and competition, while applying such reforms in the case of MENA region. Finally, we present the importance of adopting telecom reform in this group of developing countries and the reasons for which such reforms were introduced late compared to other countries.

2.1. Telecom sector reform and MENA region

MENA region is one of the largest regions in the World with high population growth rates: 2010's worldwide population growth is 1.35% compared to 3.05% in MENA region. Moreover, in 2011, MENA has the second youngest population among world regions, with half of its population under age 25 (Roudi 2011), which is further supporting the region's attractive demographics. According to IMF 2010 World Outlook, the Middle East region has one of the strongest economies, placing it at the higher end among the emerging markets.

It is noteworthy that the countries included in our study are different in terms of demographic size, natural resources dependency, economic performance, per capita income, governance and political regimes (Abdel-Rahman 2009). Some of these patterns have direct impacts on the adoption of different economic policies like the liberalization and the regulatory reforms. Although the differences between those countries, *there exists enough characteristics or challenges common to all or most of the countries in the region which would justify a focus on MENA as a highly distinct region from a broad comparative perspective* (Oni 2003). Many agglomerations regroup most of those countries or even all of them such as: Euro-Mediterranean Partnership (EUROMED)⁶, the Arab League⁷ and AREGNET⁸ that was established in April 2003 and regroups all Arab Telecom Regulators & Administrations in charge of telecom regulation in Arab countries.

About two decades after most OECD countries' reforms, the MENA region is presently experiencing a significant transformation in its telecommunication sector. MENA countries are witnessing actually a great technological progress, by the adoption of 4G technologies (such as Jordan) and by providing additional mobile licenses (such as Tunisia). Other countries experienced unbundling in telecom market (such as Bahrain and United Arab Emirates). Finally, others are more reluctant to adopt reforms like Algeria and Lebanon, which reflects the fact that liberalization in MENA telecom market is not completely established yet.

Till 1995, the telecom sector in MENA suffered from the inertia of its traditional structure: the incumbent operator was a state-owned monopolistic operator, thus, regulation took place by the government with no independent regulator in place. The first separate regulatory authority - "Telecommunications Regulatory Commission (TRC)" - was established in Jordan in 1995, as shown in table 1. Moreover, obviously, the incumbent operator was either regulated by the government and its ministers or it was self-regulated. In general, the characteristics of the telecom sector explained the need of a **regulatory authority** insulated from undue political pressures, since credibility of regulatory institutions is the only guarantee for firms to incite them to invest (Levy and Spiller 1996). Moreover, having an independent regulator is important for having commitment and to spur investment (Cambini and Jiang 2009).

Concerning the telecom performance evolution in MENA, in 1995, MENA countries show a modest landline penetration with an average of 10.2 lines per 100 inhabitants, compared to 44.8 for OECD countries. Except for some GCC countries⁹, the remaining MENA countries suffer from

⁶ The Union for the Mediterranean promotes economic integration and democratic reform across 16 neighbors to the EU's south in North Africa and the Middle East.

⁷ It is a regional organization of Arab states in North Africa and Southeast Asia.

⁸ Its official website is: <http://www.aregnet.org/ar/>

⁹ Like Bahrain, Kuwait, Qatar and UAE with penetration rates of over 20%

significantly lower landline penetration, where limited network expansion could be justified by the large geographic size and lower level of income compared to most GCC countries. For example, landline penetration for North African countries is around 3.8 lines per 100 people. In the light of the technological developments in telecommunications in the world economy, the modest performance of the telecom sector in MENA countries highlighted the need for deep sector reform. Current fixed and mobile penetration indicators for MENA countries in 2011 are depicted in table 2. Between 1995 and 2011, the MENA countries have witnessed an increase in landline penetration from 11.49 to 12.7 lines per 100 inhabitants, compared to 43.19 for OECD countries. It is noteworthy that although “Latin America and Caribbean” and “East Asia and Pacific” regions knew modest landline penetration in 1995 compared to MENA countries, the evolution in their landline penetration in 2010 is too much higher than MENA countries. There is no doubt that the deep sector reform carried out by MENA countries, the heavy investments in infrastructure carried out by many governments, in addition to the liberalization of telecom markets, has contributed to the increase in network penetration, however, it is crucial to explore the low level of penetration compared to other comparable regions for MENA countries.

Mobile services have been introduced in the late nineties and their use has quickly expanded throughout the region. In most MENA markets, the market is oversaturated: 11 out of 17 countries have a mobile penetration rate of over 100%. The average mobile penetration rate for MENA countries is 112%, which is higher than all other rates in LAC, EAP and OECD (104.7%, 83.2% and 106.6%). In GCC countries, the increasing use of mobile services has been accompanied by a decrease in landline penetration, which could explain the drop in landline penetration rates. This is not the case for the other MENA countries who initially suffered from reduced landline penetration, and where the boom in mobile services has been accompanied by an increase in landline penetration.

To conclude, in comparisons to other regions (e.g., Latin America and Caribbean or East Asia and Pacific), MENA countries have the highest mobile penetration, although the evolution of the fixed penetration is limited comparing to other regions.

In order to better understand the regulatory evolution of telecom sector in different countries, we will explore the **structural, financial and functional independence** of a regulatory institution. Obviously, regulatory independence is a necessary element for regulator, in order to be an effective institution and a credible safeguard for investors (Levy and Spiller 1994). But, the “Independency” extent needs to be discussed since complete independence is impossible to achieve. Moreover, such independence should not be unconditional; it must be balanced by accountability measures. According to Wallsten (2003), no matter what definition of independence is used, regulatory agencies will be always to some degree connected to the government.

Regarding **the structural independence**, such separation reduces the probability of a regulatory capture either by the government, or by the operators. Our focus in the paper would be rather whether there exists a separate regulatory authority from its government. Actually, as shown in table 1, 5 over 17 countries have no separate regulator:

- For Djibouti, Kuwait, and Yemen, the regulatory functions are the responsibility of the ministry of Communications.
- For Libya, the General Telecommunication Authority (GTA) is the telecommunication regulatory body since 2006 but headed by the son of Libya’s former president, who approved all decisions.
- Finally, Syria regulatory framework is the responsibility of its incumbent operator “The Syrian Telecommunication Establishment”.

The **functional independency** measures the extent of IRA powers and its capability to make decisions independently either from the government or from operators. Such functions include licensing, interconnection rates, price regulation, among others. According to the ITU 2012 country profiles, only in Jordan and United Arab Emirates, all the regulatory functions are performed by the regulator with no intervention from the ministry or the different operators.

Finally, in term of the **financial autonomy**, it implies whether the regulator is autonomous in terms of financing or if the government influences its budget, since the sources of its funds impact its autonomy and decision making process. When the regulator budget relies mainly on the government

appropriation (the ministry under whom authority resides), this may affect the degree of effectiveness of regulator. On the other hand, when relying on different sources of finance, this makes regulators less exposed to capture. Regulators in some countries like Bahrain, succeeded in having financial autonomy which gave the regulator more independence in its decision making process. Estache, Goicoechea, and Manacorda (2006) related independence with financial autonomy; which involved the regulator's ability to make decisions. The extreme case, as shown in ITU 2011-2012 report, is represented by Lebanon, where the regulator relies 100% on the government appropriation, which would affect its degree of independence.

Second type of reform concerned **privatization**. The move from state ownership to private ownership is usually a necessary condition for significant market liberalization (Parker and Saal 2003). Although theoretical works discussed well the effect of competition on performance, such as Motta(2004); Shy (1996) and Tirole(1988), it is less clear concerning the effect of privatization (Ros, 1999). According to the NIE literature (North 1990; Levy and Spiller 1996), the type of ownership affects firm behavior and performance since the incentives faced by decision makers changed according to the ownership type. For most of MENA countries, the privatization of the incumbent operator started relatively recently and it is noteworthy that privatization for MENA telecom sector did not imply the loss of state control over the incumbent operator, since the state mostly maintained the largest share of the incumbent capital. For MENA region, till 2010, 10 over 17 countries have started the process of the incumbent privatization; 9 of them are partially privatized and only one is fully privatized (Jordan).

Another dimension concerned the privatization reform: many studies, as Estache et al. (2006), considered that the commitment to privatization served as a proxy for the commitment to open the sector for competition, although it is not a perfect proxy since the existence of private telecoms companies is necessary but not sufficient to increase competition. In MENA, we have different cases, for example; in Jordan, the incumbent operator was privatized in 2000, and then the fixed market was opened in 2005 in compliance with GATS commitments. For Morocco, Maroc Telecom, the incumbent operator, was firstly privatized in 2001 by selling 35% to Vivendi France, then; the fixed market was opened to Meditel, then to Wana "Maroc Connect" in 2006 and 2007 respectively. Other countries introduce privatization of their incumbent operator but they failed to foster competitive markets, an example is the Egyptian case. The process of Telecom Egypt privatization started in 2005 but is still incomplete; in 2012, Telecom Egypt's shares are 80% owned by the Egyptian Government and 20% free float, however, Egypt failed to foster fixed competitive market. Thus, the privatization only creates *large private monopolies* (Wallsten 2003; Li and Xu 2002). In general, *privatization works best when there is competition that limits the market power of the incumbent. Competition is thus seen as a complement to privatization* (Li and Xu, 2004). So, it is not reliable to consider the privatization as a proxy for competition for MENA countries, since, in the case of incumbent privatization in MENA region, if competition occurred in the fixed segment, it took place with time lags.

Another phase of telecom reform, other than the privatization process, concerned the **entry of new operators and new services** (in MENA, it concerned mostly the entry of mobile services). We will study the effects of competition that occurs in the final markets for the local fixed and mobile services. The competition framework is important since a monopoly whether state owned or private have fewer incentives to improve services and lower prices than a firm operating in a competitive environment (Wallsten 2003). Even after the opening of the sector to competition, the incumbent PTO still has a competitive advantage that can be exploited against new entrants, since it has no incentive to establish suitable interconnection terms. Thus, when the government plays the role of regulator, as well as the owner of the incumbent operator, even partially, the interconnection agreement would be in favor of the incumbent operator. As a result, *the incumbent can be a significant bottleneck to competition* (Wallsten 2003).

For MENA countries, in many cases, specifically for the fixed market, potential entrants have been discouraged by the high set-up costs of establishing a new network. For example, in Egypt, Telecom Egypt has refused to lease its network to new market entrants as it was done by Morocco

incumbent in 2007 (Marouani and Munro 2009). Actually, competition in MENA countries is higher in mobile markets rather than in fixed markets, which started to be opened to competition lately. Moreover, even if the monopoly condition for the incumbent fixed operator has been lifted, there remain high barriers to entry like the cost of building a network; thus, leasing the incumbent network helped increasing competition in the fixed market, as in Morocco. For many MENA countries, the fixed segment is still monopolistic, which is not the case in the mobile segment where it is mostly competitive as shown in table 1.

Finally, the reform reaches its peak when full privatization takes place, as in Jordan, and full competition is about to be introduced. When reaching this phase, there is much less need for regulation, intervention is only required in issues concerning universal service and access. Obviously, investors consider the existence of IRA as a guarantee for them to invest in such country. No country in our sample reaches this phase, maybe only Jordan has reached it.

2.2.Motivations for MENA telecom reform

Further integration of MENA region into the world economy required the development of different services' sectors: transport, telecommunications, banking and insurance (Marouani and Munro 2009). From an economic point of view, telecom in developing countries has many shortages, including unmet demand for basic services, lack of advanced services provided by the private sector, poor service quality and low productivity (Ros1999). From another perspective, "*the Middle East and North Africa has been confronted with the common challenges facing all regions of the developing world, namely the impact of neoliberal globalization and the associated pressures of economic liberalization, deregulation and reform designed to accomplish greater integration into the international economy as well as enhancing competitiveness in external markets*" (Oni 2003). Thus, major reforms are introduced under the pressure of the IMF and the WB in order to reschedule debt service payments or to resort for new loans, in the context of new stabilization and adjustment agreements, largely assisted by the World Bank structural adjustment agreements. This consisted of moves towards greater trade liberalization, extensive liberalization of price controls and removal of the government trading monopolies. In order to gain access to IMF facilities; many countries should start the adjustment process and adopt different economic reforms. Moreover, the WTO membership and Euro Mediterranean Partnership are also making pressures for countries to introduce reforms. As a consequence, many countries made global and regional commitments to liberalize their telecom sector. The General Agreement on Trade in Services (GATS) established basis for reforms in telecom sector; each government expected the type of reforms it can introduce and the commitments that should be fulfilled.

All of these reasons foster reforms in MENA region. Recently, foreign equity limits have been largely relaxed for MENA to comply with GATS agreements, but this doesn't imply that this liberalization is effective in practice. For example, Egypt's telecom market has been opened since GATS commitments eliminated Telecom Egypt exclusive rights at the end of 2005 (Marouani and Munro 2009), however, only international services and leased lines services have been open by selling a minority share, but local and long distance services remained 100% owned by Telecom Egypt.

Overall, the low performance of the telecom sector in MENA region was not a sufficient driver to adopt reforms. The conditions that guide the reforms were mostly political; the reforms occur under pressure from WB and IMF under the program of structural adjustments in different countries. Thus, it is crucial to assess whether a reform, would be affected by institutional, political and economic nature of each MENA country, such as the democracy level, the legal origins, the colonization history and the economic wealth. In other words, we assess if it is efficient to impose such liberalization reform in MENA countries, given the political, institutional and economic environment.

2.3.Limitations of MENA telecom reforms

Market liberalization in MENA has been late compared to other regions, such as Asian or Latin American countries. In MENA, many countries are still reluctant and willing to protect their national investments in the incumbent operators and prevent foreign investments. In practice, liberalization

started mostly with the launch of second mobile licenses in the late 1990s and the early 2000s. Egypt was the first country in MENA countries introducing competition in the mobile market by the entry of Vodafone in 1998. Kuwait then opened its mobile market in 1999 and Jordan and Morocco followed Egypt and Kuwait in 2000. Foremost of the GCC¹⁰ countries like UAE and Saudi Arabia, they were rather late in opening up competition in their mobile sector: incumbent monopoly remained in their fixed and mobile market with no competition until 2005.

Marouani and Munro (2009) state that even if significant regulatory reforms have taken place in the services' sectors in different MENA countries over the last decade, a number of market restrictions still remain. For example, foreign equity limits have been relaxed in most MENA countries in recent years, yet many service markets remain dominated by state-owned or domestic enterprises. Dihel and Shepherd (2007) states that MENA countries are considered among the most restrictive countries for trade in fixed telecom services compared to Asian and transition economies. According to Marouani and Munro (2009), the mobile sector is more open than the fixed telephony in a selected set of MENA countries. This is due to the need of foreign investment to expand the mobile network capacities, as well as the relative infancy of the mobile industry and its regulations. *The historical operators tried in many countries to develop a mobile network on their own but failed to match the needs of an exploding demand at the beginning of the decade* (Marouani and Munro 2009).

Ultimately, the liberalization of the telecommunication sector in MENA countries started in the half of the 1990s, one decade after the liberalization of the European telecommunication sector. Even if some reforms took place in MENA region, some countries are still reluctant to changes. There remain countries with no IRA and countries with state-owned monopoly incumbent operator. Moreover, for the countries that have been engaged in the liberalization, the whole process was rather complex since most countries were not ready for such reforms. For instance, privatization, even if it took place, it is mostly partial in order not to lose government control over the incumbent operator.

3. Related literature and testable hypotheses

Our objective, in this section, is to find a relationship, if any, between different patterns of telecom reform and telecom performance. Patterns of telecom reform include: regulation, privatization and competition, as well as their interactions. Concerning telecom performance, it has three dimensions: access, affordability and productivity. In the section, we will explore empirical works from the existing literature in order to derive our testable hypotheses.

3.1. Does the establishment of an IRA improve telecom performance?

The regulatory policy and institutional framework are each greater determinants of performance than the form of ownership or management (Estache and Wren-Lewis 2009). In infrastructure industries, the importance of institutions is mainly driven by the sunk nature of the investments needed, which is the source of time inconsistency problem¹¹; to solve this problem, the trend in the last decades is to strategically delegate into an independent regulator who cares to a certain extent about the firm's rents (Trillas and Montoya 2011). The claim suggested by politicians to justify the transfer of powers to a specific regulatory agencies is that countries with independent regulators will achieve better policy outcomes than countries without independent regulators, or that countries with more independent regulators will achieve better policy outcomes than countries with less independent regulators (Hanretty and Koop 2009). Although in theory other mechanisms could solve for the time inconsistency problem faced by regulators, the literature points out that it is difficult for developing countries to find credible alternative to an independent regulatory agencies (Trillas and Montoya 2011).

¹⁰ GCC "Gulf Cooperation Council" is composed of six countries, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates.

¹¹ The problem is to induce the needed level of investment for developing countries, since investors would be reluctant to invest if they do not expect high level of prices over time.

In the Least Developed Countries (LDCs), the regulators suffer from a limited ability to implement policy, are generally short of resources and are less accountable which increase the probability of a regulatory capture (Estache and Wren-Lewis 2009). Such characteristics imply that the regulator efficiency in the developing countries is uncertain and doubtful.

The effect of the existence of a separate regulator differs across empirical studies. We will focus on the main results concerning mostly groups of developing countries.

Estache et al. (2006) use a sample of 204 countries to show that the introduction of an IRA helps decreasing the price of local calls and increasing labor productivity. Somewhat surprisingly, the introduction of an IRA has no statistically significant impact on access and on the fixed component of the tariff paid by users. Ros (2003) finds that the existence of an independent regulator is positively associated with teledensity and operating efficiency in 20 Latin American countries. According to Gutiérrez (2003), a better regulatory framework has a greater network deployment and telecommunications efficiency when applied on a sample of 22 Latin American countries.

Others studies reach different results concerning the effect of the existence of a separate regulator. Wallsten (2003), by using a large sample of 200 countries, finds that establishing a separate regulator is negatively, rarely significant, correlated with the number of mainlines, mainlines per capita, and investment; but, it is correlated positively and significantly with the number of cellular subscribers. In their panel data analysis, Trillas and Montoya (2011) confirm that the regulator independence is associated to higher network penetration, but the magnitude and statistical significance of this impact are probably low and difficult to assess.

Hypothesis 1. An independent regulator in place is expected to improve the sector performance, but given the context of MENA developing countries, this effect is doubtful.

3.2. Does ownership affect telecom performance?

Ownership matters since with state ownership the government has more resources to correct the market failure and to pursue nonprofit-generating activities, while with private ownership it has fewer resources for such goals (Laffont 2005). Although this importance of the state ownership, a critical factor behind this move to privatization is the well-documented poor performance of public enterprises; public enterprises are inefficient because they address the objectives of politicians rather than maximizing efficiency. Privatization works because it controls political discretion (Boycko, Shleifer, and Vishny 1996). For the developing countries, the occurrence of privatization may be the expression of inefficient regulation, corruption or financial problems. Privatization may happen when they should not because of corruption (Laffont 2005). This corruption, in the case of private ownership will take the form of higher prices (Estache and Wren-Lewis 2009)

Generally, a change of ownership from public to private can bring benefits even in situations where it does not lead to enhanced competition, since this may relax a capital constraint, improve the structure of the incentives and help transferring technology (Gual and Trillas Jané 2004). Although international agencies advised countries to open their infrastructure industries to the private sector to increase its investment and improve its efficiency, for countries with the lowest income, the privatization has been disappointing (Estache and Wren-Lewis 2009). These failures were accompanied by increases in prices, which have led to large dissatisfaction with privatization (Estache and Wren-Lewis 2009).

In the literature, the effect of privatization on performance is not consistent across different studies. For Ros (1999), the effect of ownership on network expansion is not so clear. From one side, privatization may have positive effects since it increases managers' incentives to reduce costs and increase productivity since they will capture the benefits (either cost savings or profits) resulting from such innovation, so he expects that this will lead to higher total factor productivity. Li and Xu (2002) get the same results when studying the impact of privatization on telecom productivity for 177 countries between 1990 and 2001. From another side, privatization can have drawbacks. Privatized firms can increase their profitability by restricting output or by restricting nonprofit objectives as provision of universal service (Li and Xu 2002). Thus, the existence of a regulator is important to prevent privatized firms from such practices.

Estache et al. (2006) state that privatization is associated with an increase in access and labor productivity, but it negatively affects affordability by increasing prices. Additionally, they find that the presence of private capital affects differently developing and developed countries; for instance, it is associated with an increase in access and fixed costs in developing countries, but with a decline in developed ones. The same for Fink et al. (2003), privatization improves performance in terms of access and productivity. Ros (1999) finds the same results. Lately, Ros (2003) finds that privatization is positively associated with teledensity and operating efficiency. For Gutiérrez (2003), privatization is associated positively with the level of network and with main lines per employee.

Other studies find different results. In Wallsten (2001), privatization alone is associated with few benefits, and is negatively correlated with mainlines penetration and connection capacity. When it is combined with an independent regulator, it is positively correlated with telecom performance measures. So, *this interaction mitigates the negative effects of privatization on mainline penetration*. Wallsten (2003) adds other results to the previous studies; he finds that privatization is negatively and significantly correlated with the number of mainlines, but positively and significantly correlated with investment and the number of cellular subscribers. Then, by testing the effect of privatization combined with a separate regulator, it is positively correlated with the number of mainlines and mainlines per capita. Thus, the presence of the regulator while privatizing the incumbent operator will have positive effects on telecom performance.

Moreover, private ownership is most efficient when there is effective competition (Gual and Trillas Jané 2004). For Estache and Wren-Lewis (2009), the private ownership have not improved performance, notably in sectors where there is no competition. Empirically, Fink et al. (2001), in the context of 12 developing Asian economies over the period 1985-1999, show that, privatization alone may not lead to great strides if the privatized monopoly is not exposed to competition. Thus, we also expect that when a privatized monopoly is exposed to competition, this will mitigate the negative effects that could arise from privatizing the incumbent.

Finally, good regulation would improve the privatization case from a normative point of view. In the UK, the fact that the regulatory system was in place at the time of privatization of the utilities, and that such regulatory system substantially limits the discretion of the regulators, reassured the private investors about the nature of the ensuing regulatory game (Spiller and Vogelsang 1997).

Hypothesis 2. Privatization is expected to lead to higher prices with null or negative effect on access. Moreover, when a privatized incumbent is exposed to competition, this helps improving telecom performance. Finally, the presence of a separate regulator when privatizing the incumbent operator improves telecom performance.

3.3. How does competition improve telecom performance?

It is well known that competition between firms brings improvements in terms of allocative efficiency, as well as internal (technical) efficiency, with a strong presumption that competition produces dynamic benefits through its impact on the incentives to improve performance and innovate (Gual and Trillas Jané 2004). Moreover, competition is crucial since it helps avoiding the problem of limited regulator capacity and serves as a pressure on the firm to keep prices low (Estache and Wren-Lewis 2009). Therefore, there is a general consensus that competition in the non-natural monopoly segments of telecommunications is beneficial for welfare, through improvements in incentives and productivity (Gual and Trillas Jané 2004).

From another point of view, in some cases, there are technical limitations for competition, such as the existence of significant economies of scale, for example due to substantial fixed costs of networks, thus competition leads to inefficient network duplication (Gual and Trillas Jané 2004). Industrial organization theory provides us with examples where some form of competition may be detrimental, e.g. for natural monopolies conditions, ex-ante competition in the form of auctions may be organized but ex post competition must be restricted to avoid a wasteful duplication of costs, thus the restriction of competition in this case may be beneficial (Laffont, 1999). From another perspective, governments are sometimes reluctant to introduce competition since introducing competition is a way that destroys the government rents from the historical operator.

However, the implementation of competition in developing countries is desirable since it helps decreasing the asymmetries of information, but is more costly to implement (Laffont, 1999). *The most compelling argument in favor of temporary protection is that development requires modern technology* (Laffont, 1999). For Gual and Trillas Jané (2004), some authors have criticized the policies that facilitate the entry of new firms and argued that this policy hurts the performance of the industry since economic efficiency is hampered due to insufficient exploitation of scope economies.

Thus, the effect of competition on network expansion depends heavily on the existence of economies of scale. In the case of persistence of economies of scale, increasing the number of firms in the market would increase the cost per unit, which will be reflected in higher prices and lower penetration. If technological evolution wipes out the idea of economies of scale, competition will rather help decreasing costs and as a consequence, decreasing prices and increasing network penetration. As stated by Ros (1999), *under non-natural monopoly conditions, competition is likely to have positive effect on network expansion*.

Ros (2003) finds that competition in the fixed segment, for 20 Latin American countries from 1990 to 1998, is strongly positively associated with teledensity. Wallsten (2001) reaches the same result for 30 African and Latin American countries from 1984 through 1997. He finds that competition, measured by mobile operators not owned by the incumbent, is correlated with increase in the access and with decrease in the price of local calls. For Gutiérrez (2003), competition is associated positively with the level of network and with mainlines per employee. Fink et al. (2003) state that competition improved performance (measured by the number of mainlines per 100 inhabitants and the number of mainlines per worker). For Fink et al. (2001), mobile penetration is positively affected by competition among digital service providers. Different results occur, like those of Ros (1999), which find that competition is not correlated with network expansion, but with efficiency in terms of lines per employee.

We know that competition kills cross subsidies (Laffont, 1999). Therefore, the effect of competition on prices might be surprising. However, Laffont (1999) suggests *a partial rehabilitation of cross subsidies in developing countries that is not incompatible with some form of competition in the important question of infrastructure building*. That is since the tax system suffers from inefficiency and corruption in developing countries, so, the financing of the network expansion would be by the cross subsidies between the rich customers in urban areas and the poor ones in rural areas (Laffont, 1999).

Given the nature of the telecom sector, the existence of a regulator is important to prevent the anticompetitive practices, by ensuring that consumers would have lower prices and that investors would have profits so they have incentives to enter the market. Laffont (1999) argued that liberalization can proceed safely only to the extent that strong regulatory institutions are established. Accordingly, it is crucial to have a regulator in place when introducing competition. Even if the competition is introduced, the regulator should reduce market power and set access prices, *experience in developing countries suggests that the regulation of partially competitive sectors may be as demanding on regulators as monopoly regulation* (Estache and Wren-Lewis 2009).

Hypothesis 3. In the case of the absence of economies of scale, the entry of new operators affects telecom performance positively specifically in terms of output and affordability. Negative effect on affordability would be due to the elimination of cross subsidies. If the economies of scale are persistent, the competition would harm the sector performance. Moreover, the simultaneous presence of a separate regulator while introducing competition is crucial for better sector performance.

3.4. Do institutional, economic and political factors affect telecom reform?

The institutional and political framework for MENA countries is crucial to be taken into account since it affects the decision to adopt different reforms. In fact, political and social institutions have an independent impact on the type of regulation that can be implemented (Levy and Spiller 1994). Moreover, the credibility and effectiveness of a regulatory framework and its ability to facilitate private investment vary with the country political and social institutions (Levy and Spiller 1994). Furthermore, 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 (Levy and Spiller 1994).

In this subsection, we argue that institutional, economic and political factors explain the reform process adopted by MENA countries. As stated by (Levy and Spiller 1994), researchers disregard regulatory governance. Laffont argued that weaknesses in institutions complicate regulation in the LDCs (Estache and Wren-Lewis 2009). According to Ros (1999), *the success or failure of privatization can depend, in part, on the regulatory framework that in turn is affected by political and social institutions*. For (Wallsten 2003), it is possible that countries with more solid political institutions are more easily able to build credible regulatory agencies, in addition to having other institutions that make reforms more likely to succeed.

First, we argue that the reform process is affected by **the level of democracy** established in each country. Thus, the intensity of the democracy indicator would affect different reforms adopted by MENA countries such as: the adoption of IRA, the attractiveness of private investments and the market openness for potential entrants. 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. They mention that while there is a large theoretical and empirical literature for the determinants of economic reforms in general, there is scarce empirical evidence on the relationships between democracy and reform. 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 empirical papers study the relationship between democracy and reforms. Giavazzi and Tabellini (2005) study the relationship between democracy and trade reform on 140 countries from 1960 to 2000. They find a positive relationship between democracy and trade reforms. Similarly, (Djankov and Amin 2009) findings confirm that an expansion of democratic rights encourages micro-economic reforms from the World Bank's Doing Business database and is likely to increase efficiency and growth. Quinn (2000) studies the relationship between international finance regulation and democracy and finds that democracies liberalize international finance. This indicator appears to be a valid instrument for telecom reforms because it can be treated as exogenous to our outcome variables; overall democracy is not likely to have a direct effect on telecom market performance other than through the adoption of different reforms. Moreover, telecom reforms are sufficiently micro-measured, thus, 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 considered as a style of social control of economic life, and such styles have developed, survived over the years and continued to have substantial economic consequences. Such styles prove its persistency in different countries. Although some changes occur in the regulatory and the legal framework, the legal system and its institutions 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). Gual and Trillas Jané (2004) consider that the legal origin per country reflect the interventionist tradition of each country and the degree to which the state has an inclination to intervene in economic matters. The deregulation policies will be more ambitious in countries with a less interventionist tradition since this helps to enlarge the scope of the markets (Gual and Trillas Jané 2004). The empirical evidence is consistent with the Legal Origins Theory. The effect of legal origin is tested on different dimensions, among them the financial development (La Porta et al. 2006), the government ownership of banks (La Porta et al. 2002), the government ownership of the media (Djankov et al. 2001) and the government ownership of labor markets (Botero et al. 2004). With a focus on the effect of legal origins on government regulation in (La Porta et al. 2008), it is found – for a broad range of activities – 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. Moreover, as was argued in (Spiller and Vogelsang 1997) in the case of UK, the institutions arrangements essentially based on the UK judiciary's respect for contracts and contract law helps restricting regulatory discretion and hence helps the privatization of various utilities sectors.

To sum up, legal rules protecting investors vary systemically among legal origins, with common law countries being more protective of outside investors than civil law countries. Thus, we argue that the historical legal origin of each country affects the reform adoption, specifically, the privatization process. Legal origins seem to be a valid instrument for telecom reforms, since legal origins are considered as historical facts, difficult to be altered, thus, they are considered as exogenous to telecom market reforms. Also, it is far from real to consider that telecom market performance could shape the legal origins of each country.

Another factor that would affect the reform adoption is **the natural resources** in MENA countries, as an important source of rents, since the contribution of natural resources to economic output is important. 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 order to reschedule debt service payments or to resort for new loans. 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 reform adoption. Thus, it is interesting to test the effect of the independence year from colonization on the lags in reform adoption.

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, therefore, the independence year could affect the lags in reform adoption.

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

Hypothesis 4. Political, economic and institutional factors shape the choice of a country to adopt different reforms, which in turn would affect telecom performance. A more democratic country is expected to have a high level of reform adoption. Also, a country with a civil law origin is less likely to adopt reforms, specifically the privatization process. Finally, countries are more reluctant to adopt different reforms when they have abundant natural resources. Briefly, institutional, economic and political factors matter and would have an effect on the different reforms.

4. Empirical strategy

Once the endogeneity of reforms is taken into account, most of the coefficients become larger. Hence OLS may underestimate the contribution of the reform variables.

4.1. Instrumental variables estimation:

To test the effect of reforms on telecom performance¹², while accounting for their endogeneity, we estimate the following model by using IV-2SLS estimation procedure (Instrumental Variable- Two Stages Least Squares estimation) while including year dummies¹³. 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

¹² The OLS estimations are presented in Table 5.

¹³ 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, which 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. *In cases where the key variables in X_t do not vary much over time, fixed effects and first-differencing methods can lead to imprecise estimates* (Wooldridge, 2002).

functional form in the first stage¹⁴. We adopt a log-linear specification to transform different variables into a normal distribution. The regression takes the form:

$$Y_{it} = \beta_0 + \beta_1 R_{it} + \beta_2 P_{it} + \beta_3 C_{it} + \beta_4 X_{it} + Z_t + u_{it} \quad (1)$$

Where Y_{it} is one of the four performance indicators we have chosen to consider. R_{it} , P_{it} and C_{it} are reform dummies. X_{it} is a vector of control variables (GDP per capita and Population density), Z_t are year dummies and u_{it} is the disturbance term. The equation is estimated for each of the dependent variables we consider here.

It is obvious that the reform variables are endogenous, which means that they could affect each other and may be also affected by different levels of performance. The low level of performance would be a motive for the government to establish an independent regulator to increase the sector performance. Moreover, the actual level of demand, productivity and prices would shape the decision of new entrants to operate in the market. Also, the existence of an independent regulator in the market might be an important determinant for new investors to serve as a guarantee that they would have profits in the long run and they would not be harmed by anticompetitive behaviors. Also, for instance, if the private investors are very interested in performance indicators before going through the privatization process, the government may increase the efficiency of the incumbent operators in order to attract investors when introducing privatization (Gasmi et al. 2013).

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

$$\widehat{\Pr}(d_i \neq 0 \mid IV_{it} + X_{it}) = \frac{\exp(\lambda_{\alpha_0} + \lambda_1 IV_{it} + \lambda_2 X_{it} + Z_{it})}{1 + \exp(\lambda_{\alpha_0} + \lambda_1 IV_{it} + \lambda_2 X_{it} + Z_{it})} \quad (2)$$

Where IV_{it} are the instrumental variables mentioned above, X_{it} are the control variables we used and Z_{it} is the disturbance term.

4.2. Data¹⁵

The previous hypotheses, mentioned in section (3), will be tested using a panel dataset of 17 MENA developing countries from 1995 to 2010¹⁶. The starting date of the study, 1995, is chosen according to data availability. Although our sample is a small set of non-random countries, there are differences in their economic development level (their GDP and the WB classification according to income level), as well as there is also diversity in the measures of their performance indicators, the sequence and the extent of reform. We construct our original database from various sources, as we will see. Not all data exist for all years and for all countries, thus, we have unbalanced panel data. Moreover, we are focusing only on Voice market in fixed and mobile segments.

To assess the performance, we use three different dimensions: access rates, productivity, and affordability of services, as used by Estache et al. (2006). We use different proxy variables to reflect

¹⁴ 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.

¹⁵ See Table 3 for variables summary

¹⁶ 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).

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 for each 100 inhabitants in natural log). This measure is used by different authors (Ros 1999; Ros 2003; Fink et al. 2001; Fink et al. 2003; Wallsten 2001; Li and Xu 2002; Gual and TrillasJané 2004; Gasmi et al. 2013; Trillas and Montoya 2011).The data on access rates comes from the ITU database. **The productivity** is measured by the number of telephone subscribers in fixed and mobile telephone per employee (employed by Total full-time Telecommunication employee) and is expected to be positively correlated to different reforms. The data on telecommunication employees comes from the ITU database. This measure is used in (Ros 1999; Ros 2003; Gutiérrez 2003; Li and Xu 2002; Gual and Trillas 2004; Gasmi et al. 2013)¹⁷. To measure **affordability**, we use prices indicators¹⁸ as the monthly subscription for residential telephone service in US\$ as in (Estache et al. 2006; Gasmi et al. 2013)and the price of a 3-minute fixed telephone local call (off-peak rate) in US\$ as in (Wallsten 2001; Li and Xu 2002; Estache, Goicoechea, and Manacorda 2006). We use also the mobile cellular prepaid price of 3 minute local call (off-peak, on-net) in US\$ to reflect mobile affordability as in (Gasmi et al. 2013), but at the peak rate. Our data about prices are not perfect since we don't take into consideration the different other options available to phone users either for fixed or for mobile services. So, the data we use is the best data available up till now. The data on prices comes from the ITU database.

Tracking evolution in the dynamics of reforms for MENA countries is very complex: especially the monitoring of regulation, as well as the evolution of private sector participation in the incumbent operators. To measure the effect of **regulation**, we use a dummy variable that equals 1 if a separate regulatory authority exists in a country in a specific year. The creation of IRA per country is documented in ITU World Telecommunication Regulatory Survey 2012, "*Does a separate Regulatory Authority exist for Telecommunication or Information and Communication Technology (ICT) in your country?*"¹⁹ This measure doesn't reflect the degree of independence, but, it is the only data available we can rely on due to the lack of detailed information on the regulatory functions for a long period of time²⁰. As a consequence, interpreting its effect in a regression is related to attempts at regulatory reform rather than the effect of being a separate entity (Wallsten 2001). We collect data for regulation from ITU database and different regulators websites. Another dummy variable is constructed for **privatization**²¹. 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 existence of licenses in a particular segment. To reflect the state of competition in the telecom market, we construct an index as in (Li and Xu 2002), it is constructed as follows:

- =0 if monopoly exists in both segments (fixed and mobile)
- =1 if at least one segment operates with more than one operator
- =2 if both segments become competitive.

Data for competition comes from ITU, different regulators and operators' websites and Ministries of communications websites per country.

¹⁷ We used 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 (Fink et al. 2001; Fink et al. 2003; Estache et al. 2006).

¹⁸ Given by ITU Database (2011).

¹⁹ In this survey, ITU defined SEPARATE as: "*independent*" in terms of finance, structure, and decision making from the operator(s) and the sector Ministry.

²⁰ We preferred 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 as we will see later.

²¹ We used a dummy variable due to lack of data on the percentage of privatization of the incumbent operator.

To test the effect of the simultaneous presence of different reforms, we construct three variables to introduce different **reforms interactions**²²; we use the three interactions variables: Regulation-Privatization, Privatization-Fixed competition and Competition-Regulation. Then, we construct a **three way interaction variable**²³ Regulation-Privatization-Competition. Each variable takes the value of 1 when the reforms in question are in place simultaneously, 0 otherwise.

In our model, we controlled for demographic and macroeconomic variables such as: **GDP per capita** as a determinant of demand and **population density** as a determinant of the market size. This data comes from WDI (World Development Indicators), the World Bank. Also, we include year dummies to measure time fixed effects.

Finally, to correct for possible endogeneity of reform variables, firstly, 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 on the Center for Systemic Peace Web site "Polity IV". Then, we normalize the variable to be in the range from 0 to 1 to be more meaningful. Then, to take into account **the legal origins** for each country - either it is civil law or common law country- as an institutional variable; we collect data from the CIA World Factbook about the legal system in each MENA country. We construct a dummy variable that equals 1 if the country has a civil legal system, zero otherwise. Moreover, we used "**Total natural resources rents (% of GDP)**" as an economic variable to reflect the country natural resources potentially leading to rents. These data comes from the WDI (World Development Indicators) database, the World Bank. Finally, we control for **the year of independence** from colonization for each country to see whether it has an effect on the reform adoption. We collect data about independence year from the CIA World Factbook data for each MENA country.

4.3. Results and Discussion

4.3.1. First stage estimation

In our first stage regression in table 4, for **the democracy level** in each country, the results are contradictory with the theory and the previous empirical evidence; higher is the democracy indicator, lower is the reform adoption – specifically the privatization process, with no effect on other reform aspects, which might be explained by the unique political characteristics of MENA countries. Then, a **civil law country** is less likely to adopt telecom reforms, specifically - the privatization process –than a common law country. Moreover, a country with higher **rents from natural resources as a percentage of GDP** is not compelled or forced to adopt reforms such as establishing a separate regulator and privatizing the incumbent operator. Finally, latter is **the independence year** from colonization for each country, less is the telecom reform adoption.

4.3.2. Instrumental variables estimation findings

Table 6 shows the estimation for the regressions of different performance indicators on our three reform variables. Then it shows the reform interactions results: Regulation-Privatization, Fixed competition-Privatization, Regulation-Competition and finally the three way interaction, respectively. The results show that the **regulation**, when tested without interactions, is statistically insignificant for some performance variables, mainly mobile access and affordability measures in terms of monthly residential subscription and the 3 minute fixed call. However, establishing a separate regulator has a positive effect on fixed access in terms of the number of subscribers per 100 inhabitants and it helps increasing productivity. The **privatization** has a negative significant effect on fixed access. Indeed, it has no effect on productivity measure but it increases the fixed prices in terms of the monthly residential subscription and the 3 minute fixed call, which validates our hypothesis on privatization.

²² Working on 86 developing countries, Fink et al. (2003) tested the effect of the existence of a separate regulatory authority when only combined with other reforms. They found that complete liberalization paid off and affected positively teledensity and labor productivity.

²³ Fink et al. (2001) found a positive contribution of liberal policy (measured by a three-way interaction term) to the performance of telecommunications services in 12 Asian developing countries.

Concerning the third reform variable, the **competition** helps reducing different components of fixed prices and mobile prices. However, it has no effect on telecom access and productivity. This validates in part our hypothesis on competition effect. In summary, these results suggest that the reform variables are endogenous; after correcting for suspected endogeneity, many results change. Overall, it is noteworthy that the privatization of the incumbent operator and the entrance of new competitors have no effect on telecom productivity in our sample of MENA developing countries.

However, in table 6, when we take the interaction terms into consideration, this affects our performance indicators. For instance, **when a separate regulator exists simultaneously while privatizing the incumbent operator**, this helps eliminating the negative effect of the privatization on the fixed access. Thus, while having a regulator in place, the privatization becomes with a net positive effect on fixed access. Moreover, this interaction has different effects on different fixed prices. With a separate regulator in place, the positive effect of privatization on the fixed monthly subscription is eliminated and is turned into a negative effect, which implies better affordability. However, a privatized incumbent might reduce the 3 minutes fixed price in order to deter entrance. Such behavior is eliminated by the existence of a regulator in place; which implies a price increase. So, the existence of a separate regulator in place helps improving the privatization effect in terms of access and it eliminates its negative effect on the fixed monthly subscription.

When we take **the interaction between the incumbent privatization and the number of fixed operators** in the market as an indicator of fixed competition, we find that it has a negative effect on fixed access. What is really surprising is the negative effect of this interaction on productivity, while testing the partial effect of privatization on telecom productivity, we find that higher is the number of fixed operators in the market, lower is the productivity measure, which means that the competition is eliminating the positive effect of privatizing the incumbent operator on telecom productivity. Moreover, the null effect of this interaction on affordability implies that the competition doesn't help reducing the negative effect of privatization on affordability. Thus, the fixed competition helps to alleviate the negative effects of privatization on fixed access, but it is deteriorating the telecom productivity with no effect on prices.

Finally, concerning **the last interaction, the simultaneous presence of a separate regulator with the introduction of competition**, the results show that this interaction has no effect on telecom access. However, it has a negative effect on productivity and positive effects on fixed prices. Concerning productivity, when we test the partial effect of regulation on productivity, we find that - with a separate regulator in place - higher is the competition, lower is the productivity. Concerning the prices, when we test the partial effect of competition on fixed prices, we find that – with a competitive telecom market - having a regulator in place eliminates the negative effect of competition on residential prices and turns it into a small positive effect, however, having a regulator in place didn't eliminate the negative effect of competition on the 3 minutes fixed prices although it reduces it.

When we take into account **the three ways interaction** between the three reform variables - the existence of a separate regulator, the privatization of the main incumbent operator and the introduction of competition – we find that the existence of the three reform variables simultaneously helps increasing mobile access and telecom productivity. However, the negative effect on the fixed access is still remaining. Also, this interaction has a positive effect on fixed prices.

4.3.3. Robustness Check: Dynamic model

For more robustness checks, we take into consideration the fact that different telecom reform in year T would affect different telecom performance indicators at year T+1 instead of year T. Thus, we test the effect of different reforms, as well as, their interactions at year T on different performance indicators at year T+1, using IV-2SLS estimation. The results for different telecom reform, as well as for their different interactions are totally robust, sometimes with different levels of significance.²⁴

²⁴ Results are available upon request.

5. Discussions

While performing the first stage, we found interesting results, some are in line with the theory and others are not, which infirms our hypothesis (4): as stated by (La Porta et al. 2008), we find a negative relationship between **being a civil law country** and the privatization adoption, which confirms the fact that civil law countries are qualified by government ownerships, while common law countries are more likely to use private contracts. Also, civil law dummy variable has no effect on the IRA establishment, since a separate regulator is not considered as a privatized entity, it remains a governmental entity but with a separate structural, functional and financial form. For **the democracy effect** on reform adoption, our results show a negative relationship between democracy and privatization and the absence of a relationship between democracy and other reform aspects, which might reflect the fact that democracy is not well established in MENA countries. In other words, depending on the political nature of MENA countries, such countries can't benefit from the positive impacts of establishing the democracy. Moreover, we found that when the country is somehow independent in its resources (**high natural resources rents as percentage of GDP**), it is not compelled or forced to adopt reforms such as establishing a separate regulator and privatizing the incumbent operator under the IMF and the WB recommendations. Finally, latter is **the independence year** from colonization for each country, less is the telecom reform adoption, which implies more lags in reform adoption and figures out the long term negative impact of colonization.

The results on **regulation** should be considered carefully, since the variable doesn't measure the extent of regulatory independence even if it claimed to be independent according to ITU reports. The insignificance of the regulation coefficients to explain some performance indicators is surprising in our sample of MENA countries. This implies the fact that a regulator by its own is not enough to guarantee the whole success of the sector and to improve its performance. In general, the presence of a separate regulator is only efficient when it has the powers, the credibility and the competences, with no corruption. Thus, the regulator has to be given all the conditions to work effectively, in a way that guarantee its transparency and accountability. In MENA countries, the political and institutional context didn't guarantee such conditions. Thus, the establishment of a separate regulator is a necessary condition to improve sector performance rather than a sufficient condition for effective regulation. **The privatization** of incumbent operator has many implications in our regressions. The negative relationship between the privatization and the fixed penetration confirms our hypothesis. It could be explained as a reverse causation problem; when fixed penetration is very low, the marginal utility of privatizing an incumbent operator increases which encourages governments to privatize. Also, shareholders may decide not to increase the number of subscribers unless it is profitable for them; this implies that a privatized firm - specifically a privatized monopoly - is able to increase its profitability by restricting output, specifically in the context of developing countries, where there is a big need to invest in infrastructures, which are not profitable in the short term. Moreover, it might be the result of ineffective regulation with no incentives to invest. Since *in developing as well as in developed countries, a lack of public expertise results in contractual incompleteness, which may be a source of inefficiency since that lack of expertise reduces the incentives of private partners to participate and exert effort* (Saussier et al., 2003). Also, the effect of privatization on residential fixed prices is positive which validates our hypothesis about the effect of privatization on prices; privatizing an incumbent operator leads to higher prices. Overall, transforming a State Owned operator to a private one may not be constructive if it remains a monopolist. This may explain why privatization has no effect on productivity, with a negative effect on fixed access. This may be due to the inefficiency of the regulator, thus, we study the effect of Regulation-Privatization interaction, as we will discuss later. **Concerning the openness of the sector to competition**, competition leads to lower fixed prices and lower mobile prices. Although competition improves telecom performance in terms of prices, it is not the case in terms of access and productivity, which is rather astonishing.

Focusing on **the separate regulator and the privatization of the incumbent operator interaction**, we found that this helps improving the sector performance by eliminating the negative effect of privatization on the fixed access and turns it into a small positive effect. Although the privatization leads to an increase in telecom prices in terms of the fixed residential subscription - which ensures the tariff rebalancing system - such increase is excessive to the point that it is attenuated

when there is a regulator in place. However, a separate regulator eliminates the negative effect of a privatized incumbent on fixed variable cost and makes it positive which implies a price increase. This negative effect on prices – which means a price decrease – may be considered as an anticompetitive behavior that deter other entrants to operate in the market, thus such behavior is avoided by the regulator in place. Obviously, this interaction is important since a privatized incumbent can make abuse of its position by restricting output, by excessively increasing prices (specifically the fixed monthly subscription) or by anti-competitively decreasing prices, which implies a regulatory intervention. Moreover, without an IRA, no privatized incumbent operator would allow competition, since it would not be profitable for it.²⁵ Thus, the simultaneous presence of a separate regulator - while privatizing the incumbent operator - is not fully sufficient to eliminate those negative effects; however, it is necessary and needs to be more efficient. This reflects the importance of institutions to set the market rules since a privatized incumbent can make abuse of its position which would have negative effects on new entrants, as well as on consumers.

The result of the simultaneous presence of **fixed competition and the privatization of the incumbent operator** is very interesting. The existence of other fixed operators in the market when privatizing the incumbent operator has negative effect on fixed access. However, it has no effect on telecom prices, which means that the fixed competition is not sufficient to reduce the high prices induced by the privatization. Moreover, the existence of other fixed competitors in the market reduces the incentives of the privatized incumbent to increase its productivity, since he has no guarantee that he would have profits in the presence of other competitors. Although, the existence of other competitors in the market is considered as a guarantee for consumers, the existence of the competition doesn't eliminate the privatization drawbacks. Therefore, more fixed competition is crucially needed in the fixed segment in MENA region, while improving the efficiency of the regulator in monitoring the market. Thus the privatized incumbent could operate efficiently in the market in the presence of other competitors.

The negative significant effect of **regulation and competition interaction** on productivity is also remarkable; the independent regulator's effect on productivity is reduced the more the market becomes competitive. Thus, this means that the regulator becomes less efficient. This may be due to some regulatory constraints on the new entrants, or to the need to improve the regulatory role in the market. Also, its positive effect on the fixed residential prices is interesting; it implies that a regulator in place, while having a competitive market, eliminates the negative effect of competition and turns it into positive effect for the fixed residential prices due to tariff rebalancing system. However, it is still with negative effect for the 3 minutes fixed prices to attenuate the excessive decrease in prices that might be considered as an anticompetitive behavior. Concerning its insignificance effect on fixed and mobile access, this implies that the regulator is not efficient for promoting competition in the market and more rules are needed to guarantee its efficiency such as: interconnection rules and avoiding regulatory capture by the incumbent operator. Stimulating competition, by IRA is very crucial since first, its role is to encourage entry by ensuring that investors would have profits, so, they have incentives to invest and second, to make competition effective by lowering consumer prices. Thus, its role is crucial to ensure that operators and consumers are not adversely affected by liberalization.

Lastly, to have an overall conclusion on telecom reform effect on market performance, **the three way interaction** between the three reforms variables has interesting results. Having the three reforms simultaneously is not enough to eliminate the negative effect on the fixed penetration, while it has a positive effect on the mobile penetration. Thus, the remaining negative effect on the fixed penetration needs more explanation: firstly, it suggests the fact that the independence of the regulator is not sufficient to mitigate the negative effects of privatization, thus, the regulator should be truly independent. Then, the incumbent may present a high barrier for new entrants by preventing interconnection which is the most important element for new entrants in the telecommunication sector, or even by adopting vertical price squeezing. Finally, the competition in the fixed segment should increase; however, there may be barriers that prevent competitors to operate in the fixed market, such

²⁵ 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.

as the persistence of economies of scale in the fixed segment, thus, having more firms operating in the market would increase the cost per unit, which is not profitable for them. Such characteristics, among others²⁶, create contracting problems that undercut the ability of ordinary market mechanisms to deliver first best performance (Levy and Spiller 1994). *The question then becomes a tradeoff between, on the one hand, the ability or inability of governments to pick the right industries and right winners when economies of scale do not allow internal competition, and, on the other hand, a form of external competition that may not put into motion transfers of technology and learning by doing* (Laffont, 1999). Moreover, this three way interaction improves the telecom market productivity significantly, which is not the case when we consider each reform separately, thus it is important to adopt the three reforms simultaneously. Also, it would be interesting in further researches to study whether the sequence of reform adoption matters for the sector performance. Concerning the three way interaction effect on telecom prices, it has positive effects on fixed prices, which means that, at the end, it is also important to give incentives to foreign investors and new entrants to operate in the market with higher-but not excessive - prices, which means higher profits for them. However this interaction has no effect on mobile prices, which are determined by the market forces in almost all countries.

6. Conclusion

Overall, this paper is a first attempt to test the effect of telecom reform on sector performance in MENA countries, as a group of developing countries. The reform process in MENA countries: establishment of independent regulator, privatization and competition introduction in telecommunications has been much slower than other regions. In order to account for the possible endogeneity, we used IV-2SLS estimation by assuming that different reform variables are affected by institutional, political and economic variables. We find that MENA countries missed truly independent regulatory institutions; such issue is more clear in the fixed market rather than in the mobile market with high degree of privatization and competition which is reflected in better performance indicators.

It is noteworthy that the interactions between different reforms matter in the telecom performance. Such results are of great importance for policy makers in MENA developing countries, since this implies that the main concern of policy makers should be the guarantee of an efficient truly independent regulator and the promotion of competition, specifically in the fixed segment to prevent the drawbacks of privatizing the incumbent operators.

Moreover, the null or negative effects of different reforms and their interactions on telecom productivity are important to be considered, although it becomes positive when the three telecom reforms are adopted simultaneously. Also, the negative effect of privatization, of its interaction with fixed competition and of the three ways interaction variable on fixed access would be the focus of attention for policy makers. New rules would be put in place to guarantee effective rules to ensure effective telecom market, effective competition in fixed segments and better monitoring for newly privatized incumbents.

Depending on our results, the situation can be best described as “managed competition”, as Fink et al. (2001) described the case of emerging market in Asian countries, where the government allows some degree of liberalization and private ownership but at the end restricts the independency of the regulator.

An interesting issue that needs to be addressed in further studies is the sequence with which the reforms are introduced in the telecom market for MENA countries. Does the prior existence of a separate regulator before privatizing the incumbent operator and before introducing competition matter for the telecom sector performance? Does an IRA in place represent a guarantee for new investors and entrants that encourage them to enter the market?

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.

²⁶ Such as the economies of scope, the high specific and non-redeployable assets and the broad range of users.

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Tables

Table 1. MENA telecom sector summary 2010

	Regulatory Authority (Creation Year)	Privatization of the main incumbent operator	Competition Level in Fixed telephone market	Competition Level in mobile cellular market
Algeria	2000	State Owned	Monopoly	3 operators
Bahrain	2002	Partially Private	More than 6	3 operators
Djibouti	No separate regulator	State Owned	Monopoly	Monopoly
Egypt	1998	Partially Private	Monopoly	3 operators
Jordan	1995	Fully private	2 operators	3 operators
Kuwait	No separate regulator	State Owned	Monopoly	3 operators
Lebanon	2002	State Owned	Monopoly	Government Owned Duopoly
Libya	2006	State Owned	Monopoly	Government Owned Duopoly
Morocco	1998	Privatized	3 operators	3 operators
Oman	2002	Partially private	2 operators	2 operators
Qatar	2004	Partially Private	2 operators	2 operators
Saudi Arabia	2002	Partially Private	2 operators	4 operators
Sudan	1996	Partially Private	2 operators	3 operators
Syria	No separate regulator	State Owned	Monopoly	Controlled Duopoly
Tunisia	2001	Partially Private	2 operators	3 operators
United Arab Emirates	2003	Partially Private	2 operators	2 operators
Yemen	No separate regulator	State Owned	Monopoly	4 operators

Source: By the author

Table 2. MENA telecom penetration

Country	Number of mainlines per 100 people (1995)	Number of mainlines per 100 people (2011)	Number of cellular lines per 100 people (2011)
Algeria	4.16	8.5	98.99
Bahrain	25.19	20.89	127.96
Djibouti	1.14	2.18	22.8
Egypt	4.38	10.56	101.08
Jordan	7.23	7.35	118.20
Kuwait	23.48	18.26	175.09
Lebanon	12.96	20.32	79.52
Libya	6.69	16.38	163.85
Morocco	4.19	11.05	113.26
Oman	7.61	10.1	168.97
Qatar	24.47	16.52	123.11
Saudi Arabia	9.3	16.5	191.24
Sudan	0.25	1.33	68.77
Syria	6.68	19.67	59.24
Tunisia	5.84	11.49	116.93
UAE	28.65	20.45	131.39
Yemen	1.23	4.33	47.05
MENA average	10.2	12.7	112.2
Low & middle income	6.6	10.81	92.73
Latin America & Caribbean (all income levels)	8.98	17.88	104.72
East Asia & Pacific (all income levels)	8.1	21.47	83.27
OECD members	44.84	43.19	106.67

Table 3. 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
Reform variables		
R_{it}	Regulation dummy variable	ITU database and different regulators websites
P_{it}	Privatization dummy variable	By the author from ITU, incumbents operators' websites and Ministries of communications websites per country
C_{it}	Competition index	By the author from ITU, different regulators and operators' websites and Ministries of communications websites per country
FC_{it}	The number of fixed operators	By the author from ITU, different regulators and operators' websites and Ministries of communications websites per country
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 Website ("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 4. First stage estimation

First stage estimation for reform variables			
Parameters' estimates for reform variables using LOGIT estimation			
Variables	Establishment of a separate regulator	Privatization of the incumbent operator	Competition index
Polity IV indicator	-0.613 (1.647)	-16.99*** (2.293)	-0.998 (1.721)
Civil law	-0.642 (0.556)	-3.365*** (0.741)	-0.877 (0.547)
Total natural resources rents of (% of GDP)	-0.110*** (0.0231)	-0.262*** (0.0405)	-0.0102 (0.0177)
Independence year	-0.0617*** (0.0142)	0.00620 (0.0214)	-0.0367** (0.0146)
Population density in log	-0.146 (0.137)	-0.360* (0.184)	0.332** (0.167)
GDP per capita in constant 2000 US\$ in log	0.640*** (0.215)	1.583*** (0.320)	-0.163 (0.250)
Constant	120.5*** (27.35)	-10.38 (41.08)	74.66*** (27.84)
Observations	218	218	183

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. OLS estimation

VARIABLES	ACCESS		PRODUCTIVITY	AFFORDABILITY		
	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 (off-peak rate) in US \$ (in log)	Mobile cellular prepaid price of 3 minute local call (off-peak, on-net) in US \$ (in log)
Establishment of a separate regulator	0.130 (0.0807)	-0.143 (0.151)	0.291*** (0.0872)	0.322** (0.148)	0.249 (0.158)	0.104 (0.138)
Privatization of the incumbent	-0.330*** (0.0753)	0.198 (0.143)	0.323*** (0.0836)	-0.0390 (0.116)	0.442*** (0.123)	-0.260** (0.112)
Competition Index	-0.0114 (0.0633)	0.449*** (0.100)	0.206*** (0.0745)	-0.0780 (0.0898)	-0.242** (0.104)	-0.192* (0.110)
Population density in log	0.173*** (0.0174)	0.217*** (0.0501)	-0.0405 (0.0317)	-0.0748** (0.0325)	-0.0776* (0.0402)	0.133*** (0.0376)
GDP per capita in constant 2000 US\$ in log	0.616*** (0.0302)	0.883*** (0.0488)	0.171*** (0.0307)	0.286*** (0.0453)	0.216*** (0.0534)	-0.0262 (0.0439)
Observations	260	255	207	225	193	202
R-squared	0.771	0.856	0.802	0.206	0.212	0.140
Establishment of a separate regulator	0.207** (0.0843)	0.297* (0.180)	0.377*** (0.109)	0.162 (0.163)	0.213 (0.178)	0.0931 (0.153)
Privatization of the incumbent	-0.130 (0.130)	1.060*** (0.247)	0.295*** (0.112)	-0.369* (0.214)	0.688*** (0.167)	-0.171 (0.179)
Separate Regulator * Privatization of the incumbent	-0.309** (0.145)	-1.114*** (0.323)	0.0166 (0.154)	0.480* (0.251)	-0.395* (0.229)	-0.185 (0.235)
Population density in log	0.166*** (0.0179)	0.205*** (0.0499)	-0.0220 (0.0308)	-0.0680** (0.0344)	-0.0916** (0.0418)	0.121*** (0.0384)
GDP per capita in constant 2000 US\$ in log	0.605*** (0.0307)	0.814*** (0.0519)	0.168*** (0.0326)	0.310*** (0.0479)	0.218*** (0.0540)	-0.0276 (0.0475)
Observations	260	255	207	225	193	202
R-squared	0.774	0.854	0.795	0.215	0.200	0.125

Table 5. (Continued) OLS estimation

VARIABLES	ACCESS		PRODUCTIVITY	AFFORDABILITY		
	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 (off-peak rate) in US \$ (in log)	Mobile prepaid price of 3 minute local call (off-peak, on-net) in US \$ (in log)
Privatization of the incumbent	-0.215*** (0.0801)	0.378*** (0.135)	0.517*** (0.0862)	0.113 (0.115)	0.489*** (0.129)	-0.214* (0.113)
Competition Index	0.0612 (0.0682)	0.598*** (0.106)	0.345*** (0.0888)	-0.0105 (0.0974)	-0.224** (0.111)	-0.167 (0.106)
Fixed Competition * Privatization of the incumbent	-0.0571*** (0.0128)	-0.207*** (0.0295)	-0.0791*** (0.0174)	-0.0297 (0.0224)	0.0320 (0.0249)	-0.00838 (0.0258)
Population density in log	0.191*** (0.0177)	0.282*** (0.0494)	-0.0273 (0.0318)	-0.0705* (0.0375)	-0.0990** (0.0434)	0.133*** (0.0415)
GDP per capita in constant 2000 US\$ in log	0.614*** (0.0297)	0.907*** (0.0500)	0.158*** (0.0295)	0.276*** (0.0426)	0.219*** (0.0552)	-0.0326 (0.0419)
Observations	260	255	207	225	193	202
R-squared	0.773	0.866	0.800	0.191	0.205	0.138
Establishment of a separate regulator	-0.0807 (0.346)	-0.135 (0.374)	0.442 (0.280)	0.0698 (0.379)	0.0459 (0.476)	-0.0302 (0.256)
Competition Index	-0.219 (0.415)	0.304 (0.448)	0.195 (0.363)	-0.665 (0.778)	-1.464** (0.669)	-0.280 (0.423)
Establishment of a separate regulator * Competition Index	0.195 (0.377)	0.208 (0.555)	-0.0114 (0.351)	0.694 (0.790)	1.458* (0.709)	0.0740 (0.470)
Population density in log	0.172** (0.0607)	0.225*** (0.0641)	-0.0237 (0.0512)	-0.0725 (0.116)	-0.0757 (0.107)	0.128 (0.0762)
GDP per capita in constant 2000 US\$ in log	0.585*** (0.0967)	0.902*** (0.0721)	0.204** (0.0842)	0.278* (0.145)	0.171 (0.178)	-0.0527 (0.0946)
Observations	260	255	207	225	193	202
R-squared	0.756	0.856	0.790	0.235	0.258	0.120

Table 5. (Continued) OLS estimation

VARIABLES	ACCESS		PRODUCTIVITY	AFFORDABILITY		
	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 (off-peak rate) in US \$ (in log)	Mobile cellular prepaid price of 3 minute local call (off-peak, on-net) in US \$ (in log)
Three way interaction	-0.130** (0.0616)	0.280*** (0.106)	0.423*** (0.0849)	0.252*** (0.0943)	0.279** (0.111)	-0.157 (0.0970)
Population density in log	0.171*** (0.0163)	0.230*** (0.0502)	-0.0428 (0.0299)	-0.0926*** (0.0352)	-0.0882** (0.0432)	0.126*** (0.0393)
GDP per capita in constant 2000 US\$ in log	0.587*** (0.0268)	0.887*** (0.0464)	0.184*** (0.0289)	0.281*** (0.0430)	0.240*** (0.0603)	-0.0467 (0.0413)
Observations	260	255	207	225	193	202
R-squared	0.758	0.849	0.779	0.212	0.179	0.107

Table 6. IV-2SLS estimation

VARIABLES	ACCESS		PRODUCTIVITY	AFFORDABILITY		
	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 (off-peak rate) in US \$ (in log)	Mobile prepaid price of 3minute call (off-peak, on-net) in US \$ (in log)
Establishment of a separate regulator	1.052*** (0.270)	0.423 (0.325)	1.019*** (0.339)	0.813 (0.613)	-0.394 (0.935)	0.555* (0.326)
Privatization of the incumbent	-1.245*** (0.320)	-0.134 (0.401)	0.215 (0.212)	1.147* (0.682)	2.488** (1.056)	0.0467 (0.330)
Competition Index	1.104 (0.753)	1.099 (0.918)	0.0421 (0.296)	-2.538** (1.278)	-4.382*** (1.597)	-1.425** (0.579)
Population density in log	0.0765 (0.0779)	0.149 (0.0986)	-0.00825 (0.0666)	-0.00402 (0.113)	-0.470 (0.306)	0.246*** (0.0683)
GDP per capita in constant 2000 US\$ in log	0.795*** (0.0759)	0.928*** (0.0989)	0.172*** (0.0480)	0.0885 (0.142)	0.503 (0.337)	-0.113 (0.0796)
Observations	218	213	173	184	153	165
Establishment of a separate regulator	0.259 (0.613)	0.201 (0.500)	0.151 (0.843)	2.254*** (0.703)	-1.177** (0.532)	1.032* (0.587)
Privatization of the incumbent	-5.785*** (1.992)	-1.268 (1.823)	-2.824 (2.301)	5.972** (2.545)	-4.655* (2.742)	4.024* (2.098)
Separate Regulator * Privatization of the incumbent	6.318** (2.488)	1.878 (2.292)	4.544 (3.483)	-7.597** (3.187)	6.332* (3.301)	-5.577** (2.616)
Population density in log	0.204 (0.136)	0.241** (0.0992)	0.00492 (0.125)	0.00116 (0.158)	-0.0801 (0.164)	0.166 (0.137)
GDP per capita in constant 2000 US\$ in log	1.128*** (0.147)	0.973*** (0.159)	0.482** (0.235)	-0.348 (0.295)	0.684*** (0.204)	-0.494** (0.234)
Observations	218	213	173	184	153	165

Table 6. (Continued) IV-2SLS estimation

VARIABLES	ACCESS		PRODUCTIVITY	AFFORDABILITY		
	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 (off-peak rate) in US \$ (in log)	Mobile prepaid price of 3 minute local call (off-peak, on-net) in US \$ (in log)
Privatization of the incumbent	0.0450	0.192	1.284***	1.786***	2.290**	0.869
	(0.673)	(0.438)	(0.314)	(0.681)	(1.044)	(0.663)
Competition Index	2.303**	1.378	0.616***	-2.390*	-4.453***	-1.294**
	(1.091)	(0.944)	(0.190)	(1.288)	(1.610)	(0.558)
Fixed Competition * Privatization of the incumbent	-0.798***	-0.164	-0.492**	-0.266	0.0260	-0.430
	(0.283)	(0.177)	(0.191)	(0.347)	(0.370)	(0.374)
Population density in log	0.397**	0.221**	0.204**	0.162	-0.450	0.440***
	(0.162)	(0.107)	(0.102)	(0.248)	(0.418)	(0.160)
GDP per capita in constant 2000 US\$ in log	0.759***	0.906***	0.0723*	0.0171	0.466	-0.202**
	(0.125)	(0.0989)	(0.0436)	(0.137)	(0.321)	(0.0898)
Observations	218	213	173	184	153	165
Establishment of a separate regulator	1.245	0.911	3.021***	0.337	-0.0794	0.636
	(0.891)	(0.723)	(1.132)	(0.461)	(0.500)	(0.799)
Competition Index	-0.538	1.327	1.125	-1.756***	-3.048***	-1.381***
	(0.779)	(0.900)	(0.820)	(0.649)	(0.792)	(0.535)
Establishment of a separate regulator * Competition Index	-0.753	-0.750	-2.675*	1.807**	2.057*	-0.0846
	(1.048)	(0.977)	(1.581)	(0.814)	(1.077)	(1.061)
Population density in log	0.177***	0.143	0.125	-0.0345	-0.166**	0.248***
	(0.0683)	(0.0916)	(0.0951)	(0.0532)	(0.0812)	(0.0779)
GDP per capita in constant 2000 US\$ in log	0.582***	0.911***	0.175**	0.237***	0.276**	-0.107
	(0.0441)	(0.0679)	(0.0717)	(0.0525)	(0.127)	(0.0701)
Observations	218	213	173	184	153	165

Table 6. (Continued) IV-2SLS estimation

VARIABLES	ACCESS		PRODUCTIVITY		AFFORDABILITY	
	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 (off-peak rate) in US \$ (in log)	Mobile cellular prepaid price of 3 minute local call (off-peak, on-net) in US \$ (in log)
Three way interaction	-0.378*** (0.134)	0.503** (0.229)	0.868*** (0.172)	0.635*** (0.202)	0.639*** (0.240)	-0.166 (0.192)
Population density in log	0.195*** (0.0283)	0.206*** (0.0709)	-0.0910 (0.0635)	-0.109* (0.0648)	-0.207** (0.0804)	0.209*** (0.0537)
GDP per capita in constant 2000 US\$ in log	0.574*** (0.0265)	0.854*** (0.0550)	0.179*** (0.0367)	0.247*** (0.0497)	0.316*** (0.0864)	-0.101** (0.0479)
Observations	218	213	173	184	153	165