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Privatization, Reforms and Firm's Performance in Mobile Telecommunication Industry

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1. Introduction

Since the introduction of mobile telephony in the early fifties in Europe, US and Japan, the demand for this service exploded. Actually there are countries that have a market penetration of more than 100 per cent. This dramatic growth in the mobile telecommunications industry can be, at least partly, attributed to the growing trend toward privatization (defined as the sale of total or partial previously state-owned enterprises to private owners), market liberalization and deregulation.

In Europe, while most national markets were monopolies in the late 1980s, by today, most of them have three or more competing mobile networks. The telecommunications reforms reflect changes in technology that might mitigate the reliance on government interventions and affect our understanding of the effects of these interventions. Many several studies have shown the impacts of telecommunications reforms on the market outcome and firms' performance. On the one hand, privatization is said to increase the incumbent's operational efficiency by reducing political control; on the other hand, it may very well deter market competition since the incumbent is able to engage in anti-competitive behaviors. The public incumbent, instead, due to political oversight may suffer from inefficient operation in competing with the rivals. Many studies point out that the privatization will produce the greatest efficiency gains where competition replaces monopoly. When both private and public firms are exposed to the same competitive pressures and market signals, they are expected to yield similar performance in terms of allocative efficiency, regardless of their ownership structure.

The introduction of competition, breaking up or unbundling monopolies, and the privatization of state-owned telecommunications operators have become the main themes of telecommunications sector reform in developing and developed countries. These reforms might result in a falling of telecommunication prices, a significant expansion of telecommunications networks and a substantial improvement in productivity. This study attempts to uncover evidence on these effects. Several recent econometric studies have examined the effect of telecommunications reform on sector performance, especially for European countries. The majority of these studies consider that competition on its own, and complementarities between competition and privatization, are positively correlated with telecommunications industry performance.

Although there has been much empirical research on the effects of privatization, competition and regulation on the telecommunications sector, very little empirical work was interested in studying these effects on mobile telecommunication sector. This chapter studies the effects of telecommunication reforms (privatization, competition and regulation) on mobile operator's performance in the OCDE area.

2. The dilemma of privatization

Many economists, policy makers and corporate managers have long believed that private firms are more efficient than public ones. Privatization, defined as the sale of (total or partial) previously state-owned enterprises to private owners, is, so, assumed to increase the firm's efficiency and profitability because, on the one hand, the change in ownership structure shifts the privatized firm's objectives and the managers' incentives away from those imposed by politicians. The managers are then subordinate to them on monitoring and discipline of profit oriented investors. On the other hand, privatization may very well deter market competition since the incumbent is able to engage in anti-competitive behaviors. The public incumbent, instead, due to political oversight may suffer from inefficient operation in competing with the rivals.

As a result, since the late of 1980s, several countries have undergone partial or full privatization of their utility sectors, especially telecommunications. In fact, until recently, in most countries, telecommunications service providers were state owned, state operated, and often monopolistic. The telecommunications sector was viewed as the quintessential public utility. Economies of scale, combined with political sensitivity, created large entry barriers and externalities. Since the 1980s, policy makers gradually began to recognize that telecommunications systems are an essential infrastructure for economic development. As the economy broadens and becomes critically dependent on vastly expanded flows of information, telecommunications acquires strategic importance for economic growth and development. Besides, rapid technological innovations in the past three decades have significantly reduced economies of scale and scope in this sector, attenuating the economic rationale for a state-owned natural monopoly in the Telecommunications sector. The solution was privatization which aims to break the monopoly and improve the efficiency and performance of the telecommunication industry.

Theoretically, privatization affects the firm's performance through multiple channels. It might cause firms to operate more productively because managers are subjected to the pressures of the financial markets and to the monitoring and discipline of profit-oriented investors. In addition, the change in ownership structure of privatized firms shifts the firm's objectives and managers' incentives away from those that are imposed on them by politicians, toward those that aim to maximize efficiency, profitability, and shareholders' wealth. By going public, firms would have many entrepreneurial opportunities because they would not be subject to government control (D'Souza, Megginson, & Nash, 2007).

Furthermore, Hartley and Parker (1991) developed a conceptual framework based on property rights and public choice approaches, in order to show that privatized firms are more efficient than SOEs because profit motivation is absent for public firms. This is why many authors found that privatization leads to significant improvements in the availability and quality of telecommunications services. In fact, privatization leads to network expansion and modernization of Telecommunications services.

In contrast to the aforementioned literature, which concludes that ownership does matter under competitive environments, other researchers pay more attention to the role of

competition rather than ownership per se. The reduction in government ownership is not, in fact, the only factor that improves the performance of privatized firms. The competitive environment and capital-market discipline also increase the efficiency of these firms (Castro & Uhlenbruck, 1997). In this context, policy makers suggest that competition can greatly improve monitoring possibilities and hence increase incentives for production efficiency. Thus, it follows that private firms are more efficient than SOEs in competitive environments. However, in noncompetitive industries or in industries with natural monopoly elements, the performance of privatized firms is ambiguous, and results from empirical studies are inconclusive (Boubakri & Cosset, 1998). Vining and Boardman (1992) argue that at low levels of competition, the differences between public and private ownership would be insignificant, as both types of firms would adopt similar rent seeking behavior. When competition increases, however, private ownership offers incentives and motivation for managers to proactively adopt profit-maximizing behavior. In addition, D'Souza and Megginson (1999) indicate that privatized firms that work in competitive industries are likely to yield solid and rapid economic benefits as long as there are no economy wide distortions that hinder competition. Parker and Hartley (1991) point out privatization will produce the greatest efficiency gains where competition replaces monopoly.

When both private and public firms are exposed to the same competitive pressures and market signals, they are expected to yield similar performance in terms of allocative efficiency, regardless of their ownership structure (Fare, Grosskopf, & Logan, 1985). In the same vein, Forsyth (1984, p. 61) states, ''Selling a government firm makes no difference to the competitive environment in which it operates; ownership and competitive structure are separate issues.'' Newbery (1999) proposed that the emphasis should be placed on breaking up monopolies before privatization. Omran (2004) further indicates that, due to spillover and learning effects, the performance of state owned enterprises does not depart significantly from that of their privatized counterparts once they anticipate later privatization and competition in the sector.

It appears that the importance of establishing an institutional framework, i.e., regulation and competition, before privatizing firms has been emphasized. So, the sequence of the telecommunication reform might affect the outcome of market competition, that is, the time and extent to which the incumbent monopoly is shattered. When privatization comes before competition, a monopoly can attract foreign investment more easily, leading to successful privatization, because the returns from investment are guaranteed by the100% market share. In this sense, the state as an owner is tempted to delay competition in exchange for the higher capitalization value of the firm during privatization (Bauer, 2003, p.12). Even if competition is allowed in a later period of time, the firm is still able to consolidate its market share since it possesses the network effects inherent in its large net work and is more likely to engage in anti-competitive behaviors in this asymmetric market (Rey&Tirole, 2007). On the other hand, the cost for the competitive rivals to challenge the established incumbent, such as interconnection charges and negotiation costs, is so formidable that they have difficulty becoming significant market players.

Seen otherwise, many papers[1] suggest that privatization without a simultaneous introduction of competition will simply create private monopolies. Most economists therefore argue that privatization works better when there is competition that limits the

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[1] See for example George Yarrow, Privatization in Theory and Practice, Econ. Policy 324 (1986); J. A. Kay & D. J. Thompson, Privatization: A Policy in Search of a Rationale, 96 Econ. J. 18 (1986); Vickers & Yarrow, Privatization: An Economic Analysis (1995); World Bank, Bureaucrats in Business (1995)

market power of the incumbent(s). The paper of Chorng-Jian Liu and al. (2009) does highlight a dilemma in telecommunication reforms, in that a not-yet-privatized incumbent under market competition can no longer dominate the market but is turned into an inefficient operation. Authors call for a rethinking of telecommunications development theory that overlooks the importance of the sequencing between privatization and liberalization. Indeed, the timing of privatization affects the speed and the degree to which a monopolistic market is transformed into a competitive one. Competition and privatization are thus seen as complementary. Besides, Product market competition is a potent force that improves performance in its own right. It tends to weed out inefficient firms, if they face hard budget constraints. The threat of bankruptcy may compel existing operators to be more efficient so as to minimize the probability of a corporate failure. Since state-owned firms rarely operate under hard budget constraints, the positive impact of market competition on performance is more likely to be present in privatized firms, further suggesting a complementarity between privatization and competition.

As a conclusion, the dilemma of privatization set a particular attention on how the degree of privatization and competition affects performance and how components of the policies interact with each other in shaping the reform outcomes. For instance, does full privatization improve the performance of a country's telecommunications sector more than partial privatization? Is privatization (or competition) alone sufficient in improving economic performance, or are privatization and competition complementary policies? And finally, how do privatization and competition affect performance measures?

Policy makers suggest that there is a strong presumption that privatization and competition in the telecommunications sector improve economic performance. Whether this presumption is true remains largely an empirical question.

3. Corporate performance: Theory and evidence

Privatization, seen as an important economic phenomenon, has attracted much attention from academic researchers and policy analysts. Studies document generally that moving companies from state to private ownership improves firm performance. However, majority of these studies show that privatization works better when it is accompanied by other major institutional and legal reforms. These two lessons represent important contributions to economic thought and help to support the emerging consensus among policy-makers about how best to use privatization as a tool for promoting economic development.

Begin first with a definition of the performance concept. Based on research long-rooted in the management discipline, performance can be defined as the accomplishment of a given task measured against preset standards of accuracy, completeness, cost, and speed. Firm performance is measured against standard or prescribed indicators of efficiency, effectiveness, and environmental responsibility (Duty or obligation to satisfactorily perform or complete a task) such as, cycle time, productivity, regulatory compliance… etc. **Efficiency** means the comparison of what is actually produced or performed with what can be achieved with the same consumption of resources (money, time, labor, etc.). It is an important factor in determination of productivity. **Effectiveness** is relative to the degree to which objectives are achieved and the extent to which targeted problems are resolved. In contrast to efficiency, effectiveness is determined without reference to costs and, whereas efficiency means "doing the thing right," effectiveness means "doing the right thing."

During the last two decades important structural policies have taken place worldwide in the telecommunication sector. A significant number of studies attempt to assess the consequences of the aforementioned changes. Two types of analysis are usually encountered in the relevant literature: empirical econometric analyses and descriptive analyses. These research papers mainly examine the consequences of the telecommunication market reform and the corporate restructuring of traditional telecommunication organizations, which were fully or partly privatized through public offer or through direct sale to one or more investors. Studies on the privatization and performance of telecommunication industry started in the early 1980s. Many papers investigated the effects of privatization and competition on the expansion and performance of telecommunication network.

Results from the study of Wallsten (2002) reveal the correlation between privatization, competition, regulation, and performances of telecommunication industry in 30 Latin American and African countries. Fink et al. (2002) examined the effects of national policy reform in the telecommunication sectors of 86 countries and found that both privatization and competition can lead to significant improvement in telecommunication performance.

Few studies analyze the impact of public enterprise reform on profitability, productivity, exports, budgetary impacts, crowding out of the private sector, etc. Moreover, many of the studies also suffer from basic methodological deficiencies. For example, using cross-sectional data, Foreman-Peck and Manning (1988) conducted total factor productivity analyses to compare the performance of British Telecom (BT), which was privatized in 1984, with the performance of five telecom firms in Europe. They concluded that British Telecom is apparently less efficient than the companies in Norway and Denmark, but more efficient than those in Spain and Italy. Their finding is inconclusive, however, since ownership is by state in Norway, but mixed in Denmark, Spain and Italy. This methodology is incapable of linking variations in performance with the change in the company's ownership.

Several sector specific studies have also been conducted on the outcome of reforming telecommunications services, albeit in developed economies (Takano, 1992; Oniki et al., 1992; Imai, 1994; Foreman-Peck, 1991). The study of Foreman-Peck (1991) examined whether the transformation in the telecommunications sector altered or improved performance over that of the previous state regime. Results suggest a substantial improvement in the productivity performance of the telecommunications industry after privatization. Takano (1992) examined the process, as well as benefits and losses stemming from the partial privatization of Nippon Telegraph and Telephone Corporation (NTT), a government monopoly producer of domestic telecommunications services in Japan. The study evaluated the benefits to four important actors: NTT proper, stockholders, users and government. Oniki et al. (1992) assessed the impact of deregulation on NTT through improved management and operations by estimating a translog variable cost function for 1983– 1989 fiscal years. According to the study, deregulation resulted in a cost reduction of 1.31 or 2.29%, depending on the specification of the cost function adopted. In the same vein, Imai (1994) estimated the cost reduction associated with the 1985 deregulation of international telephone services in Japan. The study estimated that NTT's unit cost fell by a wide margin after deregulation (54.5%).

Many studies in the telecommunications sector seek to explore the regulatory institutions of different countries using the new institutional economics. Levy and Spiller (1996) conducted a comparative analysis of the impact of core political and social institutions on regulatory structures and performance in the telecommunications industry in Jamaica, the United

Kingdom, Chile, Argentina and the Philippines. The study examines the relationship between regulatory outcomes and performance, and how each country resolved its regulatory problems.

Galal and Nauriyal (1995) explored the relationship among the outcomes of regulatory reforms, regulatory incentives and government commitment on the basis of the recent regulatory experience of seven developing countries: Argentina, Chile, Jamaica, Malaysia, Mexico, the Philippines and Venezuela. They attempt to link the performance of the telecom sector with the extent to which these countries successfully resolved the information asymmetry, pricing and contracting problems. Results show that the sector continues to suffer from under-investment and low productivity. Other countries had mixed results.

The majority of these studies were interested on telecommunication firm performance without differentiating between mobile and fixed telephone activity. However, the reform of the sector has caused the rapid increase in the proportion of penetration of novel telecommunication services, most notably mobile telephony and the Internet (Clarke and Gebreab et al. 2003, Ypsilantis 2002, Xavier and Ypsilantis 2001). It is important to note that the proliferation of main telephone lines, which appears more intense during the initial years of the reform, is reduced after the full liberalisation of the market due to the intense American Economic Review 91, 320–334.

Doove S., Gabbitas O., Nguyen-Hong D. and J. Owen, 2001. Price Effects of Regulation that develops in the mobile telephony market impacts positively on the levels of productivity (Fink and Mattoo et al 2003). Similarly, the increase in production, mostly expressed in terms of phone call flows, increases the productivity index. Moreover, the reduction in the number of employees in traditional telecommunications organizations promptly increases work productivity (Dia and N' Guessan et al 2002). Ypsilantis and Min (2001) as well as Sacripanti (1999) observe a greater reduction of prices in mobile telephony services due to the more intense competition in these markets. Ypsilantis and Min (2000) examine the percentage of successful calls and the proportion of access in order to examine the quality of mobile telephony services, and conclude that the reform is positively associated with the quality of services in mobile telephony. Nevertheless, in some cases, the quality of services on offer showed no indications of improvement, despite the reforms of the sector, thus remaining at the approximate level before the reform. Bernardo Bortolotti and al. (2002) use the number of licensed operators in the mobile (analogue and digital) telephony market as a proxy for product market competition in 25 national markets involved. They were interested in measuring the competitive pressure faced by the privatized companies, so they refer only to operators not owned by the incumbents.

The paper of Chorng-Jian Liu and al. (2009) explores the factors that hamstrung Chunghwa Telecom in competition against its rival entrants. The econometric analysis substantiates the fact that handset subsidies are the most effective instrument for mobile firms to gain market share. Chunghwa Telecom, due to its public ownership status, was nevertheless prohibited at first from adopting such a marketing strategy. The empirical results pinpoint the importance of the sequencing of reforms in telecommunications: a prolonged privatization could help to promote competition in the industry. Public ownership makes Chunghwa Telecom vulnerable to political intervention and operational inefficiency, which is a barricade to performance and competitiveness for the not-yet-privatized company in a liberalized market. Taiwan's case paves a shortcut to successful implementation of telecommunication reform in a timely fashion.

The paper of Zheng, S., & Ward, M.R., (2011) studies the effects of competition and privatization on Chinese telecommunications performance, using panel data. First, mobile service has become the dominant platform for service. Over the sample, mobile calling volume went from less than half to almost three times that of fixed service. Second, growing income levels contributed to this shift. Higher income is estimated to be associated with increased demand for mobile service and decreased demand for fixed service. Third, a significant portion of the mobile price reductions are due to greater within mobile platform competition. Fourth, there is some evidence that the movement toward private versus state ownership also contributed to this transition. Privatization is associated with lower mobile usage prices and higher usage levels. However, it is associated with higher fixed prices and reduced fixed demand.

4. Reforms and special issues on the mobile communications sector

4.1 Telecommunications policy reform

Three dimensions of public policy reforms are relevant and have been applied in developing and developed countries: a change of ownership, an introduction of competition, and a strengthened regulation.

1. The first telecommunication reform strategy implemented by states in renovating the sector is often to privatize the national telecommunications provider. By selling off a controlling interest in the national telephone company, political leaders hope to expose the organization to market pressures for efficiency and profit. However, privatization without a simultaneous introduction of competition will simply create private monopolies. Most economists therefore argue that privatization works best when there is competition that limits the market power of the incumbent(s). Competition is thus seen as a complement to privatization (Xu and Li, 2002).

2. Hence, the second strategy is to break the provider's domestic monopoly over the consumer services market. The objective of liberalization is to induce competition in prices, creating incentives to lower production cost and increasing product innovation (Nicoletti G. and Scarpetta S., 2003). Since the beginning of 1998 a number of European Union member countries opened their mobile telecommunication markets to full infrastructure and service competition by allowing competition for public voice infrastructures and services[2]. Despite this market openness, many governments maintain the two roles as industry regulator and players by holding shares or directly competing on the mobile market. This may, on the one hand, very well deter market competition since the incumbent is able to engage in anti-competitive behaviors. On the other hand, because of privatization, governments can no longer overtly affect company decisions. But they often appeal to the public interest in order to stay politically engaged via weak regulatory structures. As a result, regulation is considered as a form of state involvement (Latzer et al, 2006).

3. Consequently, the third common reform is to insure the regulatory independence. This occurs when the regulatory body is separate from and not accountable to, any supplier of basic telecommunications services. Most OECD countries defined the "independence" of the regulator as a separation from day-to-day political interference,

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[2] In addition to this opening of national telecommunication markets, was the agreement to liberalize international trade in basic telecommunications.

and independence of decision making based on powers vested in the regulatory body. However, for many years in many countries, the regulatory body is kept attached to the Ministry and the regulator is under the direct supervision of the executive of government. Hence, both scholars and international institutions advocate for the establishment of independent regulators, which means professionalizing the staff making decisions about telecommunications policy and appointing technocrats instead of political leaders to senior positions (Howard, Mazaheri, 2008). Some countries devote large resources to establish independent regulatory agencies, in compliance with the directives of the World Bank, the OCDE and the European Union.

Since there is evidence that policy reforms may have an impact on operators' performance, answering the questions above must involve assessing the effects of each of these three policy reforms on performance indicators.

4.2 Special issues on the mobile communications sector

Apart from the distribution of licenses[3] (for GSM and/or UMTS) and related questions on infrastructure sharing, several topics regarding mobile telecommunications were or still problematic for National Regulator Agencies (NRAs) and the European Union: roaming, Mobile Number Portability (MNP), Mobile Termination rates (MTR), universal services access requirements and mobile Virtual Network Operators.

4.2.1 International roaming charges

The first Regulation on international roaming services was published on 29 June 2007. The definitive text of Regulation (EC) No 544/2009 was published in the Official Journal of the European Union on 29 June 2009. Regulation on international roaming requires all operators in the EU to offer customers regulated voice and SMS retail roaming tariffs, which must comply with maximum price caps (known as the Eurotariff). The Regulation also provides that operators may offer alternative, i.e. unregulated, retail roaming tariffs alongside. Under the 2009 Regulation, the average wholesale roaming voice charge must be calculated on a per second basis, adjusted to take account of the possibility for the operator of the visited network to apply an initial minimum charging period not exceeding 30 seconds. This has led to a significantly lower surcharge in EU countries, from around 21% in Q2 2009 to around 6% in Q2 2010. Considering "Rest of World" retail voice roaming calls, typical prices are significantly greater than for calls wholly within EU/EEA. Overall, average Eurotariff retail voice roaming rates remained fairly near the regulated caps in many Member States. The Roaming Regulation does not seem to have had a significant impact on the pricing of other mobile services. Any waterbed effects would be expected to be small due to the fact that roaming revenue is a small part of overall mobile revenue (EU average of 4.2% in 2009).

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[3] Government licensing policy in mobile telecommunications has various dimensions. First, the government needs to decide whether to set a single national (or international) standard, or whether to allow multiple technological systems to compete. Second, the government has to decide to how many firms will receive a license. This also involves an important decision with respect to the timing of first and additional licenses. Third, the government needs to decide how to grant licenses. In the early days of mobile telecommunications, licenses were often granted on a first-come-first-serve basis.

4.2.2 Mobile number portability

Mobile Number Portability (MNP) is a regulated facility which enables subscribers of mobile services to change their service provider whilst keeping their existing telephone number. Its purpose is to foster consumer choice and effective competition by enabling subscribers to switch between providers without the costs and inconvenience of changing telephone number. It is an important prerequisite for intensifying market competition[4] since it lowers switching costs, churn rates should be expected to increase[5]. The EU's Universal Service Directive requires member states to implement number portability for mobile services[6]. There are a number of countries where networks do not charge customers for porting numbers. For instance, in addition to Finland, MNP is typically free in the UK and in Ireland. In Belgium, only pre-paid subscribers pay for porting their mobile number. During the porting process, the ported number cannot handle incoming or outgoing calls.

The speed of porting is also heterogeneous across countries. While in some countries porting time is extremely short—porting takes only two and a half hours in the US—operators from other countries may need days, weeks or even months to port a number. More recently, Article 30(4) of the Citizens "Rights Directive" (2009) introduced a new requirement that consumers, *"having concluded an agreement"* shall have the number activated within one working day. The article also introduces a competence on Member States to impose sanctions on service providers, including a provision to compensate subscribers in case of delay in porting or abuse of porting by them or on their behalf.

4.2.3 Mobile termination charges

Call termination charges into mobile networks are currently one of the most crucial issues facing regulators in Europe. Call termination refers to the final completion of calls on a network, and in this case regards calls to mobile phones i.e. completion of calls in mobile networks which have originated in other fixed or mobile networks. A termination charge is a wholesale charge paid by the operator in whose network the call originates, to the operator of the network in which a call ends. The retail price paid by callers for a call from one network to a mobile network is broadly made up of two components: (a) the first operator's cost to originate and carry the call and (b) the termination charge paid by the first operator to the second terminating operator.

New regulatory measures, imposed on mobile termination markets by the Regulatory Framework of 2002, induced a global decrease of mobile termination rates. According to the European Regulators Group (ERG), the average decrease of Mobile Termination Rates (MTR) levels between 2004 and 2007 is about 26%, with important disparities between countries. Besides, the European Commission increasingly invites NRAs to make termination rates asymmetries disappear and to specify, meanwhile, the convergence conditions towards termination rates symmetry, with regard to both target level and time frame. The Commission considers that asymmetry, which refers to differences between MTRs of MNOs within the same member state, requires an adequate justification.

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[4] By today, almost in all European countries number portability is possible.

[5] Unfortunately, there are no statistics on churn rates available for most European countries.

[6] The United Kingdom and the Netherlands first implemented MNP in Europe in 1999. Countries such as pain (2000), Sweden and Denmark (all 2001), Belgium, Italy, Germany and Portugal (all 2002) followed suit. Most recently, Estonia implemented MNP due to regulatory intervention.

4.2.4 Universal services access requirements

The Universal Service Directive (USD, Article 3), requires to ensure that universal services are made available at the quality specified to all end-users in their territory, independently of geographical location, in the light of specific national conditions and at an affordable price. Among services included in the scope of the universal service, we can identify:

- Provision of access at a fixed location to the public telephone network;
- Special measures for disabled end-users to ensure access to and affordability of publicly available telephone services, including access to emergency services.

In addition to the services listed above, Member States may take the following measures:

- Specific measures to ensure that disabled end-users can also take advantage of the choice of undertakings and service providers available to the majority of end-users;
- provision of tariff options or packages to consumers which depart from those provided under normal commercial conditions (Article 9(2) USD)
- Provision of specific facilities and services allowing subscribers to monitor and control expenditure and avoid unwarranted disconnection of service
- Measures to cover different parts of the national territory.

Looking at the European market, one can conclude that, in general, it is not yet possible to provide the universal service at any location. Only in the densely populated countries with a high coverage level of mobile network such a possibility exists.

4.2.5 Mobile virtual network operators

The Regulatory Framework enables the operations of virtual operators and creates them a business opportunity. If the incumbent operators are not willing to open their networks voluntarily, the regulations help the NRAs to enforce the network access with reasonable terms. These terms have to be equal to the vertically integrated service operators of MNOs. In accordance with Finnish Communications Market Act. Section 23, MNOs with SMP can be imposed obligations regarding access to the MNOs network when necessary. These obligations are to give service providers the right to access the MNOs network.

In summary, the regulatory situation concerning different types of virtual operators is not yet harmonized between the EU countries.

5. Evidence from European countries

5.1 Data and variables analysis

Our empirical work relies mainly on several primary sources. Firstly, the industry data comes from the *ITU World Telecommunication Indicators* (2010) dataset. Secondly, the policy indicators were gathered from several web sites such as *OECD regulatory* database, *ITU World Telecommunications Regulatory* database, *Privatization Barometer* database and *POLCOIII* dataset. Note that, all mobile data used concern GSM mobile business.

We consider the mobile telecommunications markets in 31 European countries over the period 1993 to 2008, using network deployment (main mobile lines per 100 inhabitants), prices, output and quality as the dependant variables. We consider three main aspects of mobile telecommunications reform-privatization, competition and regulatory development-as explanatory variables. The set of explanatory variables, other than measures of the regulatory reforms, also includes control variables such as technological progress, demographic, political and macroeconomic indicators.

5.1.1 Mobile communications performance indicators and measurement issues

Traditionally, corporate performance at Mobile Network Operators (**MNOs**) tends to be evaluated by several Performance Measurement Indicators (**PMIs**) such as gross revenues, number of subscribers, ARPU, churn[7], quality of services, profits, as well as market share. However, in this study, the precise definition of the performance measures was dictated by the availability of data and also due to well known measurement issues. This is discussed below in analyzing the quantification of each performance indicator chosen in this study for the mobile communications industry.

5.1.1.1 Productivity

Productivity of service industries and especially mobile communications is hard to define. Indeed, unlike manufactured goods, services are characterized by a greater degree of heterogeneity, which makes aggregation difficult. As mentioned below, mobile telecommunications output may include the number of users serviced, the number of minutes of communication supplied, the range and the quality of services provided as well as the (generally immeasurable) network externalities. In analyzing performance, many studies on telecommunications consider both labor productivity (LP) measured as revenues per employee per year, and total factor productivity[8] (TFP) in order to assess productivity changes (Armando Calabrese and al., 2002). Some research has found that privatization leads to lower prices through the expansion of the network or improved labor productivity (Ros 1999, Li and Xu 2002, Fink et al. 2003). However the effects of privatization and competition were complementary. Pagoulatos and Zahariadis (2011) found that labor productivity is negatively affected by state ownership. Indeed, the aim of regulation in telecommunications is to meet social goals, avoid potential abuses due to predatory behavior, and stimulate competitive pressures to enhance consumer welfare. Hence, labor productivity is expected to increase as companies become more efficient in their quest for higher profits under external regulatory constraints. Note that any increase in size of employment will have a negative effect on productivity growth. The decrease in the number of employees, reducing the denominator, enhances the labor productivity indicators.

5.1.1.2 Employment

Studies show that state-owned companies tend to over-staff workers, pay high wages, and provide generous benefits. Therefore, it is argued that the effects of reforms, namely privatization, in the telecommunication sector on employment are likely to be negative since privatization reduces overstaffing; (Li and Xu 2002, Ypsilantis and Min 2001, Xavier and Ypsilantis 2001). However, cases of little or insignificant employment reductions (or even employment increase) exist. The main explanation is that generally, overstaffing usually

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[7] The wireless industry is at an inflection point; marked by saturation, competition, stagnant revenue growth and increasing customer care and subscriber acquisition costs. As such, the ability to retain an existing customer has become critical to recapturing some of the revenue and margin sacrificed by customer acquisition programs and price promotions. With such figures, churn data, alongside subscriber acquisition costs, has become a key measure used by industry analysts to determine mobile operator performance.

[8] Total factor productivity picks up productivity gains that cannot be attributed to increases in the productivity of labor or capital usage alone. This residual productivity is attributed to the combined effects rather than to other factors.

occurs in clerical and administrative positions and not in the more technically skilled jobs such as in the telecommunications sector[9]. Indeed, in countries that carried out labor reforms early in the process, there was a minimal effect on employment post-privatization.

It is more likely that the studies reflect real differences in post-privatization employment changes between countries. However, the safest conclusion we can assert is that privatization does not automatically induce employment reductions in divested firms.

5.1.1.3 Output

One of the major obstacles in telecommunications comparisons is the measurement of output. Some studies measure output only in physical terms (for example, in the number of calls and access lines). Other studies weight physical output in terms of relative prices (for example, revenue or value of output per subscriber). Ariff, (2009), Nicoletti, (2000) and Pavlos C. Symeou, (2004) have defined the telecommunications output as the number of mobile subscribers, total revenue and outgoing telecom minutes. Heshmati and El-Rhinaoui (2009) uses as output the mobile traffic (minutes of use of all subscribers). Due to data constraints, a relatively narrow definition of output was adopted: the total revenue divided by the cost of a 3-minute local call on a mobile. In general, there is broad agreement that output increases more after reforms for telecom sector. However, results from different studies suggest that the effects of privatization are either complemented or overwhelmed by the effects of competition and/or regulation. Separating the effects is difficult, but the evidence suggests that privatization without strong regulatory support is less effective.

5.1.1.4 Prices

The weakest link in the data chain is on prices as these are notoriously difficult to know and to compare across economies. The MNOs offer increasingly complex and diversified products at lower and lower prices. Besides, changes in quality are reflected by improvements in physical and non-physical characteristics which induce several dimensions in the measurement issue (Karamti and Grzybowski, 2010). Furthermore, even though price differentials may reflect quality differences, most of the studies assume that the mobile service is provided at same quality by each mobile operator in the sample which makes the simple prices comparison irrelevant.

The tariff baskets are commonly approved as the most appropriate method for price comparisons among countries. Cross-country differences in observed prices may also reflect differences in price regulation. To account for some of these problems, OECD tariff baskets were supplemented with a measure of "average prices" in the mobile services: mobile revenues per subscriber (ARPU). However, because limitations in using price data for mobile services identified by previous studies (i.e. Magnien, 2002; Banerjee and Ros, 2004a) we were constrained, as many other studies, to proxy the price with the average revenue per minute (Sung, 2007).

5.1.1.5 Mobile density

The teledensity refers to the number of mobile phone lines per 100 inhabitants in a country (Ariff, 2009; Xu and Li, 2004). Despite the fact that the mobile telephony development is usually measured by the number of cellular subscribers in a country (Boon Lee and William

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[9] Note also that requirements of a digital system would spell technological unemployment for older workers while younger computer-trained staffs are being recruited (Ure, 2003).

Shepherd (2000)), Hamilton, 2003; Gutierrez and Berg, 2000), we prefer taking density (subscribers per 100 inhabitants) since it is considered a better indicator of the development of the traffic of mobile network.

5.1.1.6 Quality

Quality is a multi-faceted concept which includes relatively objective features such as variety, reliability and serviceability as well as more subjective factors such as user satisfaction. The quality of service in mobile communication is defined here (the objective aspect) by a number of key indicators. They include technical faults, network availability, call set up access rate and call drop rate. Some papers conclude that the reform is positively associated with the quality of services in mobile telephony. However, very few quality indicators are available on a cross-country basis for the mobile communication services.

In our analysis and since such detailed information are very scarce, another feature of quality is considered, the "coverage". Many observers assume that with the liberalization of the sector which results in an increase of the number of mobile operators, the percentage of the population covered will also grow, since competition will induce lower prices and more affordable service. However, some examples demonstrate that the reverse can be true[10]. One possible reason for this counter-intuitive finding is that many mobile operators focus on the more profitable urban areas and lack the resources and/or interest to roll service out to rural areas, where the majority of people reside and where the social benefits of mobile connectivity are higher than in well-served urban areas. Besides, as more operators enter the market and competition intensifies, the utilization levels and profitability of many carriers drop, hindering their ability to invest in the network to expand further.

5.1.2 Telecommunications policy reform variables

- *Regulation Variables:* We used three dimensions of the regulation framework. First, we construct a dummy variable 'NRA' that denotes the establishment of an independent National Regulatory Authority in the sector. The variable NRA takes a value of 1 only if the authority is characterized autonomous and 0 otherwise. In order to take into account the dynamic effect of the regulatory framework, we include a count measure of the number of years since the establishment of an independent regulatory body, '*NRA_YEARS*'. Moreover, Mobile Number Portability (MNP) is a regulatory facility which is likely to affect retail prices, termination charges, price elasticity's, market shares, as well as entry and investment decisions. It is fair to say that most analyses on MNP have supported the notion that, on the whole, MNP intensifies competition in mobile telecommunications. The effect of MNP on the mobile sector performance has never been tested before. Thus, we include '*MNP*' a dummy variable which takes 1 when number portability in mobile networks is established in a country and 0 otherwise.

- *Privatization Variables:* The effect of change in ownership of the incumbent provider on performance is captured by a dummy variable '*PRIV*' which equals 1 when the firm has allowed for the first time, private participation in its operations and 0 otherwise. A variable '**State Ownership'** measures the percent of shares owned by the state. Besides, using a single point in time can only provide a limited impact of telecommunication reforms. Thus, besides a binary measure of whether or not a country has privatized the

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[10] Despite the large number of operators (eight) in India, for example, population coverage lags significantly behind Jordan, with four operators; China, three operators; and the Philippines, three.

Variable	Definition
Performance variables	
Density	Mobile telephone density, measured by the number of telephone subscribers per 100 inhabitants.
Mobile staff	Reported number of employees.
Labor Productivity	The labor productivity, which is measured by real output per employee.
Output	The total revenue divided by the cost of a 3-minute local call on a mobile.
ARPU	Average revenue per user equals to the total revenue is divided by all subscribers.
Coverage	The percentage of the population covered by mobile telecommunication networks.
Reform Variables	
• **Regulation variables**	
NRA	The establishment of an independent regulatory body.
NRA_YEARS	Measure of the number of years since the establishment of an independent NRA.
MNP	Mobile Number Portability, a dummy for the introduction of number portability in mobile networks in each country;
POLCON III	Measures the quality of an economy's political system and rages between 0-100.
• **Privatization variables**	
State Ownership	Percent of shares owned by the state.
PRIV	A dummy equals 1 if the incumbent is privatized.
PRIV_YEARS	A count measure of the number of years since privatization.
• **Competition variables**	
COMP	A dummy equals 0 if the mobile telecommunications sector is served by a national monopoly operator, a value of 1 if the sector has two operators and a value of 2 if the sector has more than two operators.
New_entrants	Market share of the new entrants. The variable is the ratio of the number of mobile lines in operation owned by the new operator to the number of total mobile lines in the market.
MVNO	Mobile virtual network operator, a dummy for the launch of the first MVNO in each country;
MVNO_YEARS	A count measure of the number of years since the launch of the first MVNO in the country.
Control Variables	
Size	Takes the values of the size index.
Small	**A dummy takes 1 if economy is small based on the size index's median**

*) The data is available only until 2007.

Table 1. Variables Definitions

mobile sector, we use a count measure of the number of years since privatization, **'***PRIV_YEARS***'**.

- *Competition Variables:* To measure the degree of competition, we used a variables *COMP*, assigned a value of zero if the mobile telecommunications sector is served by a national monopoly operator, a value of one if the sector has two operators and a value of two if the sector has more than two operators in mobile market segment[11] (Wei Li, 2004). Besides, the market share of the new entrants captures competitive pressure in the mobile telephony market. The '*New_entrants*' variable, which concern only mobile network operators, is the ratio of the number of mobile lines in operation owned by the new operator to the number of total mobile lines in the market. However, the mode of competition has changed on the European mobile markets during the last ten years. Emergence of virtual operators, together with new content providers, has brought a large number of new players to the market. The traditional market structure of incumbent operators and their vertically integrated partners was so fragmented. Furthermore, the amount of competitors has increased and new kinds of competitors emerged. Indeed, the fast developing regulatory framework in European countries force MNOs to accept virtual operators, however, not all countries have changed their regulation to promote competition. Thus, the introduction of mobile virtual operators could be an interesting variable never taken before. Thus variable '*MVNO*' is a dummy variable which takes a value of one when the first virtual operator is launched in a country. We also added the variable '*MVNO_YEARS*' which is a count variable representing the number of years since the launch of the first MNVO.

5.1.3 Political and institutional variables

The regulation quality is very important in assessing company performance (Henisz, 2002). Indeed, the narrower the regulatory regime, the greater the political involvement is likely to be in company management. More political involvement translates into a blurring of market based performance since politicians seek to satisfy national and special interest needs that go beyond the company's "welfare." Political interference is in this case is more costly to the privatized company. The effect of the magnitude of institutional endowments on firms' performance is gauged by the variable '*POLCON III*' developed by Henisz (2002). This variable ranges between 0-100. Smaller values illustrate an economy with lower economic freedom, narrower institutional endowments, and higher political risks.

5.1.4 Country economic indicators

Firms in small economies have traditionally been assumed to encounter substantial difficulties improving their performance. They are characterized inter alia, by limited capacity which prevents them to exploit high economies of scale. This is particularly true for firms in sectors with high fixed and sunk cost such as telecommunications. Symeou (2009) analysis of the liberalization of small and large European countries finds that competition as an end in itself is less relevant to the success of liberalization in small economies. This can be explained, on one level, by the fact that market dynamics in small economies limit the prospects for efficient entry. On other level, because the number of operators required

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[11] S. Zheng & M.R. Ward (2010) used the Herfindahl-Hirschman Index (HHI) as measure of competition intensity. Wallsten (2001) used the number of mobile operators. Instead, Barros and Seabra (1999) employed a dummy variable which drew a distinction between monopoly and non-monopoly markets.

generating the expected outcomes of liberalization efficiently is much smaller than in large economies. We assume then, that there exist a relationship between economy size and firm performance. Thus, following Symeou (2004, 2009), an index for smallness suggested by Jalan (1982) is adopted which combines population, income and geographical measures. These indicators (GPD, population, arable area) are used to measure the country's economy '*Size*' variable which is an index constructed as follow:

$$Size\ Index = \frac{100}{3}\left(\frac{P_i}{P_{max}} + \frac{A_i}{A_{max}} + \frac{Y_i}{Y_{max}}\right)$$

P_i, A_i and Y_i are population, arable area and GDP of each country respectively;
Finally, "**Small**", is a dummy variable which takes 1 if economy is small based on the size index's median.

5.2 Econometric analysis
5.2.1 Panel model
The approach taken in this study is to examine how indices of market efficiency such as network deployment, work productivity, prices and quality of services offered and employment have been effected by the introduction of competition, by the privatization of the traditional telecommunications organizations and by the establishment of independent regulatory authorities over both time and countries.

To do so, our empirical analysis consists in the specification and estimation of equations for prices, subscriptions, output, quality, employment and labor productivity. In each of these equations we consider three main aspects of telecommunication reform-privatization, competition and regulatory development as explanatory variables.

The current study employs the approach used by earlier studies. Each equation was estimated using two regression models: a random effects specification and a fixed effects specification. The fixed effect specification assumes that county-specific effects are fixed parameters to be estimated, whereas the random effect model assumes that countries constitute a random sample.

The general model we refer to can be written as follow:

$$Y_{it} = \alpha_i + \beta R_{it} + \delta X_{it} + \mu t + \varepsilon_{it} \qquad i = 1, \dots, N \quad t = 1, \dots, T$$

where Y is the set of variables used to proxy performance, *i* is an individual country, *t* is a period of time (1 year), α_i the country fixed effect that controls for country specific propensity to reform and other country specific unobserved factors. Explanatory variables include a set of reform variables (R_{it}) and set of control variables (X_{it}). Time (t) is a time trend[12] and is used to catch the temporal effect and reflects technological change and ε_{it} is the error term.

In order to account for dynamics in our data, we make use of the Differenced Generalized Method of Moments (DIF-GMM) developed by Arellano and Bover (1995) for analyzing panel data. However, fixed and random models systematically outperform these dynamic regressions[13].

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[12] We have also experimented with including time dummies instead of the time trend, and the results are very similar. For ease in checking the tendency of the time trend and reporting the results, we therefore use the time trend specification.

[13] These results, not reported in this study, are available from the authors.

Generally, studies of the impact of reforms on enterprise performance encounter difficult issues namely the endogeneity bias. Indeed, the biggest potential problem is that competition, privatization and regulation may be endogenous to reforms. That is, reforms affect telecom performance, but performance may also affect reforms. A possible source of endogeneity is that unobservable factors affecting reform may also affect performance, e.g., managerial quality, that are correlated with both the dependent variable and with the included explanatory variables. The analysis deals with this issue by including country fixed effects. This permits control for a country-specific propensity to reform. The reform dummy variables, too, help control for a pro-pensity to reform, which could be correlated with performance changes.

5.2.2 Alternative specifications

For each outcome variable, we estimate the baseline equation under two different specifications and report the results in tables 2-4.

The two specifications tests for the whole performance measures are:

1. *Interaction between reform variables:* Theory suggests that simply privatizing a monopoly may not generate telecom improvements. Careful regulation is required to encourage a monopoly to improve its performance. To explore further the effects of regulation, we interact the regulation dummy with the privatization dummy. Then, following Wei Li and Xu (2004), we added an interaction variable between privatization and competition in order to estimate complementarities that may exist between the two reforms and estimate model 2 (M2). M2 allows us to explore separately the effects of competition, privatization, regulation and how they interact.

2. *Small size versus Big economies:* In order to analyze whether the effects of the reforms change with the economy' size across countries, we rerun the baseline regressions allowing the reform effects to differ between big and small economies (those with Size index lower than the median value). We do so by including interaction terms between the small size dummy variable with the reform variables and estimate model 3 (M3).

5.3 Regression results

In this section, we address the existence of relationships between the reform variables-privatization, completion and regulation- of the mobile communications services outcomes by running a set of regressions. Table A2 in the appendix show the fixed-effect and random-effect estimation results on which we build our testing procedure asking whether the reform variables, have a significant impact on the variables of mobile communications outcomes, namely, ARPU, labor productivity, employment, coverage, output and mobile density.

In addition to showing the estimated values of the parameters associated with the explanatory variables listed at the left, Tables 1-3 include three additional items. Firstly, we provide an F-statistic (F) for fixed-effects or Wald statistic (*Wald*) for random-effects for testing the joint significance of the explanatory variables. Secondly, we rely on the Hausman test while opting for random effects or fixed effects. Thirdly, we include the number of observations included in each regression (Obs.).

The results in table 2, Wu-Hausman specification test to discriminate between fixed and random effect models show that in most cases a fixed effects model is the appropriate model specification. Recall that fixed-effect models allow controlling for fixed unobserved

heterogeneity and are therefore preferred to random models when estimating the relationship between privatization and telecommunications outcomes. Four of the six equations seem to present fixed effects. Only in ARPU and labor productivity regressions random effects seems more suitable.

Tables 2-4 present the results of estimating the baseline equations besides estimates under the two alternative specifications explained above for each of the six dependent variables.

1. *Output and pricing:* Did privatized companies restrict output and raise prices? (Li and Xu, 2004). Overall, the degree of market competition (proxied by the share of new entrants) and years after the establishment of MVNOs considered as new competitors (could also be interpreted as the effect of prospective competition according to Nicolletti, 2001) emerged as the main explanations for the cross-country and time variability in output. Estimates in table 2 show that privatization have a limited, negative and statistically insignificant, effect on output. It's true that call volumes often rise with network penetration; however the number of players on the market also arises, shirking the output of each operator. This result is confirmed first, by the negative and significant impact of number portability (MNP) on output. Unfortunately, we do not have information about churn rates; however, MNP can be taken as proxy since customers who want to switch to another operator generally prefer to keep their primer phone number. Second, the negative and highly significant coefficient on the interaction variable Priv×Comp confirms once again the negative impact of both privatization and competition on output. This finding is totally different of those found in previous studies. Li and Xu (2004) find that full privatization has a positive impact on real output and no evidence of complimentarily between privatization and competition on output expansion. However, the authors consider their results as puzzling and explain them by the fact that their data are not adjusted for changes in service quality. Estimates in table 3 show that overall, Privatization and the regulation indicators performed quite well, significantly improving the fit of the regressions. The estimates broadly suggest that countries having stronger actual competition and more regulated market tend to have lower prices. These findings are quite similar to those of Nicoletti (2000). Interestingly, political constrains seems to have important, positive and statistically significant impact on firms' ARPU. Finally, privatization seems to have larger and significant effects on firms' ARPU in small size economies contrary to Competition.

2. *Employment:* Table 3 presents estimates with employment in logarithm as dependant variable under the two specifications discussed above. Inspection of the results reveals that, consistent with the hypothesis, employment is reduced due to the privatization of traditional telecommunications organizations. The estimated effects of number of years since privatization are small but highly significant. Besides, employment decreased slightly but non-significantly with both actual and prospective competition (N_MVNOs). The greatest effect on employment stems from the new enterprises in the market where market structure is the main explanatory variable with small but positive and highly significant effect on employment. In column 2, estimates of the coefficient on the interaction variable between privatization and competition is negative, contrarily to regulation, the two coefficients are however small and statistically insignificant. Finally, competition seems to have larger effects on employment in small size economies contrary to privatization.

	LN(ARPU)				LN(OUTPUT)			
	(M1)		(M2)	(M3)	(M1)		(M2)	(M3)
	FE	RE			FE	RE		
PRIV	-.027	.119	.049	.090	-.002	.222	.223	-.036
PRIV_YEARS	-.009	.029*	.031*	.027*	-.053	.0044	-.044	-.058
State ownership	.005**	.002	.003*	.002	.005*	.0021	.005*	.005*
COMP	-.100	-.174**	-.078	-.179**	-.097	-.141	.174	-.102
MVNO	.152	.158	.144	.174	.090	.0400	.089	.105
MVNO_YEARS	.064**	.015	.028	.019	-.063*	-.071*	-.066*	-.058*
New_entrants	-.003	.000	-.000	.001	.018***	.026***	.016***	.018***
NRA	-.225*	-.277**	-.382**	-.268**	.296*	.440***	.206	.319*
NRA_YEARS	.012	.008	.008	.009	-.141**	-.078*	-.139**	-.133**
MNP	.289**	.363***	.347***	.377***	-.321***	-.318*	-.260	-.316*
POLCON III	-.558	-.176	-.284	-.080	2.364***	2.346***	2.345***	2.419***
SIZE	.019	-.001	-.001	-.001	-.024	.040***	-.036	-.020
YEAR	-.089**	-.122***	-.122***	-.128***	.435***	.261***	.442***	.424***
PRIV×COMP			-.122				-.402**	
PRIV×REG			.246				.153	
PRIV_SMALL				.057				.079
COMP_SMALL				.030				.048
_CONS	6.276***	7.017***	7.06***	6.923***	18.162***	15.862***	18.525***	17.993***
Observations	297	297	297	297	317	317	317	317
R-squared	0.425	0.112	0.094	0.112	0.834	0.4288	0.840	0.835
F	34.45***				109.32***		97.79***	94.44***
Wald		284.28***	325.04***	285.14***		1302.98***		
Hausman		9.96				45.49***		

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table 2. The Impact Of Privatization, Competition And Regulation On Arpu And Output Using Fixed Effects And Random Effects

3. *Labor productivity*: Using labor productivity measured by real output per employee as the dependant variable, we estimate equation 1 under the alternative specifications and report the results in table 3. There we find that privatization increases labor productivity yet both statistically insignificant except under the second specification. This finding is ambiguous and difficult to explain since most of the previous studies confirm a positive and significant link between privatization and labor productivity. Only Nicoletti (2000) found a negative impact and explained that his result could depend on the limited concept adopted for privatization, which was defined as any initial sale of PTO shares, not necessarily implying loss of control by the state. However, these explanations could at best account for the lack of significance of this variable, certainly not a negative impact. We can adopt such explanation since our results suffer only from lack of significance. As found before for ARPU, privatization seems however to have large and significant effect in smaller economies contrarily to competition.

4. *Mobile density*: Table 4 reports the estimates of equation 1 under the two other specifications with Mobile Density as dependant variable. Focus first on the impact of privatization on network expansion. Estimates on columns 1-3 show that moving to private ownership is positively associated with the expansion of mobile network. However, unlike most of the studies under review (Li and Xu, 2004), the estimates here are small and statistically insignificant except in column 2. In our opinion, this can be explained by the fact that, in the studies mentioned above; authors consider growth in the mobile density as an expansion of the service coverage. We do not agree with such definition, since coverage is a geographic indicator of the mobile network expansion while density is simply the number of subscribers per 100 inhabitants. This indicator does not reveal the contrasting tele-densities in saturated urban areas and rural areas and could be then inflated by the number of subscribers in large metropolitan areas. Indeed, generally, statistics do not take into account the inadequacies in mobile phone coverage in the more rural and remote zones. Moreover, even though competition has prompted the mobile companies to improve coverage by adding new base stations, they generally avoid investing in difficult and less populated areas because of low revenue users in these zones. Most high end users are in urban areas only. This lead to an improvement in mobile density but more in urban zones and less in white areas where coverage is essentially non-existent. For all these reasons we consider the effect of privatization on mobile density could be limited. Regarding competition, as mentioned earlier, the market structure has a small but positive and statistically significant effect on mobile density. More interestingly, the increasing number of mobile virtual operators has a negative and statistically significant effect on mobile density. This confirms our former explanation. Even though MVNOs may have little or no network infrastructure of their own, they can focus on low penetrated rural markets which are outside the focus of that MNO, but unfortunately, this is not the case yet. In column 2, estimates reveal that the joint effects of privatization and competition are small and statistically insignificant. Surprisingly, the joint effects between privatization and regulation have a negative effect on density. Finally, competition seems to have larger effects on mobile density in larger size economies however the estimate is statistically insignificant. Finally, a sound institutional endowment consisting of a strong telecom regulatory body and a stable political system increase the level of main lines per 100 inhabitants.

	LN(Employment)				LN(Labor Productivity)			
	(M1) FE	(M1) RE	(M2)	(M3)	(M1) FE	(M1) RE	(M2)	(M3)
PRIV	-.1222	-.0248	-.0450	.0156	.2055	.2323*	.2223	-.1169
PRIV_YEARS	-.0864**	-.0607*	-.0833***	-.0841**	.0574	.0366	.0388	.0289
State ownership	-.0005	-.0022	-.0004	-.0003	.0027	.0028	.0026	.0016
COMP	-.0008	-.0178	.1188	-.0903	-.1189	-.1092	-.2198*	.0606
MVNO	.0180	-.0044	.0166	.0163	-.1451	-.1461	-.1421	-.1178
MVNO_YEARS	-.0134	-.0178	-.0143	-.0089	-.0952***	-.0841***	-.0864***	-.0851***
New_entrants	.0177***	.0219***	.0165***	.0209***	-.0032	-.0041	-.0025	-.0087*
NRA	.0210	.0465	-.0378	.0684	.0275	.2165	.3012*	.1445
NRA_YEARS	-.0132	-.0023	-.0152	-.0055	-.1631***	-.0738**	-.0769**	-.0818**
MNP	-.453***	-.438***	-.4259***	-.4619***	.3094**	.2908*	.2686*	.3283**
POLCON III	.5977	.5540	.5839	.7166	1.346**	1.580**	1.5747**	1.4566**
SIZE	.0020	.0377***	-.0028	.0094	.0108	.0102	.0100	.0130*
YEAR	.2291***	.1619***	.2355***	.2062***	.1986***	.1271***	.1263***	.1449***
PRIV×COMP			-.17480				.1532	
PRIV×REG			.0995				-.1940	
PRIV_SMALL				-.3136				.8343***
COMP_SMALL				.2373**				-.3798***
_CONS	5.999***	4.701***	6.158***	5.5717***	11.385***	11.260***	11.268***	11.421***
Observations	317	317	317	317	317	317	317	317
R-squared	0.7914	0.4407	0.7935	0.7974	0.4257	0.0834	0.0802	0.0844
F	82.00***		71.59***	73.19***	16.02***			
Wald		102.31***				187.79***	194.09***	224.93***
Hausman		27.45**				6.72		

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table 3. The Impact Of Privatization, Competition And Regulation On Employment And Labor Productivity Using Fixed Effects And Random Effects

	Ln(1+Density)				Ln(Coverage)			
	(M1)		(M2)	(M3)	(M1)		(M2)	(M3)
	FE	RE			FE	RE		
Priv	.068	.100	.254*	-.022	-.038*	.1134***	.0813**	-.0391*
Priv_Years	.019	.009	.026	.014	-.109***	.0001	-.1044***	-.1111***
State ownership	-.002	-.001	-.002*	-.002	-.0001	.000	.0001	-.0000
Comp	.057	.118**	-.055	.095	.012	.022*	.0781***	.0216*
MVNO	-.094	-.077	-.080	-.082	.001	.002	.0017	-.0013
MVNO_Years	-.138***	-.116***	-.142***	-.136***	.001	.0005	-.0002	-.0001
New_entrants	.015***	.013***	.018***	.014***	.001	.0002	.0005	.0000
NRA	.351***	.432***	.629***	.347***	.021	.047*	.0882***	.0159
NRA_Years	-.038	-.006	-.002	-.035	-.015	.000	-.0117	-.0136
MNP	-.302***	-.291***	-.327***	-.294***	-.004	-.005	-.0032	-.0044
Polcon III	1.182***	1.492***	1.261***	1.171***	.038	-.065	.0511	.0408
Size	-.005	-.003	-.005	-.006	-.0001	-.001	-.0013	-.0013
Year	.281***	.247***	.238***	.284***	.1247***	-.001	.1180***	.1269***
Priv×Comp			.141				-.0726***	
Priv×Reg			-.464***				-.0817**	
Priv_Small				.208				.0105
Comp_Small				-.072				-.0261*
_Cons	.596	.295	.462	.663	4.251***	4.436***	4.192***	4.304***
Observations	317	317	317	317	188	188	188	188
R-squared	0.946	0.419	0.948	0.947	0.779	0.839	0.803	.776
F	383.59***		345.74***	333.34***	37.82***		41.04***	35.05***
Wald		426.69***				102.46***		
Hausman		171.43***				339.18***		

* Significant at the 10 percent level.
** Significant at the 5 percent level.
*** Significant at the 1 percent level.

Table 4. The Impact Of Privatization, Competition And Regulation On Teledensity And Coverage Using Fixed Effects And Random Effects

5. *Coverage*: To begin with, privatization has a negative and highly significant effect on coverage. This result seems surprising. However, as explained before, MNOs avoid investing in difficult and less populated areas because of low revenue users in these zones. This lead to an improvement in mobile coverage and density but more in urban zones and less in white areas where coverage is essentially non-existent. Additionally, the combined effects of a new regulatory environment and of privatization of the national telecommunications organization result in a more robust decline of the coverage. It's important to note that, these findings can't be compared with findings in previous studies on mobile telecommunications, since most of them do not consider this performance indicator. Only very few studies examine the correlation between quality and reform process on the mobile sector and characterize quality as the technical performance of the mobile networks. Other studies find that cellular coverage was largely developed in the decade since the privatization of mobile telecommunication services. Further, they conclude that formulation of a regulatory policy and the establishment of an independent regulatory body impact positively on the quality (Fink and Mattoo et al 2001, Galal and Nauriyal 1995).

6. Conclusion

This research studied three chief aspects of the process of telecommunications market reform. We analyzed the effects of privatization, competition and regulation on a comprehensive set of performances in the mobile telecommunications sector in 31 European countries during the period from 1993 to 2008. Using an econometric model, the results are quite mitigated since some of them are different of those from prior research.

To preview, the results show that competition is associated with increased penetration, and lower prices while privatization by itself is associated with few benefits. Privatization combined with an independent regulator, have most a negative impact on performance indicators. Moreover, smaller size economies appear to experience similar reform impact as larger economies on output and coverage. However, the impact of competition on mobile phone density and employment seems to be higher in small economies and lower for labor productivity contrarily to the privatization effect. Furthermore, in small economies, MNOs, appear to achieve higher ARPU more if the sector is privatized but competition bring it down. Moreover, in contrast to competitive pressure, privatization reduces employment. The opposite effects that privatization and competition on employment is confirmed by the negative joint effect in the estimates. Further, privatization have no identifiable impact on output, this surprising result may be explained by the fact that most of the previous studies attribute robust growth in output to total factor productivity not considered in this analysis. More important, competition is found to raise output contrarily to labor productivity. Consistent with this result, competition and privatization exhibit strong opposite effects on output, and complementarily, yet insignificant, on labor productivity. Similarly, we find that large portion of mobile network expansion can be attributed to both privatization and completion.

We used historical average revenue per user (ARPU) as an indicator of user willingness to pay and as proxy to price. As expected, even though the number of subscribers exploded in the last decade in the European mobile telecommunications networks, the ARPU fell under both competition and regulation pressures.

Regarding quality, surprisingly, privatization seems to decrease network coverage. One possible reason for this counter-intuitive finding is that when competition intensifies, more operators enter the market, the utilization levels and profitability of many carriers drop, hindering their ability to invest in the network to expand further. Overall, even though new technological developments and the digitization of the technological infrastructure in particular, exert a very substantial effect on coverage, in some cases, the quality of services, despite the reforms of the sector, remains at the approximate level before the reform. Finally, a common finding is that higher quality of institutional endowments has globally a positive impact on firm efficiency which is confirmed by our results and concerns both small and large economies. Besides enhancing firm efficiency, higher quality of institutional endowments and lower political risk in the economy may also reduce the apparent riskiness of the economy in the global market. Higher quality institutional endowments may even overcome the regulation authority role. This reinforces the growing impression in the literature on telecommunications policy that generic competition law might be sufficient to maintain a healthy competitive environment and makes industry-specific regulation unnecessary, as long as strong institutional foundations and low political risk are in place (Symeou, 2004).

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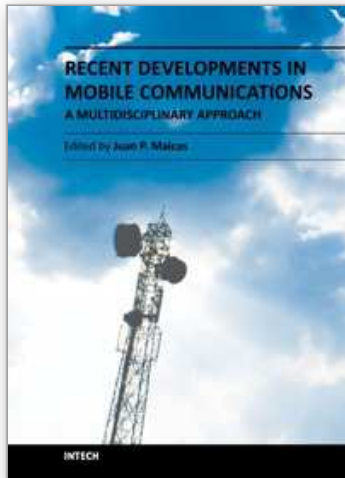
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Edited by Dr Juan P. Maícas

Recent Developments in Mobile Communications - A Multidisciplinary Approach offers a multidisciplinary perspective on the mobile telecommunications industry. The aim of the chapters is to offer both comprehensive and up-to-date surveys of recent developments and the state-of-the-art of various economical and technical aspects of mobile telecommunications markets. The economy-oriented section offers a variety of chapters dealing with different topics within the field. An overview is given on the effects of privatization on mobile service providers' performance; application of the LAM model to market segmentation; the details of WAC; the current state of the telecommunication market; a potential framework for the analysis of the composition of both ecosystems and value networks using tussles and control points; the return of quality investments applied to the mobile telecommunications industry; the current state in the networks effects literature. The other section of the book approaches the field from the technical side. Some of the topics dealt with are antenna parameters for mobile communication systems; emerging wireless technologies that can be employed in RVC communication; ad hoc networks in mobile communications; DoA-based Switching (DoAS); Coordinated MultiPoint transmission and reception (CoMP); conventional and unconventional CACs; and water quality dynamic monitoring systems based on web-server-embedded technology.

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