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The role of institutional design in the conduct of infrastructure industries reforms - An illustration through telecommunications in developing countries

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Abstract

This paper discusses the relationship between the quality of political and economic institutions and the performance of the infrastructure industries reform process in developing countries. Our point of departure is that, when thinking about this relationship, it is necessary to take into account the specific features of these countries' economies (Gasmi and Recuero Virto, 2005, Laffont, 2005). Based on two econometric analysis of time-series-cross-sectional data on the telecommunications sector, we present the empirical findings and policy implications pertaining two issues (Gasmi et al., 2006, Gasmi and Recuero Virto, 2007). The first issue concerns the impact of the quality of institutions on the performance of regulation. Our review points to the fact that political accountability of institutional systems is a key determinant of regulatory performance. The second issue relates to the factors that shape the sectorial reforms themselves and the impact on these reforms on the development of the industry. Our main conclusion is that countries' institutional risk and financial constraints are among the major factors that explain which reforms are actually implemented.

JEL-codes: L51, H11, L96, L97, C23
Key words - Political accountability, reforms, infrastructure industries, developing countries

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1 Introduction

For more than two decades now, a worldwide wave of reforms has been reshaping the landscape of infrastructure industries both in their market structure and in the institutions that govern them. In developed countries, these reforms mainly sought to improve industry performance by introducing competition in some selected segments and redesigning the legal and regulatory framework so as to enhance diversification and quality of service, efficiency, and pricing. Although based on the same fundamental principles, these reforms faced a significantly different context in developing countries. Indeed, these countries were typically characterized by not only poor infrastructures and weak economic conditions, but also and more importantly by severely inadequate administrative rules at both the sectorial and economy-wide levels inherited from the pre-reforms era. An important methodological implication then is that when evaluating the performance of regulation in a given infrastructure sector, both regulatory governance, that is, governance within the sector, and more global factors related to the governance of the economy as a whole should be account for. A first objective of this paper is to discuss the relative weight of these sectorial and economy-wide factors in the determination of regulatory performance.

Two streams of literature stand at the forefront when thinking about the determinants of regulatory performance in infrastructure industries. A first stream, empirical, emphasizes the impact of regulatory governance on performance (Cubbin and Stern, 2005). Another stream, rather conceptual, argues that when investigating regulatory performance in infrastructure sectors the relevant game to consider takes place upstream at the (higher) level of politics (Spiller and Tommasi, 2003). Our general view is that indeed the relationship between political and regulatory structures and processes has to be given due attention when assessing regulatory performance. This leads us to suggest an approach that merges the above two streams of literature by assuming that political accountability is the fundamental factor through which the economic institutions of a country impact the performance of sectorial regulatory institutions. An econometric analysis of two data sets on the telecommunications industry, one on developing countries and another on developed countries, allows us to illustrate this link and to give some empirical substance to the conjecture that political accountability enhances regulatory performance and more so in developing countries.

In addition to insufficient deployment of infrastructure and difficulties in the functioning of institutions, developing countries are often characterized by poor macroeconomic conditions. Both the structuration of sectoral reforms, in terms of their number, design, and timing, and their impact on the performance of the infrastructure industry, are subject to these constraints. Hence, the market reform conjuncture is not only conditioned by sectoral factors, but also by institutional and macroeconomic factors affecting the efficiency of institutional rules such as the corruption engrained in the political system, and the financial situation often constrained in developing countries by, among other things, high debt services and inefficient taxation. A second purpose of this paper is to explore both the impact of the sectoral reforms on the deployment of infrastructure and the conditions that lead to specific reforms and that allow them to proliferate.

The impact of sectoral reforms on the deployment of infrastructure in developing countries has largely been addressed by an empirical stream of the literature.[1] However, the determinants of these reforms have been mainly explored at the theoretical level.[2] There is room then for bringing the lessons from this theoretical literature to the empirical analysis of the role of reforms in the development of infrastructure in the developing countries. By means of an econometric analysis of a data set on the telecommunications industry in developing countries, we explore the impact of sectoral reforms on fixed-line deployment, and we discuss, in line with a series of theoretical hypothesis derived from the literature, the role of infrastructure deployment, the institutional risk, and the cost of public funds in the privatization and competition decisions, and in the decision to create a separate regulator.

Cellular competition in the analogue and in the digital segments are analyzed separately and indeed empirical evidence on the timing of their introduction and on their market implications suggests such a separate analysis. In addition, the empirical analysis emphasizes the two-way causal relationship between sectoral reforms and infrastructure deployment. Indeed, re-

[1]See Fink et al. (2002) for an overview of this stream of literature.

[2]See Auriol and Picard (2004), Warlters (2004), Laffont (2005), Emerson (2006), and Evans et al. (2005).

forms are likely to be endogenous to deployment, particularly in early stages of privatization and competition reforms.[3] Moreover, the creation of a separate regulator may also depend on conditions characterizing the periods prior to the introduction of regulation.[4]

The plan of the paper is as follows. The next section describes the data sets and the econometric methodologies used in our analysis. In section 3 we first present the empirical results on the role of political accountability on regulatory performance with two data sets on the telecommunications industry on developing countries and developed countries. We then discuss our empirical findings on the determinants of sectoral reforms and on the impact of these reforms on the deployment of infrastructure with a data set on the telecommunications industry on developing countries. We conclude with a summary of our main findings and a discussion of some policy implications.

2 Data and econometric methodology

In this section, we give a brief account of the data and the econometric methodology used to empirically analyze the role of political and economic institutions in the development of the telecommunications sector in developing countries.

The first study concerning the impact of the quality of institutions on the performance of regulation (Gasmi et al., 2006) is based on a set of regressions performed with two time-series-cross-sectional (TSCS) data samples, one containing information on 29 developing countries and another on 23 developed countries, and both covering the 1985-1999. In each of these regressions, the dependent variable measures regulatory performance. More specifically, regulatory performance is measured by a variable of output (penetration rate of fixed-line telephone service or number of subscribers to cellular service), efficiency (number of fixed-lines per employee), or price (the monthly subscription to fixed telephone service for residential consumers or the price of a 3-minute cellular call during peak hours).

[3]For instance, licences are often granted conditional on the fulfillment of targets of penetration rates and quality and associated with exclusivity periods.

[4]Gutierrez (2003), Ros (1999, 2003) already point out the potential endogeneity of telecommunications reforms.

As to the explanatory variables, they include variables describing the standard reform instruments, namely, privatization (% of the incumbent fixed service operator's assets privatized) and competition (degree of competition in the fixed and cellular segments), and some variables conveying general information on demand (population density and % of population which is rural). For the purpose of this paper, however, we focus on those variables used to capture political accountability. These explanatory variables of interest are regrouped into "local political accountability" and "global political accountability" variables.

The "local" part of political accountability indicates the state of governance within the telecommunications sector and is captured in variables indicative of the political and financial independence of the regulator, the transparency of accounts and regulatory decisions, the clarity of the allocation of tasks among alternative regulatory institutions, the nature of the legal environment, and the degree of social participation in regulatory decisions. As to the "global" part of political accountability, it refers to the state of governance in the economy as a whole. This is captured in variables reflecting the quality of the institutional framework, namely, government integrity, efficiency of bureaucracy, strength of courts and enforcement capacity, government's commitment capacity, and currency risk, and the quality of the political process inferred from the strength of checks and balances.

The second study seeking to investigate the determinants of sectoral reforms and their impact on telecommunications infrastructure deployment (Gasmi and Recuero Virto, 2007) is based on a series of regressions performed with data collected on 86 developing countries for the period 1985-1999. When running these regressions, a key point is to account for the endogeneity of some right-hand-side variables, in particular, of the variable capturing infrastructure deployment when explaining the sectoral reform variable and of the reform variable when explaining the infrastructure deployment variable. The reform variable describes the reform instrument that has been implemented, namely, privatization of the incumbent, introduction of competition in the fixed-service segment, introduction of competition in the analogue and digital cellular segments (number of granted licences), and creation of a separate regulator. The infrastructure deployment variable used is the penetration rate of fixed service. Among the other variables of the regressions, a particular attention is given to those that measure the quality of the institutional framework (all the variables described above except currency risk) and the ease of government access to public funds. The latter is assessed through the marginal cost of public funds which is parameterized using variables of debt service, taxation, and international aid.[5] Finally, some additional variables are used to control for the effect of human capital availability in the sector, state of democracy in the country, perceived country risk, and population density and distribution in the country.

We apply two different econometric estimation methods according to whether the dependent variable is continuous (regulatory performance/infrastructure deployment variables, privatization variable) or discrete (variables of competition in the fixed, analogue cellular, and digital cellular segments, creation of a separate regulator). In the continuous case, we make use of the Differenced and System Generalized Method of Moments which is appropriate for dealing with dynamics and potential endogeneity of explanatory variables, two features of our TSCS data (Arellano and Bond, 1991, and Arellano and Bover, 1995). In order to avoid the weak instrument problem and more generally the risk of inaccurate results, previously to performing the regressions, dependent variables are stationarized when there is presence of unit roots in the series.

In the discrete case, we apply the Complementary Log Log estimator based on the grouped duration methodology (Beck et al., 1998). This methodology allows to deal with temporal dependence and multiple events as in the case of our cellular competition variables since several licences where typically granted during the period under study. Moreover, the problem of the potential endogeneity of the explanatory regressors is first addressed by an exogeneity test based on the Two Stage Conditional Maximum Likelihood method and then, when needed, by an estimator, the Full Information Maximum Likelihood, that allows for the presence of endogenous regressors.

While the estimation of the coefficients of these (continuous/discrete) regressions allows us to assess the quantitative impact of the explanatory

[5] The cost of public funds has been shown in the literature to be an important determinant of telecommunications policy (Auriol and Picard, 2004, Gasmi et al. 1998, Warlters, 2004).

variables on the dependent variables, asking first whether there exists a causal relationship between some series of interest allow us to meaningfully interpret this impact. We test whether the variables that proxy political accountability "Granger-cause" those that proxy regulatory performance, and retain for our regressions only those series where causality is found (Holtz-Eakin et al., 1988). Moreover, we test whether there is a two-way causal relationship between the variables used to proxy sectoral reforms and those used that proxy infrastructure deployment, and again retain only those where causality is found.

3 Empirical results and implications

Causality

As mentioned in the previous section, before performing the econometric estimation of the relationship between political accountability and regulatory performance, on the one hand, and reforms and network deployment, on the other hand, we first investigate the existence of causal relationships between the variables of interest.

For the data on 29 developing countries and the one on 23 developed countries, we set a Granger-causality testing procedure asking whether political accountability causes regulatory performance. The tests performed support the proposition that, in both developing and developed countries, there exists a causal relationship between political accountability and regulatory performance. This relationship is particularly apparent when the quality of the institutional environment is the variable used to measure political accountability. Another interesting feature of the results is that the global accountability variables, that is, those that reflect the governance of the economy as a whole, are in a stronger causal relationship with regulatory performance than the local accountability variables that reflect sectoral regulatory governance. This result appears even more in developing countries.

For the data on 86 developing countries, we investigate the existence of a two-way Granger-causality between sectoral reforms (privatization, competition, and creation of a regulator) and infrastructure (penetration rate). Evidence of both two-way and one-way causality relationships comes out of the data. We find that the creation of a separate regulator impacts fixed-line penetration but is also conditioned by it, a result also discussed by Ros (2003) and Gutierrez (2003). A similar two-way causality relationship is found between the variable that indicates the introduction of competition in the cellular digital segment and the one that indicates fixed-line penetration. For the remaining reform instruments, we find one-way causal relationships. Privatization of the fixed-line incumbent and introduction of competition in the analogue segment both cause fixed-line deployment. Finally, deployment of fixed-line service causes the introduction of competition in the fixed local segment.

Estimation

The estimations provide strong evidence that in developing countries, the higher the political accountability, the better the regulatory performance as reflected in higher output (increase in fixed-line penetration and cellular subscription), higher efficiency (increase in fixed-lines per employee), or lower prices (decrease in price of cellular).[6] The results obtained with the data on the developed countries are much more poorer. In fact, we find that a higher level of political accountability translates into better regulatory performance only through higher output (increase in cellular subscription) and lower prices (decrease in price of fixed-line subscription).

Our findings also suggest there are reasons to believe that local political accountability is generally a relevant determinant of regulatory performance in both developing and developed countries. The higher the sectoral regulatory governance, the better the regulatory performance as reflected in the developing countries data set through higher output (increase in fixed-line penetration) and lower prices (decrease in price of fixed-line subscription and in price of cellular). In the developed countries data set, the higher the sectoral regulatory governance the better the regulatory performance as translated in higher output (increase in cellular subscription).

The story is not so clear when it comes to global accountability. In the

[6] The only result obtained that might at first seem counterintuitive is that higher political accountability (less risk of expropriation for operators and stronger checks and balances) leads to a higher price of fixed-line subscription. However, this might in fact only reflect the extent of tariff rebalancing that typically takes place in developing countries during the early stages of the reforms.

data set on developing countries, we found that the quality of the political process and the institutional environment have a favorable effect on regulatory performance when the latter is measured by any of the variables measuring output, price, and efficiency. In fact, this effect is even stronger than for local political accountability. In contrast, with the data set on developed countries the quality of the political process has only been found to have a significant impact on regulatory performance when the latter is measured by output (increase in cellular subscription). Moreover, the quality of the institutional environment showed a positive effect on regulatory performance when the latter is measured by price (decrease in price of fixed-line subscription) but an ambiguous effect when regulatory performance is measured by output.

Our regression results support the proposition that the deployment of infrastructure is a relevant determinant of sectoral reforms. More specifically, the higher the fixed-line penetration, the more likely the presence of cellular competition in the digital segment and of fixed-line competition in the local segment, while the less likely the creation of a separate regulator.[7] We can then infer that the government is more likely to introduce cellular competition in the digital segment and fixed-line competition in the local segment when the telecommunications sector is performing well, since under these circumstances higher licence fees can be expected. A separate regulator , however, appears to be created with the aim of compensating a badly performing sector.

We also find that institutional quality is an important determinant of reforms. On the one hand, the weaker the institutional environment, the less likely to find reforms such as cellular competition in the analogue segment and the creation of a separate regulator.[8] On the other hand, the weaker the institutional environment, the more likely it is to find privatization of the fixed-line incumbent, cellular competition in the digital segment, and fixed-line competition in the local segment.[9] It seems as though the higher the

[7]These results confirm the proposition of Evans et al. (2005) that regulatory independence becomes more necessary the larger the returns to investment and hence, the lower the fixed-line penetration.

[8]This result is in line with the hypothesis of Emerson (2006) that corruption has a negative impact on competition decision.

[9]Results support Laffont's (2005) proposition that the probability of infrastructure

expected price of the licence and, in general, the greater the probability of attracting investors whose rents can be extracted, the more likely a government with a poor institutional profile is going to promote the reform.[10]

Through the variables used to parameterize it, namely, debt, taxes, and aid, the cost of public funds also appears to be a relevant determinant of sectoral reforms. On the one hand, we find that the higher the cost of public funds, the more likely to see privatization of the fixed-line incumbent and cellular competition in the digital segment.[11] On the other hand, the higher the cost of public funds, the less likely to have cellular competition in the analogue segment and fixed-line competition. This results lead us to think that more profitable reforms are likely to be selected when the government is under tighter financial constraints, despite the lose of the future revenues of the firm in the public sector, and of the associated monopoly profits.

Regarding the impact of sectoral reforms on the deployment of infrastructure, we find strong evidence in our data set on the positive impact of privatization of the fixed-line incumbent on fixed-line penetration.[12] Also, our separate treatment of the analogue and digital segments allows us to shed some light on the effect of the introduction of competition in these two segments.[13] While we do find that cellular competition in the digital segment has a significant and positive impact on fixed-line penetration, cellular competition in the analogue segment is found to have a significant and negative impact on deployment. Therefore, fixed-line deployment and cellular competition in the digital segment can be viewed as complement while fixed-

privatization should decrease in countries with little or extreme levels of corruption.

[10]While the privatization of the fixed-line incumbent and the introduction of competition in the digital cellular and the fixed-line segments typically involve external investors, the first licence in the cellular analogue segment, which often remains the sole licence issued in this segment, is usually granted to the fixed-line incumbent.

[11]For a given tax system, increases in debt force the government to increase its revenue requirement through increases in the tax level which in turn increases the cost of public funds. Changes in net taxes on products and aid per capita have a direct impact on the government funding requirements and are expected to be negatively correlated with the cost of public funds.

[12]This result is in contrast with the literature which often reports an ambiguous impact of privatization.

[13]The usual strategy in empirical studies is to use an aggregate index of competition for the analogue and digital segments and the typical finding is a positive impact of competition on fixed-line penetration.

line deployment and cellular competition in the analogue segment can be regarded as substitutes.[14] Finally, we find that fixed-line competition in the local segment and the creation of a regulator have both no significant impact on fixed-line penetration.

4 Conclusion

The major point highlighted by this paper is the crucial role played by the institutional and macroeconomic foundations that characterize a country in the development of infrastructure industries. A no less major policy implication of this point is that the ongoing debate on the (re)structuring of infrastructure industries that has so far taken place mainly at a sectoral level should now be moving onto incorporating general factors of the economy as a whole. The significance of these factors call for a particularly subtle attitude towards policy design in developing countries. On the one hand, this study has emphasized that what we consider as a fundamental link between sectoral and economy-wide institutions, political accountability, has a positive direct impact on the performance of regulation. On the other hand, a country's institutional risk and financial constraints have a positive indirect impact on the deployment of infrastructure, through the sectoral reforms put in place by the government.

We find that political accountability, characterized through the quality of the institutional environment and the political process, is a relevant determinant of the performance of regulation. The higher the political accountability, the better the regulatory performance. A consequence of this result is that future reforms should not only devote attention to improving regulatory governance (structural requirements), but should also pay much attention to understanding the political context within which regulatory institutions will be performing.

In developing countries, regulatory agencies have been strongly criticized

[14]This is consistent with the fact that analogue licences appeared before digital licences, being often granted to the fixed-line incumbent in which case no strong competition between fixed and cellular segments could be expected. Moreover, capacity constraints associated with the analogue technology typically limited the number of issued licences in that segment as compared to the digital segment, which is often characterized by the presence of multiple competitor in the period under study.

since the late 90s as often failing to prevent crisis, or even worse, as contributing to their development.[15] Among the major criticisms has been their failure to retain private investment.[16] The discussion in this paper, however, suggests that the performance of regulation should not only be attributed to sectoral features in developing countries where political accountability is at an early stage of development. For these countries, additional means and resources from development partners should be directed towards promoting good global governance which will in turn enhance regulatory performance.[17]

Next to factors of this global nature, namely, the institutional environment and the level of tightness of the government's budget constraint, infrastructure deployment has also been discussed as an important determinant of sectoral reforms in developing countries. In particular, in countries subject to higher institutional risk and to tighter financial constraints, governments are more likely to promote those reforms that attract a larger number of investors whose rents can be in turn extracted through the licence price, red tape, or else, such as the privatization of the fixed-line incumbent and the introduction of cellular competition in the digital segment. For the same reasons, these governments are less likely to support those reforms that are likely to provide them with less cash, such as the introduction of competition in the analogue cellular segment and the creation of a regulator.

As it turns out, the "profitable" reforms promoted by these governments are those that have a positive impact on infrastructure deployment. Overall, this leaves us with the result that might somehow seem paradoxal that countries with poorer economic conditions and greater institutional risk are more likely to support those sectoral reforms that do enhance infrastructure deployment.[18] This might partly help in understanding the impressive growth

[15]Some examples, are the privatization process in Ghana and Philippines and the competition process in Senegal.

[16]According to the World Bank PPI database, investment rose from 0.9 million USD in 1991 to 44 million in 1997 and then decreased systematically (except in 2000) until its lowest level in 2004 with 12 million USD.

[17]In developed countries, as our results show, political accountability is already well established and practiced through an effective use by the electorate of its votes as a sanctioning tool. The focus therefore in those countries is more on regulatory governance.

[18]In Gasmi and Recuero Virto (2007), we find that the privatization of the fixed-line incumbent and the introduction of competition in the digital cellular segment have a positive impact on fixed-line deployment. These same reforms are also found to be important

of telecommunications deployment in Sub-Saharan Africa in the recent years.

drivers of cellular subscription growth as well.

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