The Impact of Macroeconomic Factors and Policy Issues on 
Telecom Sector Performance in Pakistan: 
An Econometric Analysis 

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Abstract 
Using a time-series data, the paper appraises allocative efficiency of 
the telecom sector in Pakistan through some of the macroeconomic and 
policy variables. Results of the study reveal that the openness of the 
telecom sector to foreign firms and the existing size of population have 
led to an improvement in efficiency of both the fixed and cellular 
networks. However, findings on the impact of real per capita GDP and 
the existence of a separate regulator remain mixed. The study also 
discloses that cellular networks appear to be benefiting from slow 
growth of fixed-line networks. The paper suggests that the 
attractiveness of Pakistan’s telecom sector to foreign firms needs to be 
maintained so that the country could benefit from the latest 
technological developments and could attract essential finance needed 
for development of the country. 

Keywords: Telecommunication; Regulation; Fixed Networks; Cellular Networks; Teledensity 

I. Introduction 
Telecommunication has proved to be a vibrant industry across the world with a 
high growth rate during the past few years. The on-going process of deregulation, 
privatization, and market liberalization has caused basic changes in the market structure 
of telecommunications from monopoly to that of a competitive one. These developments 
have resulted in the establishment of regulators in most countries. The regulators are 
faced with the challenge of developing a competitive environment in the industry; 
providing a level-playing field to incumbents and to new entrants in the sector. 

Historically, telecommunication has been an industry subject to extensive 
restrictions. Most of the restrictions were based upon the justification that states could run 
the business efficiently. The prevalence of such an ideology resulted in entry restrictions 
on both local and foreign firms in the sector all over the world. This discrimination, 
mainly through subsidies to the sector, further restricted the entry of foreign firms. 
Hence, the extent of government intervention in the telecom sector remained very high 
among both developed and developing countries. “Interestingly, technological developments have vastly eroded scale economies in electricity generation, telecommunications and other non-traded goods and services that were once deemed natural monopolies” (Sirinivasan, 2000). The same supposition is reinforced by Low
(2002) who asserts that digital technology has rendered the old monopoly model of public utility obsolete.

The wave of liberalization, privatization and deregulation originating from developed countries like the USA and the UK during the 1980s and the Bretton Woods institutions has rippled out to countries of the world. There exists a strong tendency to liberalize and privatize most of the industries that used to be in the public sector periphery. The phenomena of liberalization, privatization and deregulation are well supported by the notion of fostering competition among producers of various services.

From an empirical standpoint, the issue of the telecom sector’s performance across developing countries has been well addressed (see the review of literature), however, there remains a gap in the literature regarding the performance assessment of the sector in countries like Pakistan. This paper is an attempt to fill the gap. Having started in 1996, it is now more than a decade since the telecom sector in Pakistan went through liberalization. This becomes a sufficient time period to assess performance of the sector in light of the macroeconomic and policy developments in the economy.

The rest of the discussion is organized as follows. Section 2 deals with a review of the literature on the issue across the globe. Section 3 focuses on the trajectory of the telecom sector’s growth and policy developments in the country. Section 4 draws upon the methodology used to assess the performance of the sector. Section 5 discusses the results while the final part concludes.

II. Review of Literature

A study of telecommunications, deregulation and competition in the US, UK, Australia and New Zealand by Green and Teece (1998) revealed that there was considerable variation in the degree of progress across the developed countries towards the retreat of regulation. They suggested the use of light-handed approaches towards regulation to ensure greater benefits to consumers both in the short and long term.

Using standard economic analysis, Guasch and Hahn (1999) discussed the costs and benefits of regulation. With adverse effects on the standard of living, the regulation was found as a barrier to growth. In their opinion, appropriate regulatory framework is dependent upon bureaucratic expertise, resource availability, political constraints and economic impacts. They emphasized the need to evaluate regulation at both the local and national levels.

Wallsten, S. J. (2001) investigated the effects of privatization, competition, and regulation on telecommunications performance across 30 African and Latin American countries between the years 1984 and 1997. Results of the study revealed that competition was correlated with increases in per capita number of mainlines, payphones, and connection capacity, and with decreases in the price of local calls. Privatization, coupled with an independent regulator, was seen as positively correlated with measures of telecom performance. Privatization alone, however, was found to be negatively correlated with the connection capacity.

Fink et al. (2002) presented an analysis of the impact of competition on fixed-line deployment and labor efficiency across 86 African, Asian, Middle Eastern, Latin
American, and Caribbean countries for the period of 1985-1999. They discovered that privatization of fixed line networks helped in reducing the unmet demand for telecom services. Their findings are also supported by Gutierrez (2003), and Li and Xu (2004). Low (2002) reviewed the deregulation, privatization, market access, competition law and other issues in the telecommunication sector in Asian countries. She viewed integration with the global economy as a promise, while the digital divide was seen as a threat. She labeled the telecom industry as one with falling costs due to technological advancements. However, factors like incomplete infrastructure, scarcity of human resources, lack of information, a weak regulatory and institutional framework, and the limited interest of foreign investors were seen as major barriers. Regarding limitations of competition policy across telecom sectors in Asian countries, the numbers of suppliers, restrictions on type of legal entity and participation of foreign capital were referred to as the important factors. Restrictions like the use of monopoly network facilities, resale of excess capacity of leased circuits or prohibitions against interconnection with other leased circuits by suppliers, were also deemed as barriers towards growth of this sector.

While studying a group of countries, for the period 1990-1998, Li et al. (2005) explored the political economy of liberalization, privatization, and regulatory reforms across the world. They ascertained that the countries with stronger pro-reform interest groups were more likely to implement reforms in more democratic environments. Added to this, they also found that reforms were less likely to be supported and implemented in countries where incumbent operators had sunk a large part of their investments.

The econometric study by Gasmi et al. (2006) discovered political accountability as an important determinant of regulatory performance. They made a convincing argument that policies aimed at enhancing politically accountable systems ought to be given due attention in development programs.

In an attempt to estimate the impact of telecommunications reforms on deployment of telecommunications infrastructure in developing countries, Gasmi and Virto (2008) found the institutional and financial factors to be important determinants. They uncovered a positive relationship between competition in the digital cellular segment and the growth of the fixed-line segment, suggesting that the two segments had benefited from each other. They also found the policies of competition in the digital cellular segment and privatization of fixed-line networks as useful to enhance the deployment of fixed-line infrastructure. On the contrary, the effect of competition in the analogue cellular segment and that of establishing a separate regulator appeared to be negative or non-significant.

Calvin and Keck (2009) examined the impact of the telecom sector’s liberalization in Africa across sectoral performance and economic growth. Their findings revealed that the regulatory quality was found to be playing a major role in bringing down prices and improving access to telecommunications services in the region. Sectoral performance was seen as improving through competition, particularly in the cellular segment. Increase in access to cellular networks by 1% resulted into a 0.5% increase in real per capita gross domestic product.

III. Pakistan’s Telecom Sector at a Glance

Pakistan’s telecom sector has been gearing up to secure its place in a fast developing era of new technologies. The sector portrays a mixed picture as there is a
virtual monopoly in the case of fixed-line networks\(^1\) alongside “managed competition” in the case of cellular networks (Table-1). The government has been able to foster competition by declaring the telecommunications sector an industry. The drive towards competition widened the scope for private and foreign ownership further through the deregulation policy announced in July 2003. There appears to be a significant improvement in various areas, e.g. payphone services, public call offices (PCOs), number of payphone companies, issuing of long distance international (LDI) licenses, internet service providers, and revenue generation. As a result of such developments, the contribution by telecom sector towards gross domestic product (GDP) reached 3% by the year 2007-2008 (MoF, 2009).

**Table 1 Telecom Indicators in Pakistan**

<table>
<thead>
<tr>
<th>Indicators</th>
<th>1996</th>
<th>2006</th>
<th>2008</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of Fixed line networks operators</td>
<td>01</td>
<td>05</td>
<td>08</td>
</tr>
<tr>
<td>No. of Cellular networks operators</td>
<td>03</td>
<td>05</td>
<td>06</td>
</tr>
<tr>
<td>No. of Fixed line Subscribers</td>
<td>2,557,600</td>
<td>5,240,012</td>
<td>4,546,443</td>
</tr>
<tr>
<td>No. of Cellular Subscribers</td>
<td>135,027</td>
<td>34,506,557</td>
<td>89,907,198</td>
</tr>
<tr>
<td>Growth in Mobile sector</td>
<td>98.5%</td>
<td>170%</td>
<td>39.4%</td>
</tr>
<tr>
<td>Teledensity (Fixed lines)</td>
<td>2.04</td>
<td>4.05</td>
<td>4.10</td>
</tr>
<tr>
<td>Teledensity (Cellular Networks)</td>
<td>0.10</td>
<td>22.21</td>
<td>55.90</td>
</tr>
<tr>
<td>Fixed line Penetration rate</td>
<td>19.42%</td>
<td>22.32%</td>
<td>28.80%</td>
</tr>
<tr>
<td>Cellular Penetration rate</td>
<td>0.11%</td>
<td>22.4%</td>
<td>55.6%</td>
</tr>
<tr>
<td>PTCL Revenue (Rs. in Billions)</td>
<td>41</td>
<td>77.10</td>
<td>111.63</td>
</tr>
<tr>
<td>FDI (million dollars)</td>
<td>6.1</td>
<td>1905.1</td>
<td>1438.6</td>
</tr>
<tr>
<td>GDP Per Capita (in Dollars)</td>
<td>506</td>
<td>878</td>
<td>1044</td>
</tr>
<tr>
<td>Population (in Millions)</td>
<td>127.51</td>
<td>156.77</td>
<td>162.37</td>
</tr>
</tbody>
</table>

**Source:** www.pta.gov.pk.

**Note:** Cellular penetration rate is calculated as number of subscribers divided by the total population.

### i. Fixed Networks

Growth in fixed-line networks has been slow due to a conservative policy stance towards these networks. Since 2003, this approach seems to be reversing as other operators have also joined in (Table-1). However, the extent of services provided by new operators remains limited which allows the incumbent firm i.e. PTCL, to maintain its virtual monopoly on fixed-line networks. Under the deregulation policy announced in July 2003, fixed line networks have been opened up. The deregulated environment has led to an increase in the number of operators across local, long distance, and international services. However, the fixed network remains mainly under the monopoly of PTCL which is epitomized by the fact that other operators use its network for their services. This shows that there exists a service competition rather than a network competition across the fixed networks.

### ii. Cellular Mobile Networks

The first-ever cellular mobile policy was announced in the beginning of 2004 and opened up the way for the licensing of new cellular operators through an open and competitive bidding process. Under this policy, new cellular operators were issued licenses for a period of 15 years to run their operations on a nation-wide basis. The new

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\(^1\) Pakistan telecommunications limited (PTCL) serves as the incumbent firm in fixed networks. Although the number of fixed network operators has increased over time, the incumbent still enjoys an exclusive monopoly on fixed-line networks.
policy initiative resulted in increased coverage to various new cities and towns. Likewise, cellular penetration also increased drastically and crossed the fixed line penetration over time (table-1). The government is determined to offer a uniform policy framework to existing and new cellular operators addressing the issues like licensing terms, spectrum allocation, pricing, rollout obligations\(^2\), quality standards and performance benchmarking. The significant growth of cellular networks can be attributed to digital cellular technology and the opening of the mobile services market to additional operators. This may also be due to the fact that mobile services are likely to serve both as substitutes and complements. These become substitutes in areas where there are long waiting lists for fixed line connections while serving as complements for businesses and households having access to fixed networks. In the context of communications appetite, the issue of substitution becomes complex and vague due to developments in technology. For the same reasons, the teledensity in cellular networks has increased considerably and surpassed that of fixed networks (table-1).

IV. Methodology

Data and Variables

The study is a time-series analysis of the telecommunication sector’s performance in Pakistan covering the period of 1996 to 2008. Data on variables used in the study was taken from various sources (Appendix-A). The choice of the variables was mainly dictated by the extant literature and policy developments across Pakistan. An attempt has been made to select proxies that are considered to be the best indicators for measuring the impact of macroeconomic and policy variables.

Dependent variable

The dependent variable used in the study is teledensity-defined as the number of main lines per 100 inhabitants. The variable is categorized across two groups; teledensity of fixed networks and that of cellular networks. Teledensity is the most common indicator of telecom performance and has been used in studies like Wallsten (2001), Fink et al (2002) and Gasm and Virto (2008). This measure provides an indication of the level of penetration of telephone services in the country. It may overstate access since some people have several lines- one at home and two or more at workplace. It may understate access since some lines are for public phones or call centers where many people use a single line only. Nonetheless, it remains the most widely available indicator of telephone penetration (Wallsten, 2001, p.6). This is also considered as the best measure of allocative efficiency of networks (Fink et al. 2002) and is also believed to be a reliable measure of deployment of telecom infrastructure (Gasm and Virto, 2008). For the purpose of the present analysis, teledensity is used to reflect the allocative efficiency of the sector in Pakistan.

Explanatory variables

Developing countries like Pakistan are more often judged by their macroeconomic and policy environment along with the factors like institutional environment, political ideologies, reforms process and so on. Given such considerations, explanatory variables in the model consist of both the macroeconomic and policy variables. These include real per capita gross domestic product, population, openness of the telecom sector to foreign

\(^2\) Under this condition, the cellular phone companies are bound to provide services in rural areas on obligatory basis where fixed-line networks are not available.
firms and the existence of an independent regulator. A brief discussion regarding each of them is given below:

i. **Real per capita GDP**
   Despite the fact that per capita GDP is not a perfect measure of the welfare of the society, it still serves as the foremost and simplest measure of prosperity of a country. There exists a two-way relationship between the real per capita GDP and performance of the telecommunications sector. With higher levels of real GDP per capita, the people are in a better position to afford and pay for telephone calls. At the same time, telecommunication improves the real GDP per capita (Calvin and Keck, 2009) through increased sectoral contributions. Unlike Fink et al. (2002) and Calvin and Keck (2009), the study uses real per capita gross domestic product (PCGDP) as an explanatory variable to test the fact whether higher levels of real per capita GDP lead to an improvement in *allocative efficiency* of the sector across Pakistan. A positive relationship is hypothesized between the two variables. This means that the larger the country’s real GDP per capita, the better the *allocative efficiency* of the telecom sector.

ii. **Population**
   A large market size is a significant determinant of high demand for telephone lines. With a large and growing population, the demand for both the fixed and cellular network connections is bound to increase. The majority of people in Pakistan tend to reside across rural areas where access to fixed networks is limited. However, access to cellular networks is easy and cheaper than the fixed networks. As a result, following Fink et al (2002), it is hypothesized that the larger the population (PoP) in Pakistan, the greater *allocative efficiency* of the sector. It is further anticipated that the impact of population size across the *allocative efficiency* of cellular networks would be larger compared to those of fixed networks.

iii. **Openness to Foreign Firms**
   A liberal and open investment climate has always been conducive and attractive to foreign firms across all the sectors. Pakistan allows foreign investment on a repatriable basis and foreign investors are allowed to own a 100% stake in the telecommunications industry. These developments have resulted in the attraction of foreign direct investment (FDI) through cellular service companies and also through partial privatization\(^3\) of PTCL in the year 2006. FDI in the telecom sector has increased manifold compared to its levels in 1996 (Table-1). Openness to foreign firms becomes essential in countries with tighter financial constraints and lack of technology (Gasmi and Virto, 2008, p. 35). Thus, the study tests for the effects of openness of the sector across its allocative efficiency. FDI inflows in the telecom sector serve as a proxy for openness of the sector to foreign firms in Pakistan. It is expected that larger inflows of FDI in the sector would augment the *allocative efficiency* of telecom firms in Pakistan.

iv. **Regulation**
   Regulation is defined as the government control of market economy. Both economic and political considerations enter into the decisions regarding regulation. Economic considerations are dominated by perceptions of market failure\(^4\) and equity.

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\(^3\) PTCL was partially privatized with a 26% stake by Etisalat, a UAE-based telecommunications company.

\(^4\) Market failure is the inability of the market institutions to sustain desirable activity or eliminate
Political motivations are based on limiting concentration of economic and political power. Clegg and Kamall (1999) refer to the two key objectives of regulation. Firstly, regulation serves as a proxy for competitive forces and aims at creating effective competition by holding back the incumbent to behave as if it were in a competitive market. Secondly, regulation is expected to condition the market by nurturing healthy competition.

Based on the notions of strengthening competition and the concept of a market driven economy, Pakistan Telecommunications Authority (PTA) was established in 1997. The primary objective of the PTA was to develop a regulatory framework and ensure that the rules were followed by players in the market. The role of the PTA is to ensure qualitative, efficient, transparent, and competitive telecom services in the country. The PTA also assumes the responsibility of promoting fair and sustainable competition. The competition is expected to foster the best possible services to users of telecom services across Pakistan in terms of choice, coverage, pricing, and service quality. Thus, a dummy variable (DReg) is used to test for propensity of the country to undertake regulatory reforms and its impact sector’s allocative efficiency. It takes the value of one in the years when the regulator exists and zero otherwise. Although, the use of the dummy for regulation carries certain limitations (Wallsten, 2001, p: 12), but it still serves as the preliminary measure to assess the impact of telecom reforms on the efficiency of the sector in Pakistan.

The Model
The following equations are used to estimate the impact of macroeconomic factors and policy variables across the allocative efficiency of the sector in Pakistan.

\[
\ln TD_F = \alpha + \beta_1 \ln PCGDP + \beta_2 \ln PoP + \beta_3 \ln FDI + \beta_4 DReg + \mu
\]

\[
\ln TD_C = \alpha + \beta_1 \ln PCGDP + \beta_2 \ln PoP + \beta_3 \ln FDI + \beta_4 DReg + \mu
\]

Description of the variables used is provided in Table-2. Distributional properties of the data were visualized by plotting actual values of the variables against time. Additionally, each of the explanatory variables was also plotted against the dependent variable and residuals were also examined by running an initial regression analysis. Such an exploratory data analysis revealed the existence of non-linearity among the variables. Hence, to ensure symmetry and linearity across the data set, natural scale variables were converted into natural logarithms (indicated by \(\ln\)). This also enables us to interpret coefficients as elasticities. All of the explanatory variables are measured simultaneously against the dependent variable. Lag structures were also tested to find out the lagged response of the dependent variable against the explanatory ones but in every instance these resulted in inferior results.

\footnotetext[5]{Regulation brings certain costs that take place in the form of administrative burdens for regulatory agencies, deviations from optimal methods of production and misallocation of economic resources. (Hirschey & Pappas, 1992, Ch.13).}

\footnotetext[6]{Except for the dummy for the regulator.}

\footnotetext[7]{Lags were tried only for those variables that appeared as insignificant or with an unexpected sign.
Table 2 Definition and hypothesized relationship of the variables

<table>
<thead>
<tr>
<th>Variables</th>
<th>Explanation</th>
<th>Expected Sign</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Dependant Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Ln_TD_F</td>
<td>Natural log of teledensity for fixed networks.</td>
<td></td>
</tr>
<tr>
<td>2. Ln_TD_C</td>
<td>Natural log of teledensity for cellular networks.</td>
<td></td>
</tr>
<tr>
<td><strong>Independent Variables</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Ln_PCGDP</td>
<td>Natural log of real per capita GDP in PAK rupees.</td>
<td>+ive</td>
</tr>
<tr>
<td>2. Ln_POP</td>
<td>Natural log of population in million.</td>
<td>+ive</td>
</tr>
<tr>
<td>3. Ln_FDI</td>
<td>Natural log of FDI in million dollars.</td>
<td>+ive</td>
</tr>
<tr>
<td>4. DReg</td>
<td>Dummy for independent regulator.</td>
<td>+ive</td>
</tr>
</tbody>
</table>

V. Results and Discussions

The strength of the econometric analysis largely depends upon the measurement of variables, model specification, data consistency, statistical and economic significance of variables in the analysis, number of observations and the fact that all important variables are included in the analysis. A deficiency on any of these fronts is expected to jeopardize the reliability of estimates. While regressing the explanatory variables against the dependent variable, the degree of freedom constraint was taken into account. Caution has been taken to avoid any inferior results by not overloading the equations with too many explanatory variables. Statistical findings from the regression analysis presented in Table-3 below, contain the estimated equations and conventional tests of significance.

Table 3 Results on econometric analysis of telecom sector's performance in Pakistan: 1996-2008.

<table>
<thead>
<tr>
<th>Dependent Variables</th>
<th>Ln_TD_F</th>
<th>Ln_TD_C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-12.848</td>
<td>-104.220</td>
</tr>
<tr>
<td>ln_PCGDP</td>
<td>-0.010</td>
<td>0.496</td>
</tr>
<tr>
<td>ln_PoP</td>
<td>2.751</td>
<td>19.944</td>
</tr>
<tr>
<td>ln_FDI</td>
<td>0.031</td>
<td>0.312</td>
</tr>
<tr>
<td>DReg</td>
<td>0.195</td>
<td>-0.914</td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.98</td>
<td>0.97</td>
</tr>
<tr>
<td>Standard Error</td>
<td>0.02332</td>
<td>0.23480</td>
</tr>
<tr>
<td>F Statistic</td>
<td>535.429a</td>
<td>291.573a</td>
</tr>
<tr>
<td>DW Statistic</td>
<td>2.028</td>
<td>2.145</td>
</tr>
</tbody>
</table>

Notes: i. Figures in parentheses are test statistics.
ii. Significance levels are denoted by: a(1%), b(5%) and c(10%).

The coefficient of determination (R²), adjusted for the degrees of freedom, denotes the predictive power of the equations. The magnitude of the adjusted R² indicates that the equations have performed well. The value of the F-statistics, significant at 1% in both the equations, allows us to reject the null hypothesis that all of the estimated coefficients are not significantly different from zero. The Durbin-Watson statistics are in the acceptable range and there seems to be no serious concerns for the presence of positive or negative serial correlation. This confirms that there are no specification errors in the equations. As many of the macroeconomic variables tend to move together and are interdependent in
most cases, it might become difficult to avoid any collinearity among the explanatory variables. However, there seems to be no evidence of multicollinearity\(^8\) in the equations. An assessment of the tests of significance and the regression equations indicates that the results of the parameters in the equations are in line with conventional economic theory and are statistically significant except for the real per capita GDP in the case of fixed networks. The coefficient on ln_PCGDP is not only insignificant, yet appears with a negative sign. These findings are inconsistent with those by Fink et. al (2002). This might be the reason that the low levels of real per capita GDP (Table-1) fail to contribute towards improvement in the allocative efficiency of fixed networks. In the case of cellular networks, the coefficient is marginally significant although with an expected sign. One possible explanation for this phenomenon might be the fact that people are substituting across fixed and cellular networks. This is because obtaining a cellular network connection is far cheaper, with almost zero costs of connecting to the network, than that of the fixed line networks where the connection charges are significant and might not be affordable for the low income groups. Similarly, with an increase in income, people might be tempted to shift to cellular network connections since there are long waiting queues for fixed line network connections. This subtly suggests that cellular segment appear to be benefiting from slow growth of fixed networks. One possible way to overcome this problem might be the privatization of fixed networks as proposed by Fink et. al (2002), Gutierrez (2003), and Li and Xu (2004).

From the results of the study, it is revealed that there exists a robust relationship across the allocative efficiency of the telecom sector, population (ln_PoP), and the sector’s openness to foreign firms (ln_FDI). As the population goes up, the teledensity of the sector expands across both the fixed and cellular networks implying an improvement in the allocative efficiency of the sector. However, the relative impact of population increase is larger across cellular networks compared to those of fixed ones. This might partially account for the reason that cellular networks are easy to expand compared to those of their fixed counterparts since the latter requires a large initial investment outlay by the incumbent firm. These findings are inconsistent with those of Fink et. al (2002).

The results on ln FDI reveal the fact that the presence of foreign firms in the country has helped to improve the allocative efficiency of the telecom sector. Again, the relative impact of the variable ln_FDI is larger for cellular networks vis-à-vis the fixed one. This appears logical since the cellular sector is more dominated by foreign firms with large inflows of FDI.

As far as the dummy for regulation (DReg) is concerned, though it does appear as significant in both the cases, it emerges as an unexpected sign across the cellular networks. This result is consistent with the findings of Gasmi and Virto (2008). It signals that cellular companies are more sensitive to the existence of a regulator and might not like the PTA to intervene in their operational activities. This might also be for the reason that cellular services are expanding rapidly due to technological developments and the regulator might not have been able to understand the way regulation needs to be proactively designed to keep up with the fast-moving pace of technology. Hence, a

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8 This is supported by the fact that the variance inflation factor (VIF), a measure of the multicollinearity, remained around 1.5 to 6.3 for the variates. A VIF value being larger than 10.0 (a usual threshold) indicates a high degree of multicollinearity (Hair \textit{et al.} 1995, p. 152).
A careful regulatory process needs to be developed for the rapidly changing cellular sector. These findings are incompatible with those of Wallsten (2001). The existence of a regulator affects the allocative efficiency of fixed networks positively and the variable DReg is significant at the same time. Since the majority share in fixed networks still belongs to the government of Pakistan, where the existence of a regulator might not be perceived as an intervention per se, but may be considered as supportive.

VI. Conclusion

In terms of sectoral performance, the paper confirms that the openness of the telecom sector to foreign firms and existing size of population lead to an improvement in efficiency of both the fixed and cellular networks. However, findings on the impact of real per capita GDP and the existence of a separate regulator remain mixed. Since foreign direct investment by foreign firms and the population appear to be important factors in influencing the performance of telecom sector, the government needs to pay special attention in these areas. The paper suggests that the attractiveness of Pakistan’s telecom sector to foreign firms needs to be maintained so that the country could benefit from the latest technological developments and could attract essential finance needed for development of the country. Likewise, the existing population segment is attractive in terms of its large market size which is beneficial to both the incumbent for fixed networks and the cellular companies. The population needs to be served across both the rural as well as urban areas so that the potential problem of digital divide, as mentioned by Low (2002), could be avoided.

The establishment of the PTA augers well for the improvement of the performance of telecommunication sector in Pakistan. The role of the PTA becomes critical to implement competitive safeguards, nurture competition, to ensure interconnection and guarantee broad and affordable access to necessary services. The government has enacted investment and telecommunication policies that present a progressive vision and offer essential incentives to potential investors. Opening up the fixed line networks to competition is expected to strengthen both the quality and performance of the telecom sector in Pakistan.

Whilst the paper attempts to appraise the performance of telecom sector in Pakistan, certain issues still remain unexplored. Firstly, how has Pakistan benefited in terms of GDP growth, choices, and elimination of urban-rural imbalances in various regions? Secondly, to what extent has competition in cellular networks been productive to society in terms of cost, quality, and access? Lastly, how has the regulation, in terms of price caps and cost of services, impacted the various telecom segments? These are useful areas for future research.

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References


### Appendix-A: Data Sources

<table>
<thead>
<tr>
<th>Variables</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ln_TD_F</td>
<td>Pakistan Telecommunication Authority Annual Report, (Various Issues).</td>
</tr>
<tr>
<td>Ln_TD_C</td>
<td>Pakistan Telecommunication Authority Annual Report, (Various Issues).</td>
</tr>
<tr>
<td>Ln_FDI</td>
<td>Pakistan Telecommunication Authority Annual Report, (Various Issues).</td>
</tr>
<tr>
<td>DReg</td>
<td>Pakistan Telecommunication Authority Annual Report, (Various Issues).</td>
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</table>