

**TELECOMMUNICATIONS SERVICES IN AFRICA:
THE EFFECTS OF MULTILATERAL AND UNILATERAL LIBERALIZATION**

**[Former working title: Multilateral services trade negotiations: Case study of
telecommunications services in Africa]**

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Abstract

In this paper, we examine the impact of telecommunications reform in Africa on both sectoral performance and economic growth. Besides unilateral liberalization measures, we account for WTO commitments at the multilateral level fostering the credibility of reforms. However, we find that multilateral commitments often do not seem to translate into actual reform. Actual liberalization leading to an increase in the number of operators improves the availability of telecommunications services, but in itself is no guarantee for price reductions. Regulatory quality plays a major role in bringing down prices as well as in improving access to telecommunication services. Enhancing the number of subscribers to mobile telephony services in Africa by 1 per cent translates into a 1.4 per cent increase in economic growth.

Key words: Telecommunications services, liberalization, Africa, WTO, GATS.

JEL classification: F13, L96, C23, O55, O14.

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I. INTRODUCTION

The United Nations Millenium Declaration has identified access to information and communication technologies (ICT) in general and telecommunications in particular as a goal in itself and as a key instrument in achieving some of the other objectives (ITU, 2004). A dynamic telecommunications sector plays an important role in economic development both in terms of employment creation (Hodge and Njinkeu, 2002) and as an input in the production of other goods and services (Falil-Doumbouya and ILEAP, 2004).

This is certainly the case in African countries, where, especially since 2000, the telecommunications sector has boomed, in particular in the mobile telephony and internet market segments. While up to 1995, there were less the 10 million mobile phone users in Africa, more than 13 million joined African networks in 2003 alone, carrying the total number of users to about 52 million. ITU (2004) estimates that African telecommunications operators in 2003 realized more than \$10 billion in revenues and about \$1 billion in earnings. To a large extent, these developments are a consequence of telecommunications reforms carried out in the 1990s. Many African countries abolished traditional monopolies, privatized state-owned firms, allowed new telecommunications operators (at least partially) to compete and created a regulatory authority overseeing developments in the sector. The reforms led to a considerable expansion of the types of services offered, such as pre-paid cards and GSM technology (ITU, 2004). Despite these encouraging developments over the last five years the African telecommunications sector continues to lack behind other regions. According to ITU (2004) data for 2003, mobile phone penetration in Africa was about 6 per cent compared to a global average of 22 per cent. Furthermore, telecommunication charges remain higher than the world average, and more than half of the population in Sub-Saharan Africa (SSA) are not covered by mobile networks, the lowest share of all regions in the world.

So far, the unilateral reform efforts by African countries have not translated into significant liberalization commitments under the WTO General Agreement on Trade in Services (GATS) or a stronger involvement in the ongoing services negotiations under the Doha Development Agenda which is in its final stage. At this juncture, we consider it to be particularly important to determine to which extent multilateral commitments to liberalization and further reform can be expected to enhance the performance of the African telecommunications sector. With this objective in mind, the paper is structured as follows: The next section briefly describes the definition and categorization of telecommunication services under the GATS. Section III characterizes the situation of the telecommunications sector in Africa. The fourth section introduces our liberalization indicators, empirical models and data. The main section (Section V) discusses the results we obtain regarding the impact of multilateral and unilateral liberalization of telecommunications services in Africa on sectoral performance and economic growth. The final section concludes.

II. TELECOMMUNICATION SERVICES AND THE GATS

Telecommunication services can be categorized in several ways: Firstly, they can be subdivided into basic and value-added telecommunications. Basic telecommunications include all telecommunication services, both public and private that involve end-to-end transmission of customer-supplied information, i.e. voice telephone services, packet-switched data transmission services, circuit-switched data transmission services, telex services, telegraph services, facsimile services, private leased circuit services and other services, such as analog/digital cellular/mobile telephone services, mobile data services, paging, etc. Value-added telecommunication services are telecommunications for which suppliers “add value” to the customer's information by enhancing its form or content or by providing for its storage and retrieval, for instance on-line data processing, on-line data base storage and retrieval, electronic data interchange, email and voice mail.¹ This distinction is based on the GATS Services Sectoral Classification List (MTN.GNS/W/120), which breaks down

¹ See http://www.wto.org/english/tratop_e/serv_e/telecom_e/telecom_coverage_e.htm.

telecommunications services into 14 sub-sectors (a.- n.) and an "other" category (o.). Sub-sectors a. through g. of this list, as well as a variety of "other" services, including mobile communications usually listed under sub-sector o., are generally considered basic telecommunication services. Subsectors h. through n. and any "other" services, not supplied on a real-time basis or which transform the form or content of customer's information, are considered value-added telecommunication services.²

Rapid technological advances soon proved the existing GATS classification to be inadequate. During the negotiations on basic telecommunications (which took place after the end of the Uruguay Round) the following four categories were used: a) geographic distinctions - local, domestic long distance, and international; b) means of technology - wire-based (or fixed infrastructure) and wireless (or radio-based); c) means of delivery - on a resale basis or facilities-based; and d) clientele - for public use, for non-public use (e.g. services sold to closed user groups). These categories have been used, as necessary, to define the scope of a commitment or to indicate different levels of commitments depending on the category concerned. The absence of these category indications signals that the commitment encompasses all possible categories (so-called "technological neutrality" of commitments) (WTO document S/C/W/74).

Finally, a distinction can be made according to the mode of delivery, like for other services. The GATS distinguishes four modes of supply. Telecommunication services are mostly concerned with modes 1 to 3.³ Mode 1 (cross-border supply) covers, for instance, international phone calls: A telephone operator in, say, Cameroon, "exports" a cross-border service by providing access to the local network to a foreign provider for an incoming international call. Other, more recent forms of cross-border supply are call-backs and internet services. Hence, commitments on mode 1 essentially are targeted at interconnection rates and access charges to the local network for internet services suppliers and call-back operators. In addition, a common barrier to mode 1 delivery of telecommunications services is the horizontal requirement that operators be locally established in order to provide services in the domestic market. Mode 3 (commercial presence) refers to the establishment of foreign-owned subsidiaries to deliver telecommunications services. With the disengagement of governments in the telecommunications sector in Africa in the mid-1990s, foreign companies provided large part of the necessary investment and technological innovations, in particular in the market for mobile telephony, where almost 90 per cent of firms are controlled by foreigners (ITU, 2004). Typical restrictions on mode 3 refer to foreign ownership limitations, interconnection policies for new entrants and differential treatment in regard to fiscal measures. Finally, mode 2 (consumption abroad) refers, for instance, to the use of the internet in a cybercafé or of a public phone by a tourist in a foreign country. Mode 2 provision of telecommunication services may be more affected by the commercial policies applied to the tourism sector. However, the non-availability of a call-back option may force tourists to use the services of a local operator.

All WTO Members are subject to the general provisions of the GATS, notably various transparency obligations. In addition, each Member is bound by its own schedule of commitments on both value-added telecommunications services (mostly made during the Uruguay Round) and basic telecommunication services (mostly negotiated after the Uruguay Round). Commitments are specified in terms of subsectors and modes of supply. In the case of basic telecommunications, liberalization commitments sometimes make reference to the "technology" categories discussed above. A range of WTO Members with commitments on basic telecommunications made additional commitments on regulatory disciplines. Most of them did so by committing to some or all aspects of the so-called "Reference Paper". The Reference Paper contains a set of principles covering regulatory

² While basic telecommunications, notably telephone services, have traditionally been of principal interest for the African continent, increased attention has recently been paid to value-added services owing to the rapid expansion of the internet.

³ Discussions on mode 4 (temporary movement of natural persons) are more concerned with a number of general issues, such as visa policies, than with sector-specific restrictions.

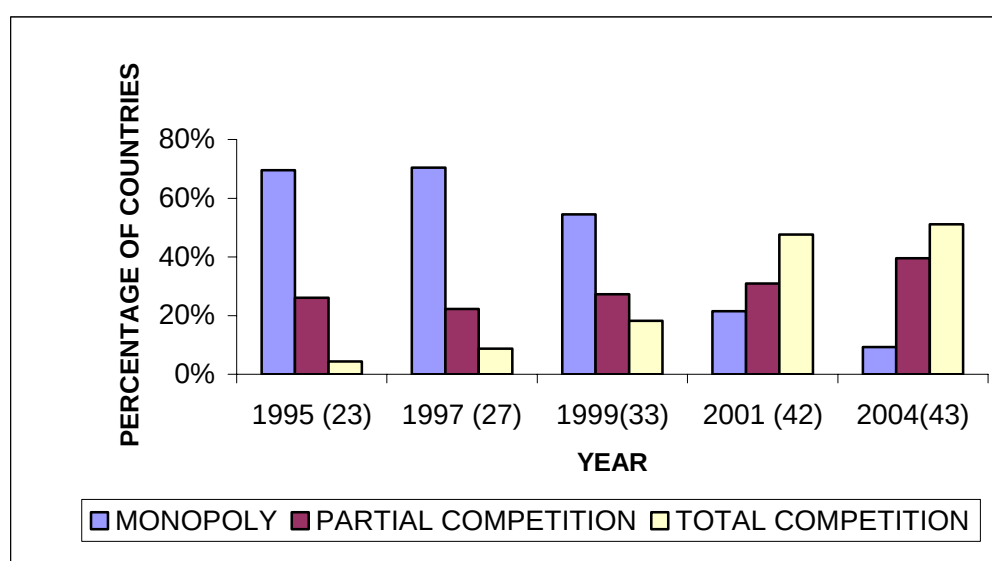
matters such as competition safeguards, interconnection guarantees, transparent licensing processes, and the independence of regulators.⁴

III. TELECOMMUNICATIONS LIBERALIZATION IN AFRICA

Traditionally, telecommunication systems in Africa were run by the government. The existing telecommunications infrastructure of the colonial area was inherited by the state after its independence. Public ownership of the telecommunications sector also squared with the economic thinking of the 1970s, which favoured large investments in key sectors that were expected to stimulate economic growth. Telecommunications in Africa were often under the control of a specifically created ministry or, for instance in Gabon, due to their "particular strategic importance", they were part of the Ministry of Defence (Ebang and ILEAP, 2005).

The debt crisis of the 1980s exposed the poor management of many publicly-owned enterprises. In addition, technological developments, such as call-backs, raised the operating costs of state monopolies. Numerous privatization and liberalization initiatives were undertaken in the context of structural adjustment programmes by the IMF and World Bank. Some of these developments even led to a coordination of efforts at the sub-regional level, like in the case of SADC. Figures 1 and 2 illustrate the evolution from state monopolies to a more liberal market environment in the African telecommunications sector for both fixed and mobile telephony. Between 1995 and 2004, the share of African countries maintaining a state monopoly in the mobile segment has dropped from 70 per cent to less the 10 per cent. Liberalization in the fixed-line segment has been somewhat slower, but progress has been made over the last five years. While all fixed operators in 1995 were state monopolies, this was still the case in only 44 per cent of African countries by 2004.

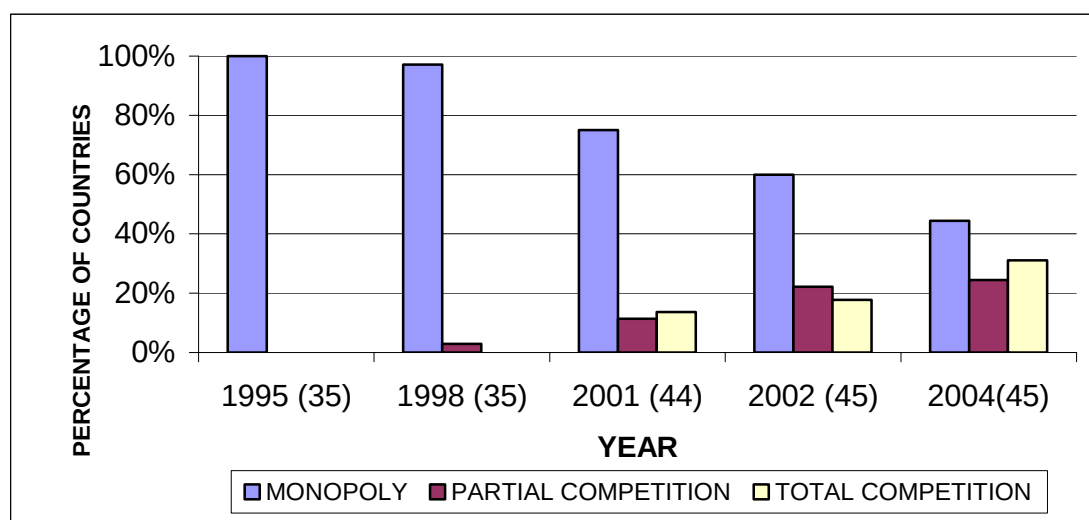
Figure 1: Evolution of competition in the mobile telephony segment in Africa



Source: authors' calculation from ITU (2004) data base

Note: Partial competition: two operators; Total competition: more than two operators.

⁴ See http://www.wto.org/english/tratop_e/serv_e/telecom_e/tel23_e.htm.

Figure 2: Evolution of competition in the fixed-line telephony segment in Africa

Source: authors' calculation from ITU (2004) data base

Note: Partial competition: two operators; Total competition: more than two operators.

Table 1 characterizes the level of liberalization in individual African countries in 2004 in terms of the level of competition in different market segments - i.e. mobile telephony, fixed telephony (local, domestic long distance, international) and internet - and the status of the regulatory authority.

Table 1: Competition and regulation in Africa in 2004

Country	Local	Long distance	International	Mobile digital	Internet	Year of creation of regulatory authority	Independence of regulatory authority	Number of members of regulatory authority
Angola	C	C	C	P	C	1999	No	5
Benin	M	M	M	C		2002	Yes	5
Botswana	M	C	M	C	C	1996	Yes	5
Burkina Faso	M	M	M	C	C	1998	Yes	0
Burundi	C	C	C	C	C	1997	No	0
Cameroon	M	M	M	C	C	1998	Yes	0
Cap-Verde	M	M	M	C	C	2004	Yes	3
CAR	M	M	M	C				
Thad	M	C	M		C	1998	No	0
Congo	C	C	P	C	C			
DRC	C	C	C	C		2002	Yes	7
Côte d'Ivoire	P	P	P	P	C	1995	Yes	10
Eritrea	M	M	M	C	C	1998	No	0
Ethiopia	M	M	M	M	M	1996	Yes	0
Gabon	M	C	C	C	C	2001	Yes	6
Gambia	M	M	M	P	C	2004	Yes	6
Ghana	P	P	P	P	C	1997	Yes	7
Guinea	P	P	P	P	C	1992	No	0
Guinea-Bissau	M	M	M	P	C	1999	Yes	3
Kenya	P	P	P	P	C	1999	Yes	11
Lesotho	P	P	P	C	C	2000	Yes	0
Liberia	P	P	C	C				
Madagascar	M	M	C	C	C	1997	Yes	0
Malawi	M	M	P	P	P	1998	No	8
Mali	P	P	P	P	C	1999	Yes	3
Maurice	C		C	C	C	2002	Yes	7
Mozambique	M	M	M	C	C	1992	Yes	5
Namibia	M	M	M	M	C	1992	Yes	0
Niger	M	M	M	C	M			
Nigeria	C	P	P	P	C	1992	Yes	9
Rwanda	C	C		C	C	2001	Yes	7
S. Tomé & P.	M		M					

Sénégal	C	C	C	C	C		Yes	0
Seychelles	P	P	P	P	P			
Sierra Leone	M	M	P	C	P			
South Africa	C	C	C	P	C	2000	No	7
Swaziland	M	M	M	M				
Tanzania	M	M	M	C	C	1994	Yes	7
Togo	P	M	P	P	C	1998	Yes	7
Uganda	P	P	P	P		1997	Yes	7
Zambia	M	M	M	P	P	1994	No	8
Zimbabwe	C	P	P	C	C	2000	Yes	7

Source: authors' calculation from ITU (2004) data base

According to Njinkeu and Hodge (2002), the situation in the telecommunications sector for many of these countries can be summarized as follows: Large part of the market is open to competition. There are generally three or more operators on the mobile telephone market and a duopoly in the fixed-line segment. New operators are admitted on the basis of licences. International calls are exclusively operated by the local duopoly. Foreign investment is permitted subject to certain ownership thresholds. Value-added services, notably internet services, with the exception of calls via the web (in order to avoid a bypass of the duopoly), are completely liberalized. Finally, a regulatory framework is in place that is comparable to the principles of the Reference Document.

The actual state of liberalization in many African countries contrasts with their low involvement in the WTO. Currently, only 13 African countries have made commitments in the telecommunications sector (Cote d'Ivoire, Democratic Republic of Congo (DRC), Djibouti, the Gambia, Ghana, Kenya, Lesotho, Mauritius, Nigeria, Senegal, South Africa, Uganda and Zimbabwe). In contrast to the actual situation, Njinkeu and Hodge (2002) observe that GATS commitments largely preserve a monopolistic structure. An exception is Cote d'Ivoire which has committed 12 basic telecommunications subsectors and adopted the Reference Document in its entirety. The latter is also the case for Ghana, Mauritius, Senegal, South Africa and Uganda.⁵

IV. MODELS AND DATA

This section explains the liberalization indicators, empirical models and data used in this paper.

A. LIBERALIZATION INDICATORS

Services trade barriers essentially consist of regulations limiting the access of foreign services providers to the domestic market or subjecting them to less favourable treatment than local providers. The methodologies to measure the degree of trade restrictiveness in the services area are inspired by approaches used to characterize non-tariff barriers on goods. Qualitative data on regulations or the behaviour of economic agents is transformed into a system of scores, which is then used to construct a restrictiveness index. Hoekman (1995) constructs an index rating countries according to the number of sectors and modes committed under the GATS. This index suffers from at least two shortcomings: First, it characterizes liberalization only in terms of GATS commitments, which may be quite different from reality (Chen and Schembri, 2002). Second, the same weight is accorded to each mode (and hence to each restriction), although not every mode is equally significant in each sector and restrictions are of a quite varied nature.

Recent approaches have used more sophisticated indexes based on actual regulatory policies that are rated according to their presumed restrictive effects. For instance, the study by Fink, Mattoo and Rathindran (2001) on telecommunications assign a liberalization score to each country on the basis of three criteria: degree of competition, government regulation and permitted level of FDI. Several studies examine both the quality of GATS commitments as well as the actual state of liberalization. Such approaches have been pursued by Warran (2001) on telecommunication services, MacGuire et

⁵ Senegal and South Africa have adopted the disciplines of the Reference Document only with certain exceptions. See Doumboya (2004).

al. (2000) and Kang (2000) on maritime transport services, MacGuire (2002) on financial services, Kemp (2000) on education services and Kalirajan (2000) on distribution services.

We adopt an approach that examines both the domestic policies actually applied in the telecommunications sector as well as the level of commitments as specified in WTO Members' GATS schedules. For both the unilaterally implemented as well as multilaterally committed reforms we distinguish two components: degree of competition and regulation.

For the level of actual (unilateral) domestic liberalization, like Fink, Mattoo and Rathindran (2001) and Wallsten (1999), we rely on ITU survey data:

- The degree of competition is characterized by the existing market structure, with a score of "1" indicating a monopoly, "2" a duopoly and "3" three and more operators.
- Regulatory quality is approximated by the degree of independence of the regulatory authority from the government. "1" is attributed to countries where the regulatory authority is independent, while "0" where it is not. We also take into account the resources it can dispose of and the number of years since its inception as proxies for regulatory competence. Finally, a general governance variable is included as a measure of regulatory effectiveness.

Unlike most other studies, we also include multilateral liberalization commitments, which may lead to additional effects not accounted for by unilateral measures. In particular in the African context, where political instability and insecurity are major drags on the level of investment, the quasi-irreversible character of external commitments in the GATS framework enhances the credibility of reforms, namely that the regulatory framework will be consistent, fair and predictable, thus lowering investment risks (Marchetti, 2004).⁶ The level of multilateral liberalization is equally characterized in a twofold manner and relies on WTO data:

- GATS commitments are used as an indicator of a country's openness to foreign competition. It is measured by a dummy variable that takes the value of "1" for a country with at least one commitment under the GATS and "0" otherwise. This variable is quite weak as a liberalization indicator, since it does not contain any information on the type or level of commitments. Moreover, as was said before commitments in the WTO may be far less liberal than actual practice.
- Adherence to the Reference Document is taken as an indicator of regulatory quality. A dummy is constructed taking the value of "0" for countries that have not subscribed to any regulatory disciplines in the telecommunications sector (beyond general GATS rules), "1" for countries which have committed themselves in regard to certain regulatory disciplines, but not the Reference Document, and "2" for countries having adopted the Reference Document in total or in part.

B. THE MODELS

This section explains the econometric models used to estimate the effect of telecommunications services liberalization on sectoral performance indicators, such as the price and access, and economic growth. We run these regressions for the mobile telephony market, for the fixed local segment and for the international segment. Few studies have examined both performance and growth effects. Doumbaya (2004) and Shirley (2001) have studied African countries looking at performance effects only. Fink, Mattoo and Rathindran (2002) and Wallsten (1999) have taken a similar approach for a group of developing countries, Boylaud and Nicoletti (2000) as well as OECD (2001) for OECD countries, Hauffman (1995) for the United States and Findlay and Warren (2000) for a range of developed and developing countries. The authors generally find a positive relationship between increased competition / privatization and sectoral performance (as measured by price reductions to consumers, phone line penetration or labour productivity). These results are consistent in regard to

⁶ Marchetti (2004) notes that not every commitment may have the same effect on enhancing investor confidence. Specific requests by mode and sector in the current negotiations may give an indication of the kind of regulatory assurances investors are looking for.

both the sample of countries (developing or developed) and the estimation method (cross-country, panel, fixed effects or heteroscedasticity correction).

Mattoo, Rathindran and Subramanian (2001) examine the growth effect of a change in telecommunications policy. Similarly, the study by Norton (2002) looks at improvements of telecommunications infrastructure and their impact on economic growth. Both studies find positive effects of telecommunications reform on economic growth.

None of these studies is sufficiently detailed or recent in order to allow for an assessment of the specific situation in Africa. To the best of our knowledge, the only study that exclusively focuses on African countries is the one by Doumbaya (2004) who estimates a fixed effects panel obtaining a significantly positive correlation between the liberalization (as measured by various degrees of competition) and the penetration of telephone services. However, the time period under investigation ends in 1999, i.e. at a point in time, as was mentioned above, when much of the liberalization in African countries was still to take place. Our examination seeks to fill these gaps: We limit our sample to Sub-Saharan countries and cover the time period from 1997 to 2003, when the major reforms in the telecommunications sector in Africa were carried out. Moreover, we correct for endogeneity by instrumental variable estimation (following Hausmann's specification test) using the method of moments to estimate the effect of liberalization on growth. Finally, we run the same models on a world sample of countries and compare these results to the ones obtained for Africa.

1. Sectoral performance regressions

In order to measure the impact of the various liberalization measures on our performance indicators of the telecommunications sector, we specify the following reduced form equation:

$$\log(Y_{it}^s) = b^s + u_i^s + w_{it}^s + \alpha^s \log(LIB_{it}^s) + \beta^s \log(Q_{it}^s) + \lambda^s \hat{Y}_{it}^{s'} + \lambda^s \log(C_{it}^s) \\ t \in [1996, 2003]; \quad s \in \{1, 2, 3\}$$

where s , i and t indicate the telecommunication services segment, country and time period respectively.

Y_{it}^s , the dependent variable, represents the performance indicator (price or service penetration) in each of the segments s (mobile, fixed local, international) in country i at time t .

LIB_{it}^s denotes the various liberalization indicators. By introducing competition, liberalization should be expected to be negatively correlated with price and positively with telecommunications services penetration. However, at least two factors may counteract such a result: Firstly, liberalization may go hand in hand with a reduction of direct or cross-subsidies formerly enjoyed by the monopolist. Hence, at least in the short-run and for some of the market segments, liberalization may lead to higher prices. The second factor is related to the market situation in many African countries which is still characterized by only two operators on average, a rather weak institutional environment in general and a lack of experience in regulation the telecommunications sector in particular, in short, by a set-up that may be conducive to some degree of collusion.

Q_{it}^s denotes the quality of telecommunication services, as measured by the percentage of calls failing and the share of digital technology among telecommunications installations. This variable is expected to be positively correlated to price, since it requires additional investments by the operator leading to higher costs. Consumers accept to pay a higher price for better service. Furthermore, better services quality is expected to more subscriptions.

C_{it}^s denotes the matrix of control variables, including exogenous factors characterizing a country's economic structure (income, population size, population density) and institutional features (governance).

$\hat{Y}_{it}^{s'}$ represents the respective performance indicator in a competing segment. For instance, in the case of the price estimation in the fixed telephony segment, $\hat{Y}_{it}^{s'}$ represents the price in the mobile segment and vice versa. This indicator is supposed to be endogenous, with performance levels in the different segments influencing each other. We correct for this problem in the same way as Mattoo, Rathindran and Subramanian (2002) by substituting estimated values obtained in an independent regression for the actual values of the respective performance variable. Like the main model, the latter regression equation contains the log of the performance indicator as a dependent variable and the same explanatory variables.

b^s is a constant, while the error term w_{it}^s captures model disturbances, i.e. the combined time series and cross-section error component, which we assume to be idiosyncratic. u_i^s denotes the individual-specific error component, which we assume to be fixed and correlated with the explanatory variables of the model. This hypothesis is based on the existence of omitted, non-quantifiable variables which have an effect on both liberalization policies and its results in terms of performance. One such factor is the existence of political will to implement the liberalization measures that a country has committed to. Thus, political will not only has an impact on the ultimate performance of the sector, but also on the timing and type of liberalization measures adopted. In other words, we take into account that some of the explanatory variables in our panel-data random effects models are correlated with the unobserved individual-level random effects.

In view of the presumed correlation between the country-specific effects and the explanatory variables, the within estimator normally used to estimate fixed effects is not efficient. Moreover, the presence of time-invariant dummy variables excludes the possibility to correct for the correlation of country-specific effects by mean-differencing the data. We therefore opt for the Hausman and Taylor (1981) estimator which assumes that a subset of the explanatory variables are correlated with the individual-level random effects u_i^s but that none of the explanatory variables are correlated with the idiosyncratic error w_{it}^s . It corrects for the problem of correlation between the country-specific effects and the explanatory variables by using generalized least-squares (GLS) instrumental variables (Sevestre, 2002).

The model is estimated in regard to the performance at each segment level and for the telecommunications sector as a whole. For each segment, the model is estimated for an African and a global sample. In the latter, an Africa dummy is introduced in order to capture continent-specific effects as compared to the rest of the world. For the sector estimation, the data for all three segments is pooled and dummies are introduced to control for the specificity of each segment (Boylaoud and Nicoletti, 2000).

2. Growth regressions

Our underlying model of endogenous growth of real GDP per capita follows Barro (1997). Apart from the classic explanatory variables, i.e. production factors (labour, capital investment), we have introduced control variables for human development (schooling), openness (trade volumes), governance (various indices, such as the Transparency International corruption index) and the level of inflation. In the African context, it is conceivable that the correlation coefficients between economic growth and our trade liberalization indicators in the telecommunications sector suffer from simultaneity bias and rather reflect the impact of growth on liberalization policies and not vice versa. In fact, many of the reforms in Africa were inspired by structural adjustment programmes. In order to correct for possible endogeneity problems linked to simultaneity bias, to measurement errors or

omitted variables, we run our regression using generalized method of moments (GMM) estimators. In other words, we estimate a dynamic panel in first differences using lagged values of the endogenous variables as instruments.

The model specification is as follows:

$$PIB_t^i = f(PIB_{t-1}^i, LIB_t^i, X_t^i)$$

$$t \in [1996, 2002]$$

where X_t^i represents all variables other than the lagged GDP variable and the degree of competition as our liberalization indicator, namely:

- credit volume to the private sector as a proxy for capital;
- population as a proxy for labour;
- exports as a share of GDP as an indicator of openness;
- ratio of secondary schooling as an indicator human development;
- inflation; and
- alternative governance indicators.

C. THE DATA

Data for the performance indicators are sourced from the ITU, while data on economic structure and growth determinants are taken from the World Development Indicators (WDI) 2005 data base of the World Bank (WB). The table below provides an overview of all variables and data sources.

Table 2: Data description and sources

Variables⁷	Descriptions	Sources
Price mobile	3 minutes call from one mobile to another; average costs of annual bill by representative subscriber	ITU
Price fixed local	3 minutes call from on a local fixed line; average costs of annual bill by representative subscriber	ITU
Prix fixed international	3 minutes call to the United States	WDI
Penetration mobile	Percentage of population subscribed and having telephone service activated within the last 9 months	ITU
Penetration fixed	Percentage of population subscribed	ITU
Unilateral regulation	Independence score of the regulatory authority multiplied by the numbers of years in existence	ITU
Multilateral regulation	Reference document score	WTO
WTO-GATS	GATS commitments score	WTO
Operator	Number of operators per segment	ITU
Governance	Regulatory quality	WB
GDP per capita	Economic development	WDI
Population density	Percentage of population per square kilometre	WDI
Technology	Percentage of digital lines per segment	ITU
Population size	Market size	ITU
Governance*Operator	Interaction term between good governance and the number of operators on the market	ITU
Schooling ratio, trade volumes, inflation, interest rates, private sector credit volumes	Other growth determinants	WDI

⁷ These terms are used to identify the variables in the regression outputs contained in the Annex.

As was said before, the dependent performance variables are the price and penetration variables with the former being measured in real constant dollars (at 2000 prices). While the price for fixed international telephony is measured by a three minutes call to the United States, the prices for mobile and fixed local telephony are measured by two indicators each. The first indicator is the official price of a three minutes phone call. However, this price does not account for discounts that are generally available in countries enjoying some level of competition.⁸ Hence, it is possible that this indicator suffers from a measurement error that is non-homogenous between countries. This may lead to an underestimation of liberalization effects on price. The second indicator seeks to address this shortcoming at the expense of other limitations. It consists of the annual telephone bill by an average subscriber and is calculated by dividing total revenues in each market segment by the number of subscribers. While it reflects the effect of discounts, the quantity of services provided at a given cost is not accounted for. Under the assumption that subscribers consume more telephone services the higher the number of operators and the higher the total number of subscribers, this indicator is bound to be error-prone in a non-homogenous manner across countries and likely to also underestimate the liberalization effect on price to differing degrees.⁹

V. DISCUSSION OF RESULTS: THE EFFECT OF LIBERALIZATION ON SECTOR PERFORMANCE AND ECONOMIC GROWTH

The panel comprises 177 countries and territories (of which 45 from Sub-Saharan Africa) over a 7-year period (1997 to 2003).¹⁰ For each regression, four different estimation methods are used (fixed effects, fixed effects corrected for heteroscedasticity, random effects and Hausman-Taylor). However, only the results of the Hausman-Taylor approach are discussed in the paper. Before interpreting the results, it is instructive to examine some descriptive statistics on the evolution of prices over time in relation to variations of the liberalization indicators. Table 3 summarizes the test results on the differences in average prices in each segment between, on the one hand, monopolies and competitive markets (defined as more than one operator) and between the time periods 1997 to 1999 and 2000 to 2003 on the other.

⁸ OECD and Nicoletti, 2002, estimate that discount prices in OECD countries are on average 25 per cent lower than regular rates.

⁹ It is possible that reductions in the annual phone bill are a reflection of lesser consumption (i.e. accumulation of fewer time units per year) rather than declining prices. However, as our regressions below show, liberalization leads to a strong increase in penetration (i.e. a rising number of providers). As a consequence, the average amount of time units consumed can be assumed to increase and this indicator would then underestimate an actual decline in prices.

¹⁰ The panel is unbalanced, hence the number of countries varies with each regression. The number of countries as well as time periods are provided in the result tables. Moreover, regressions involving African countries only cover the time period from 1995 to 2003.

Table 3: Differences in average prices

Segment	Tests	Africa	World
Price mobile	Monopoly vs competition	Price increase	Price unchanged
	(1997-1999) vs (2000-2003)	Price unchanged	Price decrease
Price fixed international	Monopoly vs competition	Price unchanged	Price decrease
	(1997-1999) vs (2000-2003)	Price decrease	Price decrease
Price fixed local	Monopoly vs competition	Price unchanged	Price increase
	(1997-1999) vs (2000-2003)	Price increase	Price unchanged

Table 4 provides the partial correlations between prices (in logarithms) and liberalization indicators. For both Africa and the world, the results do not entirely match our expectations. In none of the market segments in the African sample is the price negatively correlated to the number of operators to any significant extent. Quite to the contrary, in the mobile segment, a positive correlation exists, a result that is confirmed by the average price differences in that market. At the global level, results are also mixed with a significant positive correlation between price and the number of operators in the local fixed line segment. However, international prices feature a significant negative correlation. These statistics already point to particular price developments on the African continent: While, at the global level, prices were unaffected in the local fixed line segment and decreased in the other two segments, prices in Africa only declined in the international fixed line segment and increased in the mobile segment. We revert to these developments in the discussion of our econometric results below, where the different factors having an impact on prices are examined simultaneously.

Table 4: Partial correlations between price (in logs) and liberalization indicators

World

	Price mobile	Price fixed local	Price fixed international	Penetration mobile	Penetration fixed	Governance	Unilateral regulation	GATS	Multilateral regulation	Fixed local operator	Fixed int'nat operator	Mobile operator
Price mobile	1											
Price fixed local	0.7548*	1										
Price fixed international	-0.3287*	-0.4960*	1									
Penetration mobile	0.0154	0.1319*	-0.5454*	1								
Penetration fixed	0.2608*	0.0608*	-0.4170*	0.6491*	1							
Governance	0.2835*	0.3291*	-0.4231*	0.6172*	0.6628*	1						
Unilateral regulation	-0.1658*	-0.1044*	0.1973*	-0.0991*	-0.0787*	-0.4066*	1					
GATS	0.2218*	0.1133*	-0.3300*	0.2003*	0.3789*	0.4913*	-0.4064*	1				
Multilateral regulation	0.2715*	0.1938*	-0.3557*	0.2832*	0.4522*	0.5767*	-0.2945*	0.7216*	1			
Fixed local operator	0.0479	0.0797*	-0.3490*	0.3459*	0.2503*	0.2853*	-0.1326*	0.3855*	0.4432*	1		
Fixed international operator	0.1155*	0.1290*	-0.3845*	0.4297*	0.3179*	0.3777*	-0.1404*	0.3939*	0.4957*	0.8055*	1	
Mobile operator	0.0653*	0.0119	-0.0298	0.1992*	0.0347	0.0877*	0.004	0.1856*	0.1663*	0.3290*	0.3300*	1

* Significant at 10%; note: **Operator** refers to competition score.

Africa

	Price mobile	Price fixed local	Price fixed international	Penetration mobile	Penetration fixed	Governance	Unilateral regulation	GATS	Multilateral regulation	Fixed local operator	Fixed int'nat operator	Mobile operator
Price mobile	1											
Price fixed local	0.3758*	1										
Price fixed international	-0.0226	0.0262	1									
Penetration mobile	-0.1426	0.2075*	-0.2631*	1								
Penetration fixed	-0.4439*	-0.2564*	-0.1428	0.6411*	1							
Governance	-0.0148	0.1313	-0.1115	0.2900*	0.4431*	1						
Unilateral regulation	0.1086	-0.0768	-0.0385	-0.0658	-0.4770*	-0.3397*	1					
GATS	0.1741	-0.1572	-0.1136	0.2965*	0.2262*	-0.009	-0.0082	1				
Multilateral regulation	0.1824	-0.0981	-0.1636	0.3254*	0.2249*	0.0958	0.1076	0.8059*	1			
Fixed local operator	0.0136	-0.0558	-0.1172	-0.0374	0.2487*	-0.3073*	0.2185*	0.0819	0.0861	1		
Fixed international operator	0.2893*	0.2060*	-0.0998	-0.0201	-0.3233*	-0.0603	0.0779	-0.0486	0.0378	0.6529*	1	
Mobile operator	0.3024*	0.1528	-0.1522	0.2587*	-0.1045	0.2336*	0.2327*	0.0487	0.2065*	0.1830*	0.4312*	1

* Significant at 10%; note: **Operator** refers to competition score.

A. PRICE

We employ two price indicators in the fixed local and mobile telephony segments, namely the cost of a three minutes phone call on the one hand and the cost for the annual phone bill of an average customer on the other. As discussed in section IV.C, these two indicators are likely to underestimate the impact of liberalization measures on price as discounts and total time units consumed respectively are not taken into account. Hence, for each of these segments, we run two regression with the alternative price indicators as the dependent variable. When interpreting the results, a liberalization indicator is only considered to contribute to the reduction of telephony prices if it is negatively and significantly correlated with at least one of these price indicators.¹¹ Table 5 provides an overview of our results on price, which are further discussed in what follows.

Table 5: Overview of the effects of liberalization measures on price

Sample	Type of liberalisation measure		Price						
			Costs of three-minutes call				Annual bill		
			Aggregated telecommunications segments (pooling)	Mobile	Fixed local	Inter national	Aggregated telecommunications segments (pooling)	Mobile	Fixed local
Africa	Openness	Unilateral	0 ⁻	0 ⁻	–	0 ⁻	0 ^{-*}	0 ⁻	–
		multilateral	0 ⁻	0	0	0 ⁻	0 ⁻	0 ⁻	0 ⁻
	Regulation	Unilateral	–	–	–	–	–	–	–
		multilateral	0 ⁻	0 ⁻	0 ⁻	0	0	0	0 ⁻
World		Africa Dummy	+	0	+	0	n/a	+	+
	Openness	Unilateral	–	0 ⁻	0 ⁻	0	–	–	–
		multilateral	0	0	0	0 ⁻	0 ⁻	+	0 ⁻
	Regulation	Unilateral	–	–	0 ⁻	–	–	–	–
		multilateral	0 ⁻	–	–	0	0	–	–

Note: The coding of the cells is as follows:

0: positive coefficient and non significant at the 10% level

0⁻: negative coefficient and non significant at the 10% level

–: negative coefficient and significant at least at the 10% level

+: positive coefficient and significant at least at the 10% level

As a reminder, liberalization indicators are defined as follows:

unilateral & openness = number of operators

unilateral & regulation = regulatory authority

multilateral & openness = GATS commitments

multilateral & regulation = reference document

As a first step, we have estimated our model at the global level. A regional dummy for Africa is introduced in order to test whether Africa is different from the rest of the world in this regard, as suggested by the above descriptive statistics. Indeed, the Africa dummy is significantly positive at the 1%-level in the fixed local and mobile telephony segments. In the former segment the Africa dummy has a significantly positive impact on price for both indicators, while in the latter this is the case for the average annual phone bill indicator. This result suggests that telephone services in a typical African country are more expensive than in the rest of the world on average. It is consistent with our earlier observation about Africa's slower than average progress in telecommunications reform as compared to the rest of the world (see section III). The absence of a significant correlation between the Africa dummy and the price for international calls indicates that, in this segment, the African continent is in line with global developments, as already revealed by our simple statistical analysis which has shown that prices in Africa between 1997 and 2003 have come down. The market for international calls had experienced a rapid and strong exposure to international competition not only

¹¹ A set of complete regression results is available from the authors upon request.

with the number of national operators rising but with the arrival of alternatives such as call-back systems and calls via the internet (e.g. net-phone, Skype-Net), which nowadays are available in most African countries.

1. Openness to competition

Multilateral liberalization as measured by the absence or not of GATS commitments has no effect on price in any one of the three telephony segments in Africa, individually or combined. While this result could be due to the low level of participation by African countries (13) in terms of GATS commitments in the telecommunications sector, it does not change at the global level. Again, this indicator does not capture the differences between countries in terms of breadth (e.g. sub-sectors and modes of supply) and quality of commitments. In addition, the partial correlation between our multilateral and unilateral openness indicator is highly positively. Hence, some of the effects of multilateral openness on price are likely captured by the unilateral openness indicator. Multilateral commitments often do not reflect the actual situation in a country, in particular in Africa (Njinkeu and Hodge, 2001). Conversely, unilateral openness as measured by the actual number of operators in the market, has contributed to price reductions, at least in the global telecommunications market in both the local fixed and mobile telephony segments. For Africa, unilateral openness has a significantly negative impact on price in the local fixed line segment like in the rest of the world.

The mobile and international segments feature negative, but not significant correlations for Africa. This result is somewhat puzzling since these segments are characterized by higher levels of competition than the local fixed line segment. However, we arrive at a similar conclusion with our descriptive statistical analysis¹² and, therefore, we exclude the possibility that this outcome is due to a specification error of our model. Part of the explanation is undoubtedly related to measurement errors inherent in our indicators, which, as described in section IV.A, we expect to overestimate prices in countries and time periods experiencing higher levels of competition. Clearly, competition has unfolded more rapidly and extensively in the international and mobile telephony segments and, hence, in these markets our price indicators will be comparatively more prone to this type of measurement bias. However, for the world sample we obtain a significant negative correlation for the annual phone bill indicator in the mobile telephony segment. In other words, the lack of a significant effect on price in the African mobile telephony segment must, at least in part, be due to specific developments in Africa. One possible explanation relates to the fact that, in many African countries, competition is limited to two operators, a situation that is particularly conducive to pricing arrangements. In the international segment, though, the absence of a significant relationship between price and the number of operators for both the African and global samples is unlikely to be due to pricing arrangements. Here, the descriptive statistics point to strong price reductions between 1997 and 2003 whether under monopoly or competitive structures. The apparent lack of influence of the number of operators on price can be explained by the exposure to international competition via alternative means, such as call-backs and calls through the internet, which elude control by governments. It may therefore be surmised that, in this segment, domestic liberalization policies have contributed to a consolidation of the existing state of competition without in and by themselves having an effect on price.

2. Regulation

A common regulatory framework agreed at the multilateral level, as measured by adhesion to the Reference Document, in the world sample leads to significant price reductions in the mobile and local fixed line segments. The insignificant results for the African continent were to be expected in view of the fact that only six of them have adopted the Reference Document. The low number of African participants contrasts with the world sample which contains 69 WTO Members following the

¹² In fact, the descriptive statistical analysis above has shown that prices in the mobile telephony segment in competitive markets in Africa, on average, are higher than under monopoly structures and have remained stable over our sample time period (1997-2003); for the international segment prices remained unchanged in relation to both the time dimension and monopoly vs. competition comparison.

principles of the Reference Document in its entirety or partially, and which can therefore be presumed to produce a more reliable estimate.¹³ Again, we have also detected a highly positive partial correlation between the multilateral and unilateral regulation indicators that need to be borne in mind.

The effect of unilateral regulation on price requires a measure of the effectiveness of the regulatory authority. Above, we introduced the indicator by the ITU measuring an authority's degree of independence from the government on the basis of a range of criteria, such as legal autonomy (i.e. whether or not it is affiliated with the administration), budgetary dependence and process for appointment of members. No distinction is made as to the competence and experience of an authority. The actual power of a regulatory authority is also conditioned by the general legal environment in a country. In view of these shortcomings, we extend our set of indicators of unilateral regulation beyond the ITU measure to comprise the following:

- size of the regulatory authority in terms of staff numbers as a proxy for its overall resource endowment;
- an interaction term consisting of the product between the ITU independence indicator and the number of years since the regulatory authority has been created. This term allows for the fact that the degree of autonomy and its competence (proxied by its years of experience) may depend on one another.

Apart from the resources indicator which has no significant effect on price in any of the model specifications,¹⁴ the results of our regressions suggest that unilateral regulation is an important determinant of price.

The indicator interacting independence and experience features a significant and negative correlation with price (equally for both price indicators) for all three segments in both the world and African samples. This rather compelling result leads us to conclude that the autonomy and competence of a regulatory authority rather than the mere number of operators or extent of multilateral commitments are the decisive factors in bringing about price reductions in the telecommunications market. This result appears to hold independently of the telephony market segment and geographical region considered.

B. PENETRATION

Most other studies on telecommunications liberalization examine penetration as a measure of sectoral performance and unanimously find a positive impact of unilateral liberalization. Our approach adds to this literature by examining for the first time also the effects of multilateral liberalization. Like for the price equations, we begin by estimating the model without liberalization indicators for the world sample including an Africa dummy. In both the mobile and fixed line segments,¹⁵ the Africa dummy is significant and negative, which confirms our suspicion that Africa lags behind the world average in terms of accessibility to telecommunications services. Table 6 gives an overview of all estimated effects on penetration, which are further discussed thereafter.

¹³ In contrast to our multilateral liberalization indicator, the multilateral regulation indicator refers to the same type of obligation (adoption of a common text) with those Members having reserved certain exceptions only obtaining half the score.

¹⁴ Results for this indicator are not presented in Table 4.

¹⁵ In terms of penetration, we are interested in the availability of either fixed or mobile telephone networks. Hence, no distinction is made between local and international fixed line segments.

Table 6: Overview of the effects of liberalization measures on penetration

Sample	Types of liberalisations		Penetration		
			Penetration		
			Aggregated Telecommunications (pooling)	Mobile	Fix local
Africa	Openness	Unilateral	+	+	+
		multilateral	0 ⁻	0 ⁻	0 ⁻
	Regulation	Unilateral	+	+	+
		multilateral	0	0 ⁻	0
World		Africa Dummy	-	-	-
	Openness	Unilateral	+	+	0 ⁻
		multilateral	-	0	0 ⁻
	Regulation	Unilateral	+	+	+
		multilateral	+	0 ⁻	0

Note: The coding of the cells is as follows:

0: positive coefficient and non significant at the 10% level

0⁻: negative coefficient and non significant at the 10% level

-: negative coefficient and significant at least at the 10% level

+: positive coefficient and significant at least at the 10% level

As a reminder, liberalization indicators are defined as follows:

unilateral & openness = number of operators

unilateral & regulation = regulatory authority

multilateral & openness = GATS commitments

multilateral & regulation = reference document

1. Openness to competition

Like in the price equations, multilateral GATS commitments have no significant effect on penetration at either the global or African level whether in the fixed line or mobile segment. The same caveat applies as above, namely that this indicator does not do justice to the value of multilateral commitments as it ignores any differentiation in terms of their extent and quality. Unilateral openness by contrast, as measured by the number of operators, significantly increases penetration in both market segments. However, we are puzzled by the fact that the partial correlation between multilateral openness and penetration is significantly positive at both the global and African levels. Again, we need to emphasize that our multilateral and unilateral openness indicators have turned out to be highly positively correlated. It would therefore be incorrect to deny any significant effects of multilateral openness on penetration, as part of such an effect is likely to be captured by the unilateral openness indicator, thus taking away from the significance of the multilateral variable.

2. Regulation

Adoption of the Reference Document does not lead to any significant effects in terms of penetration. However, due the high partial correlation with the unilateral indicator, the latter may capture some of these effects. Unilateral regulation, as measured by a regulatory authority's independence and experience, indeed has a significant and positive impact on penetration both in Africa and the world in both the fixed and mobile segments.¹⁶ Hence, our earlier conclusion about the role of regulation at the national level as a key factor affecting the performance of the telecommunications sector is robust to the use of an alternative performance indicator.

¹⁶ Again, this result is in line with the descriptive statistics.

C. GROWTH

Finally, we are interested in testing whether liberalization beyond better price performance and accessibility of telecommunications services trickles through to have an impact on economic growth. Especially, liberalization of the mobile phone sector and the more widespread availability at reduced costs it entails are often touted as a blessing for Africa, as it allows people in remote locations to communicate with each other at affordable prices. There is also evidence that this has enabled them to establish market relationships.¹⁷ In fact, World Bank (2006) notes that most of the recent growth in the telecommunications market has involved mobile phones outnumbering fixed ones. In Nigeria, for instance, the number of mobile subscribers jumped from 370,000 in 2001 to 16.8 million in September 2005. The report holds that mobile phones have an especially dramatic impact in developing countries by substituting for scarce fixed connections, increasing mobility, reducing transaction costs, broadening trade networks and facilitating searches for employment, all of which are elements conducive to higher levels of economic growth.

As a liberalization indicator we choose the number of operators in the mobile phone market for both the Africa and world samples.¹⁸ Although we have estimated both fixed and random effects panels as well, the GMM estimator produces the most efficient results, correcting for a potential endogeneity bias. All standard growth variables have the expected signs. Our unilateral openness indicator proves insignificant. This result is robust for the different estimation techniques and samples. However, if an indicator of actual performance in terms of the number of subscribers is substituted for the number of operators, we obtain a positive impact on growth at the 10% significance level for Africa. Enhancing the number of subscribers to mobile telephony services by 1 per cent translates into a 1.4 per cent increase in economic growth. This result is in line with our earlier finding of a significantly positive relationship between liberalization and penetration. In other words, liberalization seems to only have an indirect effect on economic growth by contributing to an increase in the number of subscribers.

VI. CONCLUSIONS

In this paper, we have examined the impact of telecommunications reform on sectoral performance and economic growth in Africa. Africa suffers from higher prices and lesser penetration compared to the world average. For the African continent, the quality of unilateral regulation in terms of independence and competence of the regulatory authority seems to play a major role in bringing down prices and improving access to telecommunication services. This finding is remarkably stable across samples and market segments. While an increase in the number of operators improves availability of telecommunications services, as measured by the number of subscribers, it is no guarantee for price reductions. Descriptive statistics suggest that multilateral engagements, whether in the context of sub-sectoral GATS commitments or adherence to a common regulatory framework, may increase penetration and reduce prices. However, in our regression model, unlike unilateral liberalization, multilateral liberalization measures have no significant impact on performance in Africa. Conversely, at the global level adherence to the Reference Document is associated with price reductions. These results support our hypothesis that GATS commitments, especially in African countries, may be less ambitious than existing market conditions and that only real reform, which increases the number of operators and improves the regulatory environment, can shed tangible benefits to consumers. Better performance of the telecommunications sector, in turn, translates into higher economic growth.

¹⁷ See, for instance, *Neue Zürcher Zeitung* of 15 January 2006 for a powerful account of "virtual" agricultural markets being established in Africa.

¹⁸ There is also more variation in the number of operators in the mobile than fixed market segments.

References

- Barro, R. J. (1997) *Determinants of Economic Growth: A Cross-Country Empirical Study*, Cambridge, MA: MIT Press.
- Boylaud, O. et Nicoletti, G. (2000), “Regulation, market structure and performance in Telecommunications”, document de travail n° 237 de l’OCDE, Paris.
- Chen, Z. and Schembri, L. (2002) 'Measuring the Barriers to Trade in Services: Literature and Methodologies', Ministry of Foreign Affairs and International Trade, Canada.
- Doumbouya, S. F. and ILEAP (2004) 'Le Cycle des négociations du Millénaire : L’Afrique et le commerce international des services de télécommunications', mimeo.
- Ebang, A. and ILEAP (2005) 'La Participation Des Pays D’Afrique Centrale Aux Négociations Sur Le Commerce Des Services A L’OMC: Le Cas Du Gabon', mimeo.
- Fink, C., Mattoo, A. and Neagu, I. (2001) 'Trade in International Maritime Services: How Much Does Policy Matter', World Bank Working Paper No. 2522, Washington, D.C.: The World Bank.
- Fink, C., Mattoo, A. and Rathindran, R. (2002) 'Liberalizing Basic Telecommunications: Evidence from Developing Countries', Presentation made at the meeting of services experts organized by the OECD and World Bank held in Paris on 4 et 5 March 2002.
- Hauffman, J. (2000) 'Mobile telephone', in: Cave, M. E. (ed.) (2002) *Handbook of Telecommunications Economics*, Elsevier: Amsterdam: 564-603.
- Hoekman, B. (1995) 'Assessing the General Agreement on Trade in Services', in: Martin, W. and Winter, L. A. (eds) *The Uruguay Round and the Developing Economies*, World Bank Discussion Paper No. 307, Washington, D.C.: The World Bank.
- Hodge, J. ; Njinkeu, D. (2002) 'Télécommunications: Engagements, Politiques, Offres et Demandes éventuelles de l’Afrique', mimeo.
- ITU (2004) *Rapport annuel des télécommunications en Afrique*, Geneva: ITU.
- ITU (2005) *Enquêtes de l’UIT sur la concurrence et les organes de regulations*, available at <http://www.itu.int/ITU-D/treg/index.html>
- Kalirajan, K. (2000), “Restrictions on Trade in Distribution Services”, Productivity Commission Staff Research Paper, Ausinfo, Canberra.
- Kang, J. (2000) 'Price Impact of Restrictions on Maritime Transport Services', in: Findlay, C. and Warren, T. (2000) *Impediments to Trade in Services: Measurement and Policy Implication*, New York: Routledge: 189-201.
- Kemp, S. (2000) 'Trade in Education Services and the Impacts of Barriers to Trade', in: Findlay, C. and Warren, T. (2000) *Impediments to Trade in Services: Measurement and Policy Implication*, New York: Routledge: 231-245
- Marchetti, J. A. (2004) 'Developing countries in the WTO services negotiations', WTO Staff Working Paper ERSD-2004-06, Geneva: WTO.

Mattoo, A. (2004) 'Les pays en développement dans le nouveau cycle de négociations de l'accord general sur le commerce des services (AGCS): vers un role plus dynamique', in: Njinkeu, D. (ed.) *L'Afrique et les defies de l'OMC*, Paris: Karthala

Mattoo, A., Rathindran, R. and Subramanian, A. (2001) 'Measuring Services Trade Liberalization and Its Impact on Trade Growth: An Illustration', World Bank Working Paper No. 2655, Washington, D.C.: The World Bank.

McGuire, G. (2002) 'Restrictiveness of International Trade in Banking Services, in: Findlay, C. and Warren, T. (2000) *Impediments to Trade in Services: Measurement and Policy Implication*, New York: Routledge: 172-189.

Nielson, J. and Taglioni, D. (2004) 'Libéralisation des échanges de services : Identification des possibilités et des avantages', OECD Working Paper No.1 Paris: OECD.

Norton, S. (1992) 'Transaction Costs, Telecommunications, and the Microeconomics of Macroeconomic Growth', *Economic Development and Cultural Change* 41(1): 175-196. Re-printed in OECD (2001), *Revue économique* 32: Paris: OECD.]

Roller, L. and Waveman, L. (2001) 'Telecommunication Infrastructure and Economic Development: A Simultaneous Approach', *American Economic Review*, 91, 4: 878-909, September 2001.

Sáez, S. and World Bank (2005) 'European Union's Bilateral Negotiations in Trade in Services: A Review of the Experience with Developing Countries, mimeo.

Sevestre, P. (2002) *Econométrie des données de panel*, Dunod,

Shirley, M. (2001) The Effects of Regulation and Competition on. Telecommunications in Africa; available at <http://cbdd.wsu.edu/edev/kpi/shirley>

UNCTAD (2000) 'Report of the Expert Meeting on National Experiences with Regulation and Liberalization: Examples in the Construction Services Sector and its Contribution to the Development of Developing Countries", TD/B/COM.1/32, Council on Trade and Development, Commission on Trade in Goods and Services and Commodities, 5th Session, Geneva 19-23 February 2000.

Wallsten, S. (1999) 'Competition, privatization, and regulation in telecommunications markets in developing countries: An econometric analysis of reforms in Africa and Latin America', mimeo, Washington D.C. : World Bank.

Warren, T. (2000) 'The Impact on Output of Impediments to Trade and Investment in Telecommunications Services' in: Findlay, C. and Warren, T. (2000) *Impediments to Trade in Services: Measurement and Policy Implication*, New York: Routledge:85-101.

World Bank (2004) 'World Development Indicators', available at <http://www.worldbank.org/data/countrydata/countrydata.html>

World Bank (2006) *Information and Communications for Development 2006: Global Trends and Policies*, Washington D.C.: The World Bank.