

# **Public enterprise reform in Nigeria: Evidence from the telecommunications industry**

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# Abstract

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This study examines the qualitative and quantitative evidence relating to allocative and productive efficiency in the publicly owned Nigerian Telecommunications Limited (NITEL) in the wake of its commercialization and the deregulation in 1992. Estimates of changes in internal efficiency using total factor productivity analysis suggest a substantial improvement in efficiency as a result of the regime shift. Furthermore, the reform undertaken resulted in increased profitability, network expansion and modernization of telecommunications services. However, the momentum generated by reform has proved impossible to sustain. The industry is still characterized by under-investment and large unmet demand. The study recommends greater private sector participation in the delivery of telecommunications services in Nigeria, the introduction of competition in the sector, and the strengthening of ongoing reform efforts to embrace full privatization of NITEL with a view to overcoming protracted constraints on telecommunications performance and growth.

# 1. Introduction

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In recent years, several developing countries have embarked on the reform of public enterprises, including privatization, within the framework of macroeconomic reform and liberalization. More than 100 countries across every continent, most of them developing, have privatized some of their state-owned enterprises (SOEs). Equally striking is the volume of transactions. Between 1988 and 1993, over 26,000 privatization transactions with sales values exceeding US\$50,000 each were recorded world-wide, generating a gross receipt of US\$271 billion. Of these transactions, about 900 were conducted in 1993 alone, against only about 60 in 1988. Developing and transition economies accounted for much of this tremendous growth (Sader, 1995). Between 1988 and 1994, developing countries around the world sold about 3,300 SOEs, with sales revenue rising from only US\$2.6 billion at the beginning of the period to a peak of US\$29 billion in 1992 (Megyery and Sader, 1997).

The resort to privatization/commercialization was informed by several considerations. First, by 1985, the quantum of resources required to sustain the SOEs had become an unbearable burden on the affected nations. Second, it was envisaged that a carefully planned privatization programme would be an effective strategy for improving operational efficiency, broadening share ownership, attracting foreign investment and reducing the role of the state where the private sector has the capabilities to operate more efficiently. Finally, since the beginning of the 1980s, privatization of public enterprises has become a major policy tool in both developed and developing countries following the apparently successful privatization programme in Britain. Privatization gained considerable momentum in developing countries given its endorsement by the multilateral financial institutions as a major plank of adjustment policies. The urge for privatization was further reinforced by the need to reduce government expenditure in the face of burgeoning fiscal deficits, and was also in conformity with the resurgence of “economic liberalism” in the development literature.

Yet despite widespread privatization efforts, empirical evidence indicates that its anticipated benefits are yet to be felt in African countries. Most studies have documented the relatively poor performance of SOE reform efforts in Africa compared with other areas of the world in both relative and absolute terms (World Bank, 1996; Kikeri et al., 1992; Adam et al., 1995). However, only limited efforts have been made to identify the causes and determinants of the uniquely unsatisfactory performance of SOE reform in Africa relative to other environments.

As in most developing countries, the Nigerian economy until recently witnessed a growing involvement of the state in economic activities. The expansion of state-owned

enterprises (SOEs) into diverse economic activities was viewed as an important strategy for fostering rapid economic growth and development. Massive foreign exchange earnings from crude oil, which exacerbated unbridled federal government investment in public enterprises, reinforced this view. Thus, by 1990, there were over 1,500 public sector enterprises in Nigeria, 600 of which were owned by the federal government, and the rest by state and local governments (Jerome, 1995). The public enterprise sector excluding petroleum accounted for about 15% of Nigeria's gross domestic product in 1990. Unfortunately, most of the enterprises were poorly conceived and economically inefficient. They accumulated huge financial losses and absorbed a disproportionate share of domestic credit.<sup>1</sup> By 1985, they had become an intolerable burden on the budget, as they were being sustained through budgetary allocations from the treasury.

In the wake of the economic recession that began in 1981, following the collapse of oil prices, the activities of public enterprises attracted more attention and underwent closer scrutiny, much of it centring on their poor performance and the burden they imposed on government finance. The poor financial returns from these enterprises against the background of severe macroeconomic imbalance and public sector crisis precipitated the concern of government towards privatization.<sup>2</sup>

With the adoption of the structural adjustment programme (SAP) in 1986, SOEs came into the forefront as a major component of Nigeria's economic reform process. Consequently, the Technical Committee on Privatization and Commercialization was established in 1988 to implement the SOE reform component of SAP. In what appears to be a uniquely comprehensive initiative, 101 enterprises in virtually all sectors were slated for total or partial privatization and another 35 for commercialization. Subsequently, public utilities such as Nigerian Telecommunications Limited (NITEL), the Nigerian Postal Services, Nigerian Airways and the Nigerian Electric Power Authority, among others, were restructured and reoriented towards higher efficiency.

Nigeria is probably the only country in the world that carried out a hybrid programme of privatization and commercialization simultaneously. The decree defined commercialization as the reorganization of enterprises, wholly or partly owned by the government, into profit making commercial ventures without subvention from the government. The process entails explicit performance-based contracts with managers of SOEs.<sup>3</sup> In return for managers' expanded power over pricing, procurement, production and personnel, the enterprise is subjected to a hard budget, which entails cutting subsidies and transfers.

The telecommunications industry in Nigeria also witnessed the deregulation of telecommunications services in 1992 through the promulgation of Nigerian Communications Commission (NCC) Decree, No. 75 of 1992, introducing private participation in the provision of telecommunications services in Nigeria, thus ending the state-owned NITEL's monopoly of the sector and ushering in competition.

Deregulation is expected to enhance efficiency in two ways. First is through the curtailment of the inefficiency that arises as a result of regulation and isolation of firms from actual and potential competition. Second, rents accruing to rent-seeking groups benefiting from regulation would be dissipated by a more competitive market environment (Winston, 1993). While much has been written about the experience of developed

economies with deregulation and privatization of public utilities (Oniki et al., 1992; Imai, 1994; Wellenius and Stern, 1994), there have been few studies on the experience of developing countries especially those in Africa. Yet, these economies are more vulnerable to disruptions associated with grossly inadequate provision of infrastructure services. What is the quantitative and qualitative evidence concerning allocative and productive efficiency? To what extent have ex ante expectations and results been realized? Have reforms induced more rational and profitable investment? What lessons are to be learned? These are the issues that form the crux of this study.

In the main, this study examines the impetus for reform, what happened in the wake of commercialization and deregulation, and the changes in the regulatory framework. The study also looks at the institutional details of the economic environment. Our choice of the telecommunications sector arises because the industry presents some of the most difficult issues currently confronting microeconomic policy makers. Furthermore, it is the most rapidly growing and technologically dynamic sector and the pressure to move the sector out of its traditional public utility, monopoly status is being exerted all over the world and is ultimately irresistible.

The study comprises eight sections. The structure of the Nigerian telecommunications industry is examined in Section 2, while a review of related literature is undertaken in Section 3. Section 4 details the methodology and Section 5 chronicles the reforms undertaken in NITEL. Section 6 appraises the impact of deregulation on NITEL; the empirical results are presented in Section 7 and Section 8 concludes.

## Justification for the study

Telecommunications infrastructure lies at the heart of the information economy. Countries lacking modern telecommunications infrastructure cannot compete effectively in the global economy. Until the early 1980s, the telecommunications sector was viewed as the quintessential public utility. Economies of scale, combined with political sensitivity, created large entry barriers and externalities. Beginning from the 1980s, however, 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. Rapid innovations in telecommunications and information technology are lowering costs, creating new services and changing the cost structure of many industries. Driven by unrelenting technological and market forces, telecommunications has become one of the world's most dynamic sectors (Wellenius and Stern, 1994; Saunders et al., 1994).

In response to the need to overcome persistent shortfalls in telecommunications investments and performance, telecommunications restructuring has assumed a global dimension and the wave of telecommunication reforms that began in the 1980s in a few highly developed economies quickly spread to several developing countries. By 1993, major reforms had been undertaken in at least 15 developing countries and a comparable number were in preparation (Wellenius and Stern, 1994). The impact of these new policy

initiatives has been profound, but if the new pragmatism in telecommunications policy is to succeed, policy initiatives will need to be broadened and deepened.

Even though the International Telecommunications Union's Harare Declaration contained a commitment by several sub-Saharan African countries to increase private sector participation in telecommunications, most governments have been reluctant to put this policy into practice. Six sub-Saharan<sup>4</sup> countries have announced plans to privatize their national carriers, but only Guinea has actually implemented such a policy—although several others are believed to be considering this move (Mustafa et al., 1997). Thus, the telecommunications sector in Africa is still predominantly state owned and has yet to show the benefits from the transformation in pattern of ownership, market structure and provision of service that is taking place world-wide. As a strategically important but relatively neglected sector in sub-Saharan Africa, telecommunications is largely characterized by poor performance manifested in low profitability, large unmet demand for services, poor technical and operational quality of service, and absence of new services. Economic studies for the International Telecommunications Union indicate that each new telephone line added in the region contributes approximately \$4,500 to gross national product, a far higher contribution than in developed economies. The future of telecommunications lies with private commercial provision of services under liberal regulatory environments.<sup>5</sup> Against this background, a pertinent question today is how can African countries begin to move this new pragmatism from the periphery to the centre of the telecommunications reform agenda? There is a renewed clamour for a proper investigation of the underlying causes of this unacceptable scenario to enhance the design or redesign of results-oriented telecommunications sector reform programmes in Africa.

This study intends to examine how to promote this shift on the basis of the experience of several countries reforming their telecommunications sector. It recognizes, however, that there is no universally acceptable template for implementing telecommunications restructuring. Although fairly universal policy issues and options face governments attempting to reform their telecommunications sectors, their relative importance, the sectoral solutions adopted and especially the strategies to implement them are highly country specific (Saunders et al., 1994).

## Objectives of the study

The main objective of the study is to ascertain the quantitative and qualitative evidence concerning the efficiency and welfare improving effects of deregulation of the telecommunications sector in Nigeria. The specific objectives of the study are:

- To analyse the production structure of Nigerian telecommunications and estimate the total factor productivity growth.
- To decompose total factor productivity growth into scale economies and deregulation effects with a view to estimating efficiency gains due to deregulation.
- To assess the regulatory changes in the sector in the wake of commercialization.
- To analyse the options for evolving a viable telecommunications sector in Nigeria.

## 2. The structure of the Nigerian telecommunications industry

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The provision of telecommunications services in Nigeria has until recently been the preserve of public sector monopolies. Currently, the largest provider is NITEL, a public limited liability company whose antecedent was Nigerian External Telecommunications Limited (NET) established by Cables and Wireless of United Kingdom during the colonial era. The Nigerian government acquired 51% of the company in 1962 and by 1972 had taken over the remaining 49%. The name of the company was changed from Cables and Wireless incorporated to NET.

In December 1984, the telecommunications arm of Post and Telecommunications (P&T), a commercial department of the Ministry of Communications that had started out as a postal branch of the British Post Office in 1851, was detached from its postal affiliate and merged with NET to form NITEL, an autonomous public company incorporated under the Companies Decree of 1968. NITEL officially commenced business on 1 January 1985. At inception, the company inherited NET's authorized share capital of 4 million shares of ₦1.00 each with ₦2 million fully paid. The company was commercialized and renamed NITEL Plc in 1992, although no public shareholding other than government is known to exist in it.

Prior to commercialization, NITEL operated as a very inefficient monopoly grappling with lack of clear policy direction, counterproductive bureaucratic red tape and a myriad of other problems. These problems led to suboptimal performance in all spheres of its operations, from inadequate infrastructure to very low quality customer service. Up to 1991, access to telephone services was limited to about 20% of the population and area of coverage. As at December 1991, there were about 450,000 direct exchange lines giving an average penetration level of about 1 line per 250 inhabitants as against International Telecommunications Union recommendation of 1 line per 100 persons for developing nations. There were over 500,000 waiting applicants nationwide, while telex subscriber figures stood at 7,985. These figures reflect poor capacity utilization since installed telephone and telex capacities were over 500,000 and 15,000, respectively. The quality of service was also poor and constant congestion of switching equipment led to long dial tone delays and very low call completion rates. On average, the call completion rates for local, long distance and incoming international calls were as low as 40, 40 and 45%, respectively, as against the expected 60 and 50% for local and international calls (Nwafor, 1997).

Furthermore, an efficient billing system was lacking and in fact it was suspected that about 20% of subscribers did not receive bills, while only 7% of amounts generated were being collected. These factors culminated in consistent operating losses and low returns on investments as shown in its audited accounts, which recorded persistent losses.

NITEL currently operates as a statutory monopoly for voice telephony and telex services, although plans are being made to license a second carrier in 1998. Services other than voice telephony and telex are organized as separate subsidiaries. Other major actors in the telecommunications industry as shown in Figure 1 are the Ministry of Communications, the Nigerian Communications Commission (NCC) and newly licensed private operators. The Ministry of Communications, which represents the government, determines policy and supervises NITEL (the incumbent operator), M-TEL and the Nigerian Communications Commission (NCC), a regulatory organ. Created in 1992 to regulate the industry, NCC is responsible for the approval of standards as well as the licensing and regulation of operators and service providers. The federal government, through the promulgation of Nigerian Communications Commission (NCC) Decree No. 75 of 1992, introduced private participation in the provision of telecommunications services in Nigeria. The second schedule of the decree listed telecommunications business open to private operators in different telecommunications service areas open to competition. Table 1 presents the category of services and numbers of licences issued.

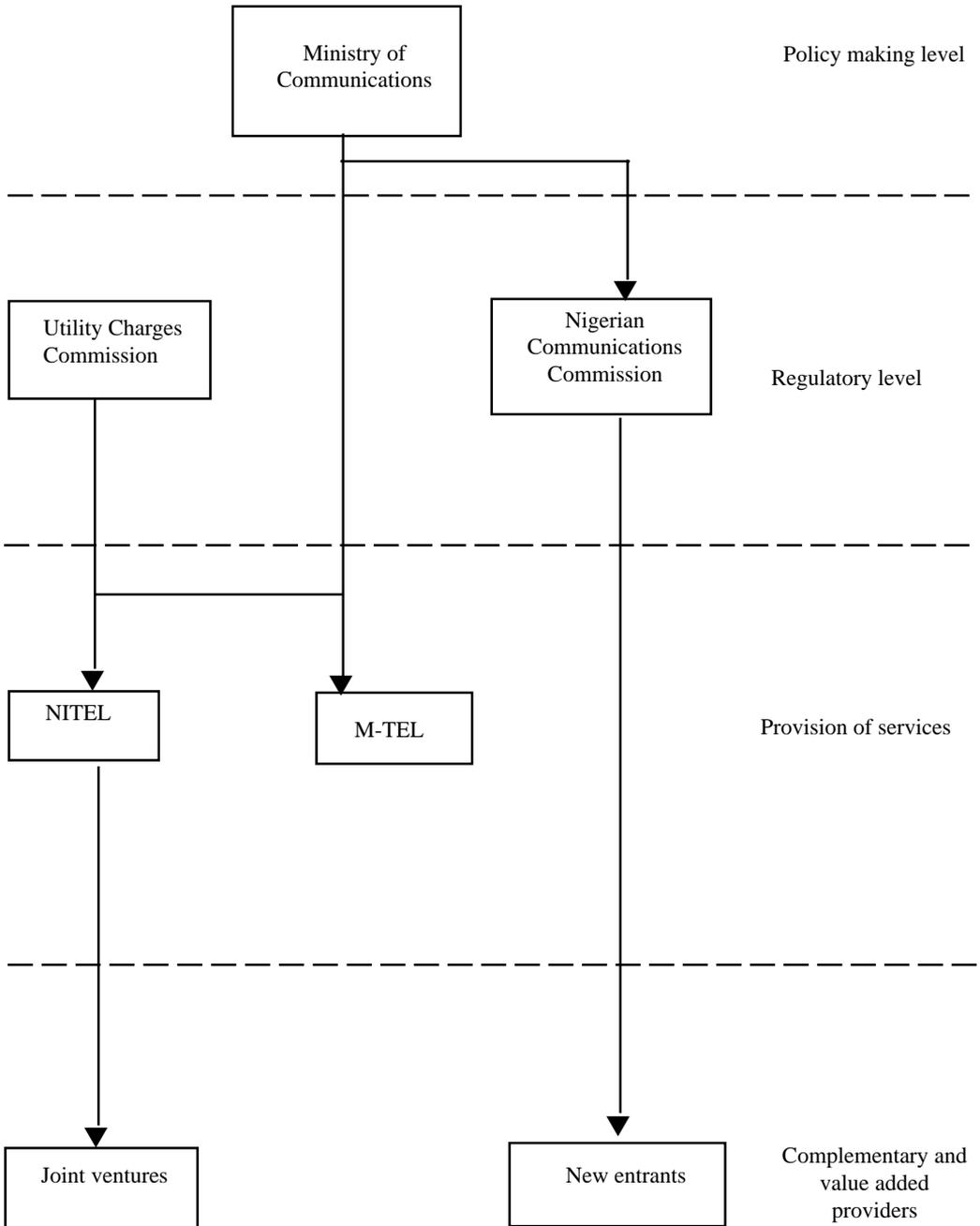
The effect of these private operators is yet to be felt, but it must be noted that some of the licensed firms are bracing for the challenges of deregulation. Multi-

**Table 1: Category of services and number of licences issued to private operators as at February 1997**

Service group	Number of operators	Percentage
Installation of terminal and other equipment	25	18.2
Provision and operation of public payphones	10	7.3
Provision and operation of public mobile communications	22	16.1
- Cellular	5	
- Paging	17	
- Trunked radio	-	
Provision and operation of private network links	32	23.4
- Mobile satellite services	-	
- Fixed telephony services	17	
- Fixed satellite services (VSAT)	15	
Provision and operation of community telecommunications	2	1.5
Provision and operation of value added networks	40	29.2
- Voice mail	13	
- E-mail	1	
- Internet (general services)	26	
Repair and maintenance of telecommunications equipment	4	2.9
Cabling	2	1.5
<b>Total</b>	<b>137</b>	<b>100.0</b>

Source: Nigerian Communications Commission.

**Figure 1: The organization of the telecommunications sector in Nigeria**



One of the newly licensed firms, signed an interconnectivity pact with NITEL on 7 October 1997 thus breaking the jinx that has stalled interconnectivity for five years. The Multi-Link Exchange has a capacity of 50,000 lines for Lagos alone, out of which the entire 10,000 lines being introduced initially are already subscribed. Some companies have gone ahead to procure systems and put up elaborate management structures. Already, network development, financing and systems procurement deals are being concluded between private operators and foreign systems designers and sellers.<sup>6</sup> The Nigerian precedent of regulatory reform has influenced several other African countries such as Tanzania and Zambia in establishing similar bodies.

The Utilities Charges Commission is currently responsible for the regulation of NITEL's tariff. The function is clearly an abnormality considering that telecommunications services cannot be treated as utilities in the strict sense and the NCC can best perform this role. Other organizations that influence the telecommunications sector but cannot be located in the official sectoral set-up include the Bureau for Public Enterprises and the Ministry of Finance.

### 3. Review of related studies

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The phenomenal increase in the number of SOE reform programmes in both developed and developing economies has generated a lot of research interest in the last decade. The bulk of the research efforts, however, are intuitive, mainly theoretical and country specific. They address why governments have opted for reforms, how reforms were implemented, the degree of implementation and the problems encountered (Onis, 1991; Ramandaham, 1989; Jerome, 1995). While these studies may be useful guides to policy makers on how to carry out successful state enterprise reform including privatization, they are deficient because they fail to address systematically how privatization has affected the performance of divested firms and they do not link outcomes to their causal factors.

Very few studies analyse 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.

In a related study, Bishop and Kay (1988) compared the performance of a number of privatized firms in the United Kingdom (shipping, airline, gas, telecom, oil and automobile industry) with another set of firms under state control (in rail, steel and postal sector) using several indicators, including revenue, employment, profit margin and total factor productivity. Their finding is also inconclusive since both privatized and non-privatized firms experienced an upsurge in all the indicators used. Thus, the emphasis on privatization as a means of enhancing efficiency is not supported by the evidence on the relative performance of private and public enterprises in the United Kingdom. It should be noted, however, that the study did not adjust for differences in the sectoral characteristics of the firms analysed.

Galal et al. (1994) probably represents the most comprehensive study on the impact of privatization on efficiency and state budget. They examined the welfare consequences of privatization in Chile, Malaysia, Mexico and the United Kingdom through a sample of 12 firms covering telecommunications (three firms), airlines (four firms), electricity (two firms), a lottery company, and a port and transport company. The welfare implications

were measured in terms of the impact of divestiture on major economic actors (the government, consumers, buyers of firms and competitors). The study compared the post-divestiture performance of the selected enterprises with what their performance would have been without divestiture. Thus, a counterfactual scenario was created for each enterprise, with the difference between the level of welfare under divestiture and the counterfactual scenario attributed to divestiture. With the exception of Mexico Airlines, divestiture was found to improve world welfare in all the 12 cases. The expected stream of benefits to the society from divestiture was estimated at an annual average of 26%. This was attributed to several factors, including a dramatic increase in investment and improved productivity in 9 of the 12 firms. In all but five cases, consumers were considerably better off or unaffected. This study is deficient on two grounds, however. First, it omits countries typical of Africa, which are characterized by low per capita income, highly distorted markets and relatively weak institutional capabilities. Second, despite the scope and subtlety of the methodology used, the underlying assumptions were highly tenuous, did not relate to the environmental realities and hence incompatible with the policy-oriented nature of the study.

The World Bank (1996) recently conducted a very innovative study on the political economy of state enterprise reform. The study investigated the economic problems that arise when governments own and operate enterprises that could be managed by the private sector and the political obstacles to reforms. It substantially advanced privatization beyond its current micro and macro studies to include meso level phenomena such as laws, regulations and institutions. The 12 countries constituting the sample for the study included Chile, China, the Czech Republic, Egypt, Ghana, India, Mexico, the Philippines and Poland. Others were the Republic of Korea, Senegal and Turkey. The study appraises common obstacles to reform and ways in which some countries have overcome them. It reports a wide range of experience on the basis of which the performance of each country was assessed relative to the criteria established by the study team. At one extreme are Chile, Korea and Mexico with success stories, and at the other are India, Senegal and Turkey with woeful results. The others were adjudged to have recorded mixed results. Ghana was the only marginally acceptable success story in Africa. The report thereby offers guidance for successful SOE reform and suggests ways in which foreign assistance can be harnessed to enhance the success of these reform efforts.

The report is flawed on several grounds, especially from an African perspective. First, the criteria for the inclusion of the countries in the sample were not explained. Second, regardless of the basis for the selection, the problems and issues identified in the sample countries do not adequately reflect the situation in most African economies, in spite of the presence of Egypt, Ghana and Senegal in the sample of countries studied. Apart from the very limited coverage, there are several formidable obstacles confronting privatization in Africa. These include the technically difficult nature of the privatization process, lack of transparency in the conduct of the exercise and absence of well-established capital markets. The generalized analyses and findings do not hold sway as privatization in Africa has been adopted against the background of extremely distressed economic circumstances. It is therefore not surprising that privatization has failed to meet expectations in several countries.

Several cross country and multiple industry studies have also been conducted, beginning with the pioneering study by Megginson et al. (1994). They compared the pre- and post-privatization financial and operating performance of 61 firms that experienced full or partial privatization through public share offerings from 32 industries in 18 countries (6 developing and 12 industrialized) between 1961 and 1990. Several financial indicators were examined, including mean and median level profitability, sales level, operating efficiency, capital investment, leverage (gearing) ratios and dividend pay-out figures. The study documents strong performance improvements undertaken without sacrificing employment security. After privatization most of the firms experienced an upsurge in real sales, profitability, capital investment spending, operating efficiency and labour force. While the study overcame the difficulty of obtaining comparable pre- and post-privatization data for a large, multinational, multi-industry sample of countries, it is unfortunately limited to mostly Organization for Economic Cooperation and Development (OECD) and other developed countries. Moreover, the method of privatization was through the issuing of shares on the local stock exchange (often referred to as an “initial public offering”, or IPO). One could argue that since most of the cases reviewed came from industrialized settings, and that the IPO method is usually applied to high-quality candidates, then the positive findings might not apply in non-industrialized countries, or to firms divested by methods other than share issuing.

In a related study, D’Souza and Megginson (1998) compared the pre- and post-privatization performance of 78 firms from 25 countries privatized through public offering between 1990 and 1994. The sample included 14 firms from banking, 21 in utilities and 10 from telecommunications. The performance indicators are mean and median levels of returns on sales, employment, sales efficiency, capital expenditure/sales and debt/assets. The study represents a marked improvement on the earlier study on two counts. First, it includes samples from 21 developing countries. Second, it also differentiates between competitive and non-competitive sectors. The results are sufficiently robust for proponents of privatization. Profitability increases significantly, although the increase is more in regulated or non-competitive industries, whereas operational efficiency increases less in those cases indicating that a certain degree of market power is being exploited. The study reports that employment increases in all cases and this is inconsistent with the literature.

Boubakri and Cosset (1998) extended the analysis by looking at privatizations conducted in developing countries. They examined transactions in 21 developing countries—mainly middle income, but including Bangladesh, Jamaica, Nigeria, Pakistan and the Philippines. They document that privatized firms, on average, show significant increase in profitability, operating efficiency, capital investment spending, real sales, employment levels and dividends. This study is quite encouraging for proponents of privatization, since it finds positive results in non-industrialized settings, arising from a variety of sales methods. However, the study also documents an important fact: the number and degree of success of privatization are significantly associated with a country’s level of income. The lower the income level of a country, the more difficult it will be to start privatization, and the more likely it will be that results will be modest.

La Porta and López-de-Silanes (1997) analysed the performance of 218 enterprises

in 26 sectors privatized in Mexico between 1982 and 1991 using seven broad indicators, including profitability, operating efficiency, employment, and wages and capital employed. Others were taxes, total output and prices. For each firm, they measured the change in any given indicator of performance by comparing its value in 1993 with its average value of the four years preceding privatization (year  $t-4$  to  $t-1$ ). The study controlled for macroeconomic and industry factors by computing the same indicators for a sample of private firms. It documents remarkable increases in profitability after privatization, underpinned by higher operating efficiency: on average, a 24-percentage-point increase in the ratio of operating income to sales, significant increases in profitability and output, and substantial decreases in unit costs and employment levels (though the blue-collar workers who retained their jobs received large salary increases). The authors attribute 57% of the performance improvement to productivity gains, 30% to laying off workers and 10% to price increases. They also document that deregulation—particularly the removal of trade barriers and price controls—is associated with more rapid convergence to industry performance using regression analysis.

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). Most of the studies on the impact of reform in the telecommunications sector have relied on total factor productivity analysis. Foreman-Peck (1991) appraised the success of the British privatization programme. Specifically the study examined whether the transformation in the telecommunications sector altered or improved performance over that of the previous state regime. Estimates of changes in internal efficiency were obtained by two methods: total factor productivity analysis and econometric simulation. Both approaches 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. The methodology adopted was to analyse in depth the changes that took place before and after privatization between 1985 and 1990. It estimated the overall net benefit to be US\$65.8 billion, with the largest gains accruing to the government and users.

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%). The efficiency gain was fully passed on to telephone users in the form of user rates. The increment of consumers' surplus was estimated at 253.4 billion yen after deregulation.

Recent studies in the telecommunications sector seek to explore the regulatory institutions of different countries using the new institutional economics (Levy and Spiller,

1996; Galal and Nauriyal, 1995). A common feature of these studies is lack of formal statistical testing; rather, they rely on an analytical framework and systematically collected and researched evidence. 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, among others, how each country resolved its regulatory problems and explicates the relationship between regulatory outcomes and performance.

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. Chile was found to be the most successful in resolving the information, incentives and commitment problems through competition, benchmark pricing and embodying the regulation in a law that is difficult to change. On the other hand, the Philippines was the least successful despite over four years of private sector involvement in the telecom sector. Consequently, the sector continues to suffer from under-investment and low productivity. Other countries had mixed results.

The foregoing review suggests the paucity of empirical evidence to gauge the success of state enterprise reform programmes in African economies. The need for more empirical studies in this direction has become apparent in view of the desirability and even the inevitability of SOE reform as a major tool for meaningful and sustainable economic reform. It is necessary to identify the major factors that need to be considered to ensure an appropriate design and to facilitate successful implementation of SOE reform in Africa.

## 4. Methodology

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A microeconomic analytical approach is adopted to assess the impact of deregulation on the telecommunications sector in Nigeria. This choice is predicated on the need to capture, at the firm level, the differential effects of deregulation on telecommunications services. This approach follows to a large extent that of Denny et al. (1981), Nadiri and Schankerman (1981), and Imai (1994).

First, we define total factor productivity (TFP) as the ratio of aggregate output (Q) to aggregate input (F). Aggregate output (input) is an index of disaggregated output (inputs). The Divisia indexes for aggregate output (Q) and input (F) are defined in terms of proportionate rate of growth ( $\dot{Q}$  and  $\dot{F}$ ) as:

$$\dot{Q} = \sum_j \frac{P_j Q_j}{R} \dot{Q}_j, \quad (1)$$

where

- $P_j$  = the price of output  $j$
- $Q_j$  = the quantity of output  $j$
- $\dot{Q}_j$  = the proportionate rate of growth of output  $j$
- $R = \sum_j P_j Q_j$  the total revenue

$$\dot{F} = \sum_i \frac{w_i X_i}{C} \dot{X}_i, \quad (2)$$

where

- $w_i$  = the price of input  $i$
- $X_i$  = the quantity of input  $i$
- $\dot{X}_i$  = the proportionate rate of growth of  $i$
- $C = \sum_i w_i X_i$  the total cost

Since  $TFP = Q/F$ , the proportionate rate of growth of total factor productivity ( $\dot{TFP}$ ) is defined as:

$$\dot{TFP} = \dot{Q} - \dot{F} \quad (3)$$

Equations 1-3 are defined in terms of instantaneous changes. For data obtained at yearly intervals, the most commonly used discrete approximation to the continuous formula (1 and 2) is given by the Tornqvist approximations:

$$\Delta \log Q = \log\left(\frac{Q_t}{Q_{t-1}}\right) = \frac{1}{2} \sum_j (r_{jt} + r_{j,t-1}) \log\left(\frac{Q_{jt}}{Q_{jt-1}}\right) \quad (4)$$

where

$Q_{jt}$  = the quantity of output produced in period  $t$

$$r_{jt} = \frac{P_{jt} Q_{jt}}{\sum_j P_{jt} Q_{jt}} \text{ the revenue share of output } Q_{jt} \text{ in total revenue during period } t; \text{ and}$$

$t$  and  $t-1$  are adjacent observations.

$$\Delta \log F = \log\left(\frac{F_t}{F_{t-1}}\right) = \frac{1}{2} \sum_i (S_{it} + S_{i,t-1}) \log\left(\frac{X_{it}}{X_{i,t-1}}\right) \quad (5)$$

where

$X_{it}$  = the quantity of input  $X_i$  used in period  $t$

$$S_{it} = \frac{w_i X_i}{\sum_i w_i X_i} \text{ the cost share of input } X_i \text{ in the total cost during period } t$$

The corresponding discrete approximation to Equation 3 is provided by

$$\Delta \text{TFP} = \Delta \log Q - \Delta \log F \quad (6)$$

Equation (6) is estimated to provide measures of TFP growth for NITEL.

Conventional total factor productivity measures can only provide evidence of overall increase in aggregate input. Since we intend to separate measures of productivity into a number of effects, we then estimate the production structure of NITEL on the basis of the theory of duality between cost and production functions. The specification of the cost function follows the transcendental logarithmic form with two inputs, capital and non-capital (materials and labour), and a single output, telecommunications service. A time trend beginning in the year deregulation started is included to capture the effect of deregulation on total cost. We anticipate that the coefficient of this variable must be negative, reflecting the improvement in management and operation prompted by competitive pressure.

$$\begin{aligned} \ln C = & a_o + a_T + a_L \ln P_L + a_K \ln P_K + a_Q \ln P_Q + 2 b_{LL} (\ln P_L)^2 + 2 b_{KK} (\ln P_K)^2 \\ & + b_{LK} \ln P_L \ln P_K + 2 b_{QQ} (\ln Q)^2 + b_{LQ} \ln P_L \ln Q + b_{KQ} \ln P_K \ln Q \end{aligned} \quad (7)$$

where

$C$  = total cost

$T$  = time trend beginning in the year deregulation started

$P_k$  = service price rental of capital

$P_L$  = price index of non-capital inputs

Partially differentiating the translog function (7) and using Shepherd's lemma, we obtain the set of cost share equations:

$$S_L = a_L + b_{LL} \ln P_L + b_{Lk} \ln P_k + P_{LQ} \ln Q \quad (8a)$$

$$S_k = a_k + b_{kk} \ln P_k + b_{kL} \ln P_L + b_{kQ} \ln Q \quad (8b)$$

There are several parametric restrictions on the translog function. First, the cost function must be linearly homogenous in factor prices. Also, the Hessian matrix with respect to input prices must be negative and semi-definite since the cost function is quasi-concave in input prices. Thus,  $a_L > 0$  and  $a_k > 0$

$$a_L + a_k = 1 \text{ and } S b_{LQ} = S b_{LL} = 0 \quad (9)$$

Joint estimation of the cost function and share equations enhances the statistical precision of the estimates. We intend to estimate the system of equations comprising the cost function (7) and N-1 of the cost share equations (8), using Zellner's seemingly unrelated regression technique (SURE).

We then decompose TFP growth into its component-output scale effect and the deregulation effect. Denny et al. (1981) developed a method of decomposing TFP using the estimated equations of the translog function.

Hence<sup>7</sup>:

$$TFP = [1 - a_Q] Q - \alpha T + \text{Residual} \quad (10)$$

where TFP is total factor productivity growth,  $a_Q$  is the elasticity of cost with respect to output and  $\alpha T$  is the elasticity of cost with respect to time, both obtained from estimating Equation 7. NITEL's total factor productivity growth for each year will be decomposed into the scale effect, the deregulation effect and the residual, using Equation 10.

## 5. The reforms undertaken in NITEL

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With the acceptance by both developed and developing countries of the inevitable need to restructure the telecommunications sector as a response to the dynamics of improved technology and the increased consumer demands that have characterized the last quarter of the century, various countries adopted reforms ranging from outright privatization to various forms of commercialization. All telecommunications reforms so far involve some degree of change along four directions: (1) commercializing and separating operations from government; (2) increasing the participation of private enterprise; (3) restraining monopolies, diversifying supply of services and developing competition; and (4) shifting government responsibility from ownership and management to policy and regulation (Wellenius and Stern, 1994). It is usually the practice to adopt a mix of these four components.

In spite of the mounting difficulties of the public enterprise sector in Nigeria, pressures for its privatization were not felt until the mid 1980s with the onset of the structural adjustment programme. In the enterprise restructuring and operational efficiency that characterized the privatization drive in Nigeria, the poor performance of NITEL made the organization a target for reform. Between 1988 and 1991, the Technical Committee on Privatization and Commercialization (TCPC) carried out a comprehensive diagnostic appraisal of NITEL's operations and adopted the commercialization option. For enterprises that were considered strategic, including NITEL, commercialization was a more viable option. It was felt that this would increase competition, lead to greater managerial autonomy and improve the incentive structure through the eradication of some of the principal-agent problems. The culmination of the restructuring process was the signing of the performance contract with the federal government and TCPC on 22 May 1992. The performance contract spelled out details of the terms and conditions that govern the relationship between NITEL and its supervising ministry, the obligations of all parties, the removal of areas of conflict and controversy in their relationship, and the enthronement of autonomy. The contract was intended to be in force for an initial three-year period with annual performance reviews. To this end, it infused enhanced accountability and specified the conditions that govern the financial relationship between the government and the management of the public enterprise. The trade-off of the newly won freedom of management without ministerial regulatory controls is the imposition of a hard budget constraint and the attainment of set targets. Under the new dispensation, NITEL was denied access to subsidies, privileges and other forms of soft capital that enabled it to compete without improving efficiency.

The NITEL Corporate Plan 1992–2001, one of the principal documents for the

commercialization exercise, outlined the qualitative and quantitative targets to be achieved by NITEL within the specified period. The performance agreement then laid out the performance measurement criteria for NITEL, with targets for services (telephone, telex, telegraph and specialized services) and revenue clearly spelled out. Service targets included network capacity, market penetration, exchange capacity, traffic volume and service quality; revenue targets focused on collection, generation and profitability. In view of its new stature as a commercial enterprise with a new capital structure, NITEL has an obligation to attain the minimum targets with internally generated revenue, funds raised from local and international capital markets, and multilateral institutions with or without government guarantee. NITEL was expected not only to engage in competition in a deregulated market environment but also to fix its prices and charges to enable it to earn profits. With these profits, it was expected to finance the necessary investments.

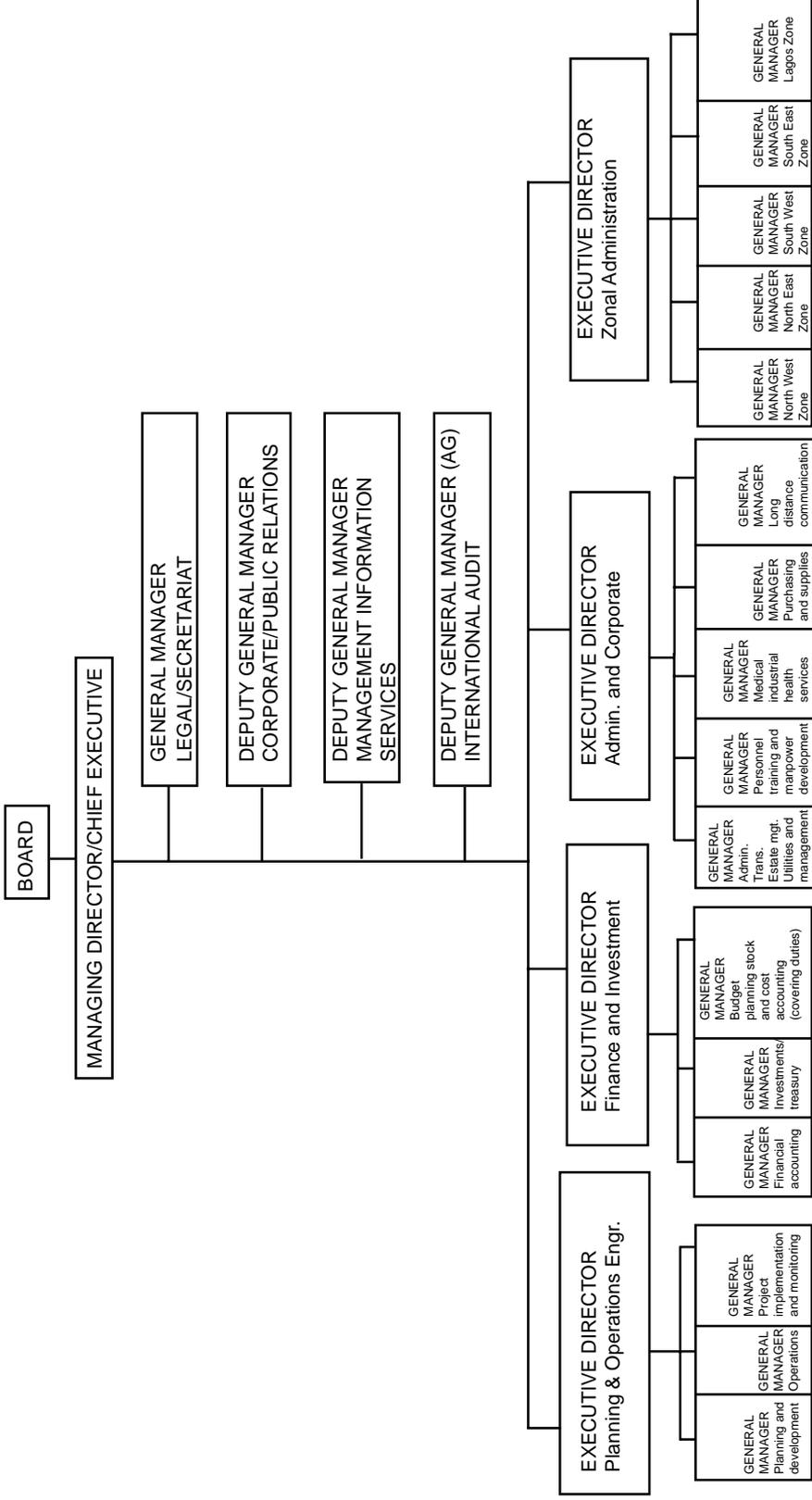
An integral component of operational autonomy from ministerial interference is the debureaucratization of NITEL. Ministerial circulars relating to conditions of service and other operational matters no longer applied to staff of NITEL. The role of government and management was redefined. The government retained the right to appoint and remove directors in accordance with the statutory right of shareholders and to appoint the chief executive on the recommendation of the board of directors. The supervising ministry, on the other hand, retained the right to nominate candidates for appointment of non-executive directors. The term of office of chief executives was fixed for an initial period of four years renewable for a second and final term of three years. In addition, the roles of the board of directors were streamlined and properly defined. More importantly, commercialization was quickly followed by deregulation, which put an end to state-owned NITEL's monopoly of the sector and ushered in the era of greater competition. NITEL thus had to restructure to meet not only with the obligations of commercialization but also the dictates of deregulation and competition.

NITEL responded to the competitive environment by articulating a strategic plan aimed at ensuring growth and retaining a greater market share. The company was re-registered as a public limited company (Plc) under the Companies and Allied Matters Decree of 1990 with a completely new capital structure of fully paid 55 million ordinary shares of ₦100 each, giving an equity base of ₦5.5 billion and a new gearing ratio of 3:2. The company's stature as a fully commercialized enterprise invariably meant greater expectation from government, customers and the general public. Consequently, another organizational structure was considered necessary in order to meet these expectations (Nwafor, 1997). The new organizational structure, approved by the Board and implemented in July 1992,<sup>8</sup> addressed most of the problems of the structure designed by British Telecommunications Consultants (British Telecoms International) in 1985 and adopted in 1986.<sup>9</sup> The new organization structure is presented in Figure 2. At the apex of the structure is the managing director/chief executive, assisted by four executive directors, responsible for planning all operations, finance and investments, administration and corporate, and zonal administration.

The commercialization of NITEL has not proceeded very far. NITEL still operates like the civil service, with functions organized within hierarchical and poorly coordinated departments and service provision organized along geographical lines corresponding to administrative regions in the country.

The autonomy and provision of the contractual agreements entered into by NITEL at commercialization have turned out to be on paper only. Government interference, policy inconsistencies as well as the rapid turnover of ministers and MDs/CEOs, and the resultant frequent changes in policy directives are responsible for the failure to uphold, enforce and when required defend NITEL's autonomy and the provisions of the performance agreement.

**Figure 2: Post-commercialization organization structure of NITEL**



Source: Nigerian Telecommunications (NITEL).

## 6. NITEL's performance since deregulation

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There are several motives for reforming public sector enterprises, prominent among them being the widespread dissatisfaction with the performance of SOEs. Many of the normative rationales for establishing SOEs have become less convincing to policy makers, while patience with SOEs has worn thin in recent years especially in view of their unsatisfactory operational and financial performance. State enterprise reform finds its strongest argument in the claims that it will improve both allocative and productive efficiency, and reduce the budgetary burden. It is being advocated primarily as a means of improving the performance of the public sector (Cook and Kirkpatrick, 1988), but is also expected to lessen the scope for political interference in the operation of reformed enterprises. In this section, we appraise the extent to which NITEL has met these expectations.

### Profitability

Against the background of resource-limited conditions of the 1980s and 1990s, and an environment undergoing rapid and dramatic political and socioeconomic changes and upheaval worsened by external pressures, NITEL accomplished a most impressive and extraordinary performance after the deregulation of telecommunications services in Nigeria. The commercialization of NITEL in May 1992 indeed ushered the company into a select group of high revenue generating enterprises in Nigeria. After its commercialization, the company's generated revenue increased by 300% at the end of 1992, and by 400% by May 1993. The net result was a steep climb in traffic revenue, which increased from ₦3.124 billion in 1991 to ₦6.367 billion in 1992 and ₦9.885 billion in 1993. Corresponding figures for 1994 and 1995 are ₦10.074 and ₦16.886 billion, respectively, as shown in Table 2. NITEL recorded a profit in 1992 for the first time since it formally started operations in 1985. There was a dramatic jump from a loss of ₦0.154 billion (₦0.49 billion) in 1991 to a profit after tax of ₦0.680 billion (₦0.164 billion) in 1992 in nominal and real terms, respectively, an increase of 540% (120%) over the 1991 figure. Profit after tax peaked at ₦3.007 billion (₦496 billion) in 1993, nose-dived to ₦0.722.06 billion (₦0.066 billion) in 1994 and then increased moderately to ₦1.274 billion (₦0.064 billion) in 1995 as indicated in Table 2 and Figure 3. The bulk of the profits generated in NITEL could be attributed to price increases. Juxtaposing the profitability trend with episodes of price increases as presented in Appendix Table A1, indicates that NITEL recorded tremendous profits in the years' prices, especially for international telephone (1991, 1993 and 1995)

A clear distinction needs to be made between financial profitability and economic efficiency.<sup>10</sup> An enterprise may increase its profits in a number of ways that are not based on increase in efficiency and that may in fact mask a decline in efficiency.

The fiscal implication has also been positive as a result of reduction in the need for operating subsidies and investment capital. In fact, NITEL has become an important contributor to the national treasury through annual tax flows.

Apart from the high level of revenue generated, other financial indicators also recorded tremendous growth. For example, total fixed assets increased from ₦5,525 billion in 1992 to ₦9.235 billion in 1993, while earnings per share rose from 1.236k to 5.468k during the same period. Abdulkadir (1996) attributed this favourable development to improved connectivity and call completion rates, which gave rise to increased revenue generation and collection.

**Table 2: Profitability indicators for NITEL (1985–1995)**

Year	Total traffic revenue	% increase	Total revenue ₦ million	% increase	Profit after tax ₦ million (nominal)	% increase	Profit after tax ₦ million (real) 1985=100	% increase
1985	268.55	-	279.6	-	-429.67	-	-429.67	-
1986	266.68	-0.70	273.6	-2.16	-1,427.13	-232.14	-1,047.05	58.96
1987	369.82	38.68	408.5	49.31	-942.07	33.99	-406.63	-98.35
1988	664.83	79.77	766.8	87.79	-586.37	37.75	-406.63	-29.82
1989	998.83	50.24	1,134.5	47.95	-1,615.27	-175.43	-715.67	43.18
1990	2,214.86	121.75	2,430.6	114.24	-1,799.85	-11.43	-720.22	0.63
1991	3,124.23	41.07	3,295.5	35.58	-154.38	91.42	-49.04	-1,368.66
1992	6,367.28	103.80	6,868.6	108.42	679.68	540.26	163.70	129.96
1993	9,885.13	55.25	10,130.2	47.49	3,007.25	392.95	496.00	67.00
1994	10,073.64	1.90	10,409.2	2.75	722.06	-75.99	66.62	-644.52
1995	16,885.94	67.63	17,378.4	66.95	1,274.27	76.48	64.10	-3.93

Notes: 1995 figures are from NITEL's unaudited accounts for 1995.

Source: Author's calculation is from NITEL's audited accounts.

Analogous to increased profitability is the increased funding of NITEL's projects with revenue generated from operations. In a bid to tackle the problems of ageing equipment, largely analogue facilities, and the attendant unreliable characteristics such as delayed dialling tone, low call completion rates, billing and reconciliation problems, and inadequate network facilities, NITEL has invested over ₦100 billion of internally generated revenue on several projects mainly in the area of switching, external line plant, long distance communications and civil construction since 1992.

## Pricing

Nevertheless, there has been a continuing upward review of tariffs since commercialization. Prior to commercialization, NITEL's tariffs were very low and did not reflect the cost of doing business. They had remained stagnant since 1972, changing only in February 1988 when international calls were revised upward by 600%. In 1989,

**Figure 3: Profitability of indicators for NITEL (1985–1995)**

however, NITEL submitted a proposal for tariff increases: 100% for installation charges, 300% for rental charges and 200% for call charges. These rates were approved and became effective in 1990. In the same year, the domestic telephone rate (pulse unit) was increased from 10k to 90k. These tariffs neither covered cost nor reflected economic realities, including the high inflationary trend and depreciation of the naira. Since commercialization, domestic telephone rates have been reviewed upward twice (1992 and 1996) and international telephone rates four times (1992, 1993, 1995 and 1996), as shown in Appendix Table A1. This trend is not significantly different from what it obtains in the telecommunications sectors of other developing countries where tariffs are usually adjusted for inflation. For example, while tariffs are reviewed less frequently in Chile (five years) and Mexico (four years), reviews in Argentina are semi-annual and in Venezuela quarterly (Galal and Nauriyal, 1995). Frequent revisions of tariffs are costly to manage while at the same time creating disincentives by preventing the firm from reaping interim benefits from cost savings. NITEL, however, currently operates a pricing scheme based on cost recovery.<sup>11</sup> There is a growing recognition that this traditional analysis of historical accounting costs does not reflect current resource choices. This variant of rate of returns regulation<sup>12</sup> leads to a number of inefficiencies, including a bias towards capital investment and higher than optimal capital/labour ratios. Furthermore, it induces firms to inflate costs, invest excessively and engage in cross subsidization by shifting costs from unregulated to regulated services (Galal and Nauriyal, 1995).

## Expansion and modernization

With commercialization, NITEL set ambitious and challenging expansion and modernization targets with a view to introducing an extensive range of state-of-the-art technologies and diversified value-added services comparable to what is obtainable in countries with the most advanced telecommunications systems. The national network expansion and modernization was primarily aimed at satisfying telecommunications service requirements in Nigeria, while the network digitalization was designed to achieve service diversification as well as enhance service delivery.

In 1992, a total of 149,484 digital lines in 22,222 national and 10,000 international trunks were added to the telephone network. The additional facilities increased the country's telephone capacity from 450,516 lines in 1991 to 600,000 lines in 1992, an increase of 33.3%. The performance in 1992 maintained the rising trend with 180,000 new digital lines installed to increase the network capacity to 780,000 lines in 1993. The cumulative effects of these developments were the introduction of digital facilities in Abuja (20,000 lines), Lagos (45,000 lines), Kaduna (10,000 lines), Minna (5,000 lines) and Ibadan (25,000 lines), among others. Expansion work is proceeding in various locations including Jos (20,000 lines), Bauchi (10,000 lines) and Maiduguri (5,000 lines). NITEL also extended its services to several rural communities with the installation of digital exchanges or the use of cellular phone technology.

**Table 3: Growth in installed lines capacity and connected lines**

Year	1985	1986	1987	1988	1989	1990	1991	1992	1993
Installed capacity	295,370	308,350	335,698	360,518	385,788	404,400	450,516	600,000	780,000
Connected	194,499	215,255	232,582	256,743	281,419	294,075	294,166	320,934	342,278

Source: Nigerian Telecommunications.

In the course of modernization, NITEL also introduced sophisticated new customer-located products to augment the basic telephone. It introduced modern mobile cellular telephony in 1992 through a joint venture agreement signed with Digital Telecommunications of the United States of America in June 1992 to provide cellular mobile radio services and manufacture terminal equipment and other accessories. The new company, known as Mobile Telecommunications Services (MTS), commenced operations in October 1992 providing 10,000 cellular mobile telephone lines—which were instantly oversubscribed. NITEL has also established private networks using the INTELSAT and INMARSAT, and the computer oriented switch for international transfer (COSIT) for electronic mail. Other services provided in the modernization programme include associated value added services like trunked radio, 15,000 voice mail lines and paging system with an initial 100,000 pagers, multi-communications media services like teleconferencing and packet switching, video and cardphones, videotext, voice phone, cable television, and data network services.

**Figure 4: Installed capacity and connected lines for NITEL (1985–1993)**

## Quality of service

Expansion and modernization have been accompanied by an appreciable improvement in the quality of service. Remarkable increases in the number of lines and trunks, and the application of digital and fibre optic technologies, resulted in overall improvement in service quality as indicated in Table 4, which presents the major service indicators between 1991 and 1995.

Despite these claims, available evidence, although fragmentary, indicates that the quality of NITEL's services must still improve considerably. In a survey conducted by the Foundation for Economic Education (1996) to determine the effectiveness of and pricing in public utilities in Nigeria, one-quarter of respondents rated NITEL services as "poor", less than half as "fair", and one-fifth as "good". Most subscribers complained of congestion and slow dialling tone, which are symptomatic of low telephone density. The contradiction arising from the remarkable achievements in network expansion and modernization vis-a-vis the persistence of low call completion rates, poor dial tone reception and other indicators of poor quality service<sup>13</sup> have been attributed to severe shortages of lines (Nwafor, 1997). The problem of inadequate network facilities for the provision of services is a major weakness of NITEL. This makes it impossible for the company to satisfy customer demands, thus resulting in the existence of large numbers waiting for services. The telephone density remains critically low at 0.3 lines per 100 inhabitants. The gap between current supply of approximately 666,016 lines, which is

less than 0.6 penetration rate, and the demand for telecommunications services is enormous and continues to widen. Where the services are available, the quality hardly meets the expectations of customers. This has resulted in individuals and corporate bodies exploring the use of private networks that are relatively independent of the public network. Although there is currently no facility-based competition in public switched services, some multinational corporations are already by-passing the national carrier to take advantage of lower costs.

**Table 4: Comparison of the major service quality indicators (1991–1995)**

Service quality indicator	1991	1992	1993	1994	1995
% call completion rate					
- International (outgoing)	50.97	63.45	43.40	57.77	55.25
- International (incoming)	20.54	24.66	26.88	33.30	51.28
- National	49.35	51.74	57.45	51.88	49.50
- Local	65.60	67.44	59.81	60.58	70.08
Dial tone - % within 3 sec.	83.81	80.16	90.10	88.90	87.70
Average no. of days to provide service (TAF 1)	50.57	13.86	14.13	12.37	21.68
Average no. of days from metering to billing production	21.88	19.98	32.14	25.48	15.72
% of faults cleared					
- within 24 hours	25.33	30.54	33.37	33.97	30.87
- within 7 days	56.89	56.14	60.02	56.11	55.07
- within 10 days	70.98	70.31	66.64	64.19	61.98
- within 30 days	77.12	82.49	72.79	74.21	70.40
Total staff/1000 DEL	36.60	37.74	32.82	26.42	24.88
Exchange utilization (National)	72.69	69.63	66.82	67.77	70.19
Telephone density - DEL/100				0.15	0.19

Note: DEL = Direct exchange line, TAF = Telephone application form.

Source: Nigerian Telecommunications.

## 7. The empirical evidence

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This section presents the assessment of the empirical effects of deregulation of telecommunications services on NITEL. The estimates in internal efficiency are obtained by productivity analysis. First, we examine changes in productive efficiency by estimating total factor productivity growth in NITEL.

### Productivity measurement

The productivity measures are calculated from weighted indexes for the quantities of eight outputs, and corresponding quantities of the various inputs used in production. Specifically, these are a capital input index, material input index and labour input. The data construction method is presented in Appendix B.

Table 5 and Figure 5 present the index of output, input and total factor productivity. The aggregate output index posted an average growth rate of 3.46% over the period, with the highest figure recorded in 1991. The post-reform average of 2.8 was lower than the 3.99% attained in the pre-reform era, but the growth rate of aggregate input was considerably lower. The aggregate rate was 0.85 on average, declining from 2.08 in the

**Table 5: Total factor productivity growth in NITEL (1987–1995)**

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Year	Aggregate output index (Q)	Aggregate input index (I)	Total factor productivity index (TFP)
1987	2.69	10.77	(8.08)
1988	(2.09)	6.94	(9.04)
1989	(6.42)	10.39	3.97
1990	(4.00)	(2.90)	(1.10)
1991	29.76	5.97	23.79
1992	2.75	1.41	1.34
1993	6.70	(1.39)	8.09
1994	3.77	(4.23)	7.99
1995	(2.02)	1.47	(3.49)
Average	3.46	0.85	2.61
Post-reform average	2.80	(0.68)	3.48
Pre-reform average	3.99	2.08	1.91

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Figures in parentheses indicate negative numbers.

Source: Author's calculations.

pre-reform era to -0.68 in the post-reform period. One can infer that there is a positive contribution to growth as a result of increased output share. The company was able to increase the quantity of output more than the corresponding increase in the quantity of inputs, including wages, factor rentals and intermediate inputs. The disproportionate increase in output can also be attributed to a significant increase in fixed capital formation.

The productivity index is also presented in Table 5. As indicated in the table, there is substantial variation in productivity growth across periods. Prior to reform, NITEL recorded negative increases in productivity growth except in 1989 and 1991, when productivity gains of 3.97% and 23.79%, respectively, were recorded. In the wake of commercialization and the deregulation of telecommunications services in 1992, productivity increases have been considerable, with an annual average of 3.48%. The index was positive for all the years except 1995, when a growth rate of -3.49% was recorded, indicating substantial gains in productive efficiency.<sup>14</sup> The most significant improvement in productivity was recorded in 1991, however, the year preceding reforms. This observation is consistent with the findings of Bishop and Kay (1989) that British monopoly industries recorded the most significant improvements prior to reforms. A plausible explanation for this accomplishment is the threat of competition. The reforms initiated began to exert their toll on NITEL in 1991 as most staffers started to mend their ways in the fear that the enterprise would be privatized, thus resulting in loss of jobs. The high productivity performance recorded since 1992 can be attributed to the fact that NITEL was essentially a badly managed organization prior to commercialization. The revenue earning capacity was heavily undermined by poor quality of service due to poor maintenance of the network as a result of lack of parts and proper maintenance systems and procedures, both of which resulted in low revenue traffic. Other constraints to revenue generation were high billing inefficiencies and poor collection, high operating costs, staff inefficiencies, and high staff ratios.

In the key area of international traffic, only an estimated percentage of the traffic was billed due to technical and other reasons, prominent among which is fraudulent activities by NITEL staff. The conditions for reform in these vital areas, which were intended to put the company on a high revenue-generating track, were promoted by commercialization. Productivity improvement can also be attributed to technological change through digitalization and improved management and operations prompted by competitive pressure. There were substantial improvements in economic benefits flowing from the rapid introduction of commercial management with the ability to respond more effectively to the demand for services and better use of available resources. By 1995, however, the commercialization pressure had gone down considerably. The productivity decline experienced in recent years can be attributed to slack. There is lack of innovation as long as NITEL is deemed to be performing satisfactorily. Of late NITEL has developed a crusty rigidity and complacency, indicating that the reforms undertaken have not been sustained.

**Figure 5: Total factor productivity for NITEL (1987–1995)**

## Decomposition of productivity growth

Measured productivity growth will usually reflect a combination of causal factors. These are likely to include scale effects, technological change and short-term disequilibria that may affect productive efficiency.

Using Equation 10, we decompose TFP into the output scale effect, the deregulation effect and the residual. Since the specified production function could not be estimated because of data constraints, we experimented with the required coefficients from similar studies and performed sensitivity analyses. Following Imai (1994), instead of decomposing TFP directly, we decompose the fall in NITEL's unit cost.

The unit cost index is by definition the reciprocal of the total factor productivity index. The estimated coefficients from Imai (1994), i.e.,  $\alpha_T = -0.20$  and  $\alpha_Q = 0.475$ , indicate increasing returns to scale. NITEL attained a 23.1% reduction in unit cost between 1992 and 1995.

The results of the decomposition of the fall in unit costs are presented in Table 6. Of the 23.1% decline in unit cost as part of commercialization and deregulation, 19.6% and 6% are attributable to the expansion of output and to deregulation, respectively. We conducted some simulations with different parameter values and some of the results are presented in Table 6. For example, assuming that  $\alpha_T = 0.1$  since NITEL is relatively more inefficient, the unit cost declined by 11.4%, of which 9.6% and 2.0% are attributable to output scale effect and deregulation, respectively, as shown in Table 6. On the other hand, assuming  $\alpha_T = 0.7$ , the unit cost declines by 28.4%, of which 21.3% is attributable to scale effect and 6.9% to deregulation effect.

**Table 6: Decomposition of the fall in unit cost and simulation results**

	Value of $\alpha T$	Unit cost index	Output scale effect	Deregulation effect	Residual
1992–1995	0.2	(23.1)	(19.7)	(6)	0.4
1992–1995	0.1	(11)	(9.6)	(2.0)	0
1992–1995	0.7	(28.4)	(21.3)	(6.9)	0.2

Source: Author's computation.

Our analysis indicates that scale effect has been the major dominant factor explaining observed productivity growth in NITEL. Since commercialization in 1992, NITEL has invested heavily and made a modest difference in the quantity and quality of service. Modernization of equipment and introduction of new technology, which enabled the firm to realize substantial economies of scale, accompanied expansion. Some of the trunk cables are now made of fibre optic technology, which offers an almost unlimited bandwidth. Some manual exchanges have been digitalized and replaced by semiautomatic and automatic switches. Reputable companies including Siemens provided the new technology.

There is weak evidence for deregulation since the net effect of deregulation on productivity growth is found to be minimal. This finding, however, underscores the true impact of deregulation since part of the scale effect is due to deregulation. Corresponding output increase may have been an adaptive response to a new competitive environment. This conclusion is tentative, however, since we lack direct evidence on NITEL.

## 8. Conclusions

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Initial attempts to reform the telecommunications sector in Nigeria have brought encouraging results. The reforms yielded increased profitability, and greater productivity. Network expansion and modernization was reflected in the expansion of the telecommunications system and availability of new services. Notwithstanding these achievements, the sustainability of the improvements is in doubt as there are indications that the reform undertaken in 1992 has lost momentum and there is real danger of policy reversal. These can be inferred from the non-renewal of the performance contract, which was due for revision and renewal in 1995, and the unabated ministerial interference in the affairs of NITEL.

In spite of the results of modernization and expansion in the wake of commercialization, it is becoming increasingly clear that NITEL is incapable of meeting the needs of all users. There is growing consensus that only competition and private participation will ensure lasting improvements. The industry is still characterized by under-investment and large unmet demand, not only for basic services but also for specialized services needed by modern businesses to compete more effectively. Established and suppressed demands currently stand at about 3 million telephone lines and 200,000 cellular lines. An estimated US\$4 billion in investment funds will be required to meet these demands, while the waiting time for telephone connection is 3.5 years. This situation reveals the vast potentials in the industry and calls for greater private sector participation in the delivery of telecommunications services in Nigeria. Given the slow pace of internal reform in NITEL, there is need to strengthen the reform efforts by moving down the continuum to embrace outright privatization of NITEL. With the bidding for a second provider of niche services almost at hand, NITEL is in no good stead at the moment to compete in a deregulated industry. The second national carrier would drive NITEL out of business and create another virtual monopoly situation. To prepare the company for the impending dispensation, the government may consider allowing international telecommunications firms to buy into the company.<sup>15</sup> This will create new opportunities as well as pressure to overcome protracted constraints on telecommunications performance and growth.

The decision to license a second national carrier to provide local, long distance and international services is commendable. Competition in facilities will help to prod the dominant carrier into being more responsive to users' needs. The presence of a facility based carrier as a competitive alternative may also promote rate realignment and a more rapid adjustment of the policies of the dominant carrier to the new environment. Allowing new enterprises to supply services and networks can attract new sources of capital and

management to the telecommunications sector, prompting rivalry among service providers in performance and prices. The success of deregulation can only be measured in terms of falling rates and improved service availability.

The issue of regulation and competition must be addressed with a view to attracting private participation and investment in telecommunications. Tardiness in undertaking regulatory change can have a negative effect on the economy through slow diffusion of new technologies and services, economic inefficiency, and retarded employment growth opportunities. In an environment characterized by scarcity of information, an established culture of ministerial interference, and political instability accompanying high turnover of policies and policy makers, the regulatory authority must strive to take full control of all operational issues: pricing, interconnectivity, service obligations and procedures for settling disputes. The institutional framework must also change in tandem with reforms—notably with regard to property rights, enforcement of contracts and adjudication of disputes. Given these changes, policy emphasis should now be more on strengthening the regulatory and institutional framework.

Because of the monopolistic market structure in which NITEL operates, there is need to review the pricing formula currently in place with a view to granting the firm a fair rate of return while at the same time preventing consumer exploitation. A more appropriate approach will be to set prices on the basis of incremental costs of expanding output in order to maximize economic efficiency, taking into consideration the emerging potential for competitive supply. The literature is replete with guidelines for appropriate price adjustments by reformed enterprises without exploiting clients. Price regulation in the telecommunications sector has been accomplished in several ways. The most predominant are the rate of return regulation, price cap and benchmark pricing. Under rate of return regulation, prices are set so that the firm can recover its costs and make a fair rate of return on investment. Firms are in principle allowed to set their prices, subject to the overall return constraint so that prices for different services reflect the different cost of providing these services. The regulators are expected to monitor the firm's revenue, costs and capital stock to ensure that the firm remains within the imposed rate of return ceiling, an administratively sophisticated and burdensome task. The price cap system, also known as RPI-X regulation (retail price index minus an adjustable X factor), as adopted by the United Kingdom and Mexico, imposes a ceiling on the average tariff increase for a pre-specified basket of services in which the firm has a monopoly. Since RPI-X targets an umbrella of prices rather than the rate of return, the firm has an incentive to pursue both efficiency and static gains. Finally, under benchmark regulation (e.g., Chile), tariffs are set with reference to some yardstick other than actual cost. The yardstick could be the incremental costs of an efficient firm, or the cost of a similar firm. It shares some of the advantages of the RPI-X formula. Since the firm's price is set against that of an ideal firm, it can retain as profit all cost savings realized from superior performance, and it bears all the cost of inferior performance. However, it is quite demanding in the sense that the regulators are expected to be experts, and disputes can arise over the definition of an ideal firm. In spite of these limitations, the Chilean model is perhaps the most appropriate for Nigeria since it has a tendency to induce expansion in situations characterized by excess demand.

There is considerable scope for improving Nigeria's telecommunications infrastructure by adopting the wireless mobile network, which is already witnessing unprecedented growth in Africa as a result of competition buoyed by private ownerships and foreign investors, lower installation costs, and prepaid cards. The number of cellular subscribers has already surpassed conventional fixed lines in several economies, as shown in Table A2 in Appendix A. Uganda, for example, tripled its telephone network between 1995 and 1999, from 0.21 telephone subscribers per 100 people to 0.67. More than 50% of Uganda's population is now covered by mobile telecommunications and about 40 towns have been connected. Finally, the disparate rationales for reform are only justified if reforming enterprises, albeit regulated, are insulated from arbitrary government intervention. The government must confine itself to limited and predetermined regulatory mechanisms free from interference. To curb such ad hoc interventions, there is need for a definite and well-understood assignment of responsibilities between the sector minister and regulatory authorities.

## Notes

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1. Between 1980 and 1985, Nigeria's federal government invested ₦23.26 billion in public sector enterprises comprising ₦11.43 billion equity investment, ₦10.43 billion direct loans and ₦1.4 billion guaranteed loans in local currency. At the same time, subvention amounted to ₦11.6 billion while guaranteed loans in foreign currency were DM 2.1 billion, DEL 8.9 million and US\$16.2 million. Against the huge expenditure above, the federal government received a return on investment of only ₦933.7 million and from subventions a repayment of only ₦67.96 million, with ₦25 million as interest. Overall, returns on investment of over ₦23 billion was a paltry 3%, made up mainly of dividends from the banking and oil sectors. The government was thus not receiving a fair return on investment outlay.
2. Prior to the adoption of privatization as a major plank of adjustment in Nigeria, two previous presidential commissions were instituted to rationalize the operations of public sector enterprises. These were the Onosode commission instituted in 1981 and the Al-Hakim committee in 1984. The recommendations of these commissions were never implemented.
3. The influential World Bank publication, *Bureaucrats in Business*, reported that performance contracts were in use in 28 developing countries, largely in Asia and Africa in the mid 1990s, although most of these contracts had little positive impact (World Bank, 1996: Chapter 3)
4. These countries are Congo, Côte d'Ivoire, Ghana, Guinea, South Africa and Uganda.
5. The reasons evoked to justify state intervention in telecommunications no longer exist. Some of the recent developments obviating the justification for existence of large monopolies are technological advances that have reduced sunk costs and therefore economies of scale and barriers to entry, the contestability of some segments of this sector, and lessons from successful privatization in several countries.
6. Some of the firms bracing for the challenges of deregulation are NITTI Company Ltd. (NCL), Wireless Telecoms Limited (WTL), Intercellular (Nig) Limited, EMIS (Nig) Ltd., United Telesys Nigeria (Ltd.), Starcoms (Nig) Ltd., and GPT Payphones

among others. NITTI Company is reputed to have awarded a contract to British Telecoms (BT) to supply 1 million telephone lines to Nigeria. Under this arrangement, BT will build and operate the fixed line network for a period of five years.

Wireless Telecoms is working in collaboration with Dumor Telecoms Limited of Dublin, Ireland, wholly owned by Motorola International, to introduce the digital handy phone cellular schedule for April. WTL recently placed an offer for 5 million ordinary shares to raise ₦50 million. The 5 million ordinary shares offered at ₦70 each are being brokered by International Merchant Bank, ICON Stockbrokers Limited, and Security Transaction and Trust Company Limited. Intercellular recently concluded a ₦540 million arrangement with Motorola to facilitate the first phase of the supply of a digital switching system to supply about 10,000 subscriber lines. It already has an equity base of ₦300 million and has secured a supplier credit of US\$3.5 million.

7. See Imai (1994) for the formal derivation of Equation 10.
8. The new structure was put together after consultations with several professional bodies including the Nigeria Society of Engineers (NSE) and the Council of Registered Engineers (COREN). Seasoned technocrats, scientists and academics also served on committees for reorganization and commercialization of NITEL and participated in preparing the structure.
9. Between 1985 and 1992, the organizational structure of NITEL was changed four times. The implementation of the first reorganization exercise put up by British Telecoms following the merger in 1985 proved particularly difficult because it called for a drastic reduction of the large number of staff inherited by NITEL from P&T and NET.
10. One may wish to determine the extent of inefficiency in NITEL using either stochastic frontiers or data envelope analysis (DEA). For methodological details, see Coelli (1995).
11. Tariffs are determined on the following basis:
  - (a) Access charge: This is the cost charged to a customer for taking up a line. It is a fixed charge built into the monthly bills of every customer irrespective of the use of the line.
  - (b) Capital costs: This consists of such items as cost of external line plant (ELP), switching costs, transmission costs, and cost of fixtures and fittings, all of which are amortized over a period of time to obtain the charges to be made in the accounting period.
  - (c) Variable costs: This consists of such costs as salaries and wages, sundry expenses, etc.

These costs are computed for each accounting period. The addition of these cost components yields total cost. The total cost plus a mark-up margin (15–20%, depending on the prevailing interest rate) is then divided by the total number of lines in the system to obtain unit costs/pulse rate (in naira). The pulse rate is then charged per minute of use and is also distance dependent, i.e., the farther the distance, the higher the pulse rate. These charges or tariffs are subject to approval by the Utilities Charges Commission.

12. Prices can be regulated using rate of returns regulation, price cap regulation or benchmark regulation. Each of these pricing schemes has its own incentive properties. See Galal and Nauriyal (1995) for details.
13. It may be desirable to conduct a nationwide survey to determine several indicators of service quality, such as: the time it takes for a line to be connected, average clearance time for reported faults, proportion of bills that are recovered early, how bills are transmitted, corruption among staff, and incidence of wrongly computed bills, among others.
14. Our productivity measurements must be interpreted with caution, however. Denny et al. (1981) have pointed out the bias in TFP measures for regulated industries with economies of scale.
15. *The Guardian* editorial of Tuesday, 3 September 1997 suggested a spin-off of NITEL's operations into independent regional baby-tels. Telecommunications is not perfectly contestable; moreover, such a step is uncommon in the sector. The only example is the United States, where the regional Bell operating companies created through divestiture will be permitted to compete in the provision of long distance services with AT&T. This proposal is also not very attractive because large operators are the most sought-after partners for consortia and the supply of foreign capital and expertise. Apart from the potential loss of scale economies, transaction costs will increase since each component organization would have to negotiate interconnection agreements.

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# Appendix A: Supplementary tables

Table A1: Price(s) of product from 1984-1997

Service	1985	1988	1990	1992	1993	1994	1995	1996
	N	N	N	N	N	N	N	N
Domestic telephone (pulse unit)	0.10	0.10	0.90 (1/2/90)	1.40 (1/8/92)	1.40	1.40	1.40	1.80 (1/1/96)
DEL installation per line	100.0	500.0	500.00	1,890.00	1,890.00	1,890.00	1,890.00	1,890.00
Rural DEL	50.00	250.00	250.00	1,890.00	1,890.00	1,890.00	1,890.00	1,890.00
External extension rural DEL	100.00	500.00	-	-	-	-	-	-
Internal extension	30.00	97.50	250.00	250.00	250.00	250.00	250.00	250.00
Private wire per Km per annum	200.00	1,000.00	700.00	700.00	700.00	700.00	950.00	950.00
TP access/annum/line								
- Private	60.00	60.00	240.00	600.00	600.00			
- Business	120.00	120.00	600.00	1,200.00	1,200.00			
International telephone (per min)								
Zone:								
America	4.00	25.00(1/2/85)	25.00	62.00(1/8/92)	75.00(1/4/93)	75.00	170.00(1/8/95)	220.00(1/1/96)
Asia & Oceania	3.60	25.00	25.00	62.00	75.00	75.00	220.00	280.00
Europe	3.00	22.00	22.00	60.00	60.00	60.00	170.00	220.00
Africa	2.50	16.00	16.00	53.00	62.00	62.00	120.00	150.00
Telex installation per line	300.00	500.00	500.00	1,890.00	1,890.00	1,890.00	1,890.00	1,890.00
Telex rental (per month)	170.00	170.00	170.00	170.00	170.00	170.00	170.00	170.00
Domestic telex (per min)	0.05	0.05	0.90	1.40	1.40	1.40	1.40	1.90
International telex (per min)								
Zone:								
America	4.00	20.00	20.00	57.00	67.00	67.00	160.00	220.00
Asia & Oceania	3.50	20.00	20.00	57.00	67.00	67.00	210.00	280.00
Europe	3.00	20.00	20.00	52.00	60.00	60.00	160.00	220.00
Africa	2.50	15.00	15.00	49.00	57.00	57.00	110.00	150.00
Domestic telegraph								
Ordinary TG per word	0.30	0.30	0.30	0.25	0.35	0.35	0.35	0.50
Urgent telegram per word	0.06	0.06	0.06	0.50	0.60	0.60	0.60	1.00
Greeting TG per message	0.50	0.60	0.60	0.50	0.50	0.50	0.60	0.50
Press TG per 50words	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.50

continued.....

**Table A1: continued**

Service	1985	1988	1990	1992	1993	1994	1995	1996
<u>International telegraph</u>								
Zone:	N	N	N	N	N	N	N	N
America	0.64	1.62	5.00	10.00	13.00	13.00	13.00	20.00
Asia & Oceania	0.40	1.26	5.00	10.00	13.00	13.00	13.00	20.00
Europe	0.36	1.10	5.00	10.00	13.00	13.00	13.00	20.00
Africa	0.42	1.62	5.00	10.00	13.00	13.00	13.00	20.00
Fascimile (per page) international								
Zone:								
America	7.50	50.00	60.00	60.00	60.00	60.00	170.00	220.00
Asia & Oceania	10.50	60.00	60.00	60.00	60.00	60.00	220.00	280.00
Europe	-	60.00	60.00	50.00	50.00	50.00	120.00	150.00
Africa	9.50	60.00	60.00	50.00	60.00	60.00	170.00	220.00
International telecast								
Video/audio/voice	645.00	4,095.00	4,095.00	4,095.00	4,095.00	4,095.00	4,095.00	4,095.00
- Coordination (first 10 min)								
- Terrestrial segment	33.00	220.00	220.00	220.00	220.00	220.00	220.00	220.00
- Video/audio (1st 10 min)								
International leased circuit per annum								
- Quarter speed	12,000.00	178,200.00	178,200.00	190,813.00	190,813.00	190,813.00	484,620.00	14,772.00
- Half speed	20,000.00	297,000.00	297,000.00	310,021.00	310,021.00	310,021.00	808,848.00	9,864.00
- Full speed	30,000.00	445,500.00	445,500.00	477,032.00	477,032.00	477,032.00	1,211,286.00	5,910.00
- 75 band yr	33,000.00	490,050.00	490,050.00	537,845.00	537,845.00	537,845.00	1,332,500.00	16,250.00
Alternate voice data/AVD 9.6km	120,000.00	1,782,000.00	1,782,000.00	1,908,129.00	1,908,129.00	1,908,129.00	4,845,462.00	59,091.00
64km						252,000.00	10,332,000.00	126,000.00

Note: The calculation and upward review of all international services were based on the official exchange rate as it affects the local outpayments of NITEL. Access charges replaced rental charges after the review of the principle of tariffication in 1992.

Source: Nigeria Telecommunications Limited.

**Table A2: Economies with more mobile than fixed telephone subscribers at end of 1999**

Economy	Date mobile overtook fixed	Mobile subscribers (000') in 1999	Fixed-line subscribers (000') in 1999	Total mobile subscribers (%)	Mobile density	Fixed density	Total density
Cambodia	1993	89	28	76	0.81	0.25	1.07
Finland	Dec. 1998	3,445	2,856	55	66.70	55.29	121.99
Paraguay	May 1999	436	297	59	8.13	5.54	13.67
Uganda	July 1999	87	59	59	0.40	0.27	0.68
Venezuela	Aug. 1999	3,400	2,586	57	14.34	10.91	25.25
Italy	Sept. 1999	30,296	26,500	53	52.83	46.21	99.05
Portugal	Sept. 1999	4,671	4,230	52	6.81	42.39	89.20
Côte d'Ivoire	Oct. 1999	257	219	54	1.77	1.51	3.28
Korea (Rep.)	Nov. 1999	23,443	21,250	52	50.44	45.72	96.16

Source: ITU World Telecommunications Indicators Database.

## **Appendix B: Data construction method**

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The required data include measures of aggregate output, and the quantities and prices of labour, capital and materials for Nigerian Telecommunications Limited. The major sources of information are NITEL's annual reports. Where the data are not sufficiently disaggregated, recourse is made to NITEL's trial balance accounts from which the annual reports were prepared.

### **1. Aggregate output index**

The output index was obtained following the Tornqvist procedure as the weighted index (based on the revenue shares) of eight types of output: telephone subscriber dial, telephone trunk ticketed calls, international telephone, international telex, internal telex, international telegram, internal telegram and a miscellaneous category representing other telecommunications services. The output quantity indexes were constructed from subscriber dial (units), telephone trunk ticketed calls (paid minutes), international telephone (paid minutes), international telex (paid minutes), internal telex (units), international telegram (words) and internal telegram (words). The operating revenues for each service are deflated using the price index for NITEL obtained from Nigerian National Accounts, Federal Office of Statistics, Lagos.

### **2. Aggregate input index**

This quantity index was obtained following the Tornqvist procedure as the weighted index of adjusted total number of employees, the quantity index of materials and the capital stock index. The weights are the aggregate expense shares of three inputs (labour, materials, and capital). Aggregate expenses are the sum of total wage payments, current expenses, the payment to NITEL for the use of its telecommunications facilities, and the value of capital service. The quantity index of materials was constructed by dividing the sum of current expenses and the payment to NITEL for the use of its telecommunications facilities by the input price index for NITEL. NITEL annual reports list the number of employees each year. The quantity of labour is the quality adjusted person-hours actually worked excluding holidays. The capital stock index is the index of capital stock in constant prices.

The price of labour is the implicit price derived by dividing the quantity of labour by total employee expense. The price of materials is the implicit price obtained by dividing current naira materials by constant materials. The service price of capital was obtained by dividing the value of capital service by capital stock at the market value.

### **3. Capital stock**

On the basis of the capital stock and depreciation data from annual reports and price indexes, the series of capital stock in constant prices were constructed for three kinds of capital stock: production equipment, building and land. Capital stock is computed as the sum of capital stock at the end of the previous year and gross investment during the current year net of depreciation, all in constant prices.

The value of capital service was computed for two types of capital. This is the sum of: (a) the theoretical return during the current year on capital stock (at the market value) held at the end of the previous year, and (b) depreciation of the capital stock. The values of capital service for the two types of capital stock were added up to obtain NITEL's value of capital service.

### **4. Total cost**

Total cost is the sum of nominal expenditures on labour and materials, and the product of the service price of capital and the value of the net stock of capital. The sum was deflated by the price index for NITEL.

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