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TELECOMMUNICATIONS AND ECONOMIC GROWTH: AN EMPIRICAL ANALYSIS OF SUB-SAHARAN AFRICA

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Telecommunications and Economic Growth: An Empirical Analysis of Sub-Saharan Africa[♣]

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Abstract

We examine the effect on economic growth of mobile cellular phones in sub-Saharan Africa where a marked asymmetry is present between land-line penetration and mobile telecommunications expansion. This study extends previous ones along two important dimensions. First, we allow for the potential endogeneity between economic growth and telecommunications expansion by employing a special linear generalized method of moments (GMM) estimator. Second, we explicitly model for varying degrees of substitutability between mobile cellular and land-line telephony, so that greater expansion of mobile telecommunications can have a different impact whenever the level of land-line penetration differs. We find that mobile cellular phone expansion is an important determinant of the rate of economic growth in Sub-Saharan Africa. Moreover, we find that the contribution of mobile cellular phones to economic growth has been growing in importance in the region, and that the marginal impact of mobile telecommunication services is even greater wherever land-line phones are rare. Given the low cost of mobile telecommunications technology relative to other broad infrastructure projects, especially land-line infrastructure, we advocate that mobile telecommunication services be encouraged in the area.

♣ The findings, recommendation, interpretation and conclusion expressed in this paper are those of the authors and not necessarily reflects the view of the Department of Economics of the Universidad del Rosario

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1. Introduction

Mobile and land-line (fixed-line) telephones offer great promise for improving economic wellbeing in Africa. When a farmer in a remote village can get quicker information of the prices of his products in two different towns, he can put resources where they are most needed and most valued. Resources can be better coordinated between sectors and across geographies. Better information also allows for better long-term planning, as local producers can better assess global resource demands.

The two technologies, however, are imperfect substitutes, offering different types of services. Clearly, mobile phones offer most, and possibly all, of the services of land-line telephones. The opposite statement is less true. Land-line telephones do not offer text message services or mobile internet access. Often, all that is required for an efficient decision to be made is a price quote. In this regard, a simple text message is far more cost-effective.

In this paper, we investigate the different effects that mobile and land-line phones may have on economic development, accounting for the possibility that causation may run in both directions.

Since a seminal paper by Hardy (1980) investigated the impact of telephones per capita on economic growth, a growing number of studies have attempted to identify telecommunications as an essential component of the economic infrastructure, fostering productivity and economic growth. The received implications of telecommunications infrastructure for economic development have evolved out of both direct and indirect benefits to economic growth of telecommunications expansion. For example, more efficient flow of information reduces communication and transaction costs, and accelerated information diffusion enhances market efficiency and competition as well as the potential for technological catch-up.[1]

In the literature, the relationship between telecommunications investment and economic growth has been examined in various ways. Several studies have employed time series analysis such as Granger causality tests and modified Sims tests, and have focused on the strength and direction of the causal relationship between telecommunication infrastructure investment and economic growth. For instance, Cronin et al (1991, 1993b) and Wolde-Rufael (2007) confirmed a two-way causal relationship in the U.S. between telecommunications infrastructure investment and economic growth. In a similar study, however, Beil et al. (2005) conducted Granger-Sims causality tests for a time series of 50 years in the U.S., and suggested a one-way causality from economic growth to telecommunications investment. Dutta (2001) applied Granger causality tests for a cross section of 30 developing and industrialized countries in three different years, and found a bi-directional causality for both developing and industrialized countries. Perkins et al (2005) also identified a bi-directional causality in South Africa using a PSS *F*-test (Pesaran et al., 2001).

On the other hand, a few studies have attempted to quantify the impact of telecommunications on economic growth by incorporating telecommunications infrastructure investment explicitly into a macro (aggregate) production function or a cross-country growth framework. Madden and Savage (2000) extended Mankiw et al. (1992) to develop a supply-side growth model where teledensity (the number of main telephone lines per 100 persons) and the share of telecommunications investment in national income were controlled for as telecommunications capital proxies. Their results from data on 43 countries over 1975-1990

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[1] For discussions on direct and indirect benefits to economic growth of telecommunications sector, see Tisdell (1981), Leff (1984), Antonelli (1991), Cronin et al (1993a) and Greenstein and Spiller (1995).

suggested a significant positive cross-country relationship between telecommunications capital and economic growth. In another study, Roller and Waverman (2001) endogenized telecommunications infrastructure into aggregate economic activity. They first specified a micro model of the demand for and supply of telecommunications infrastructure, and jointly estimated the micro model with the macro production function. They found a significant causal relationship between telecommunications infrastructure and aggregate output. More recently, Datta and Agarwal (2004) extended the cross-country growth framework of Barro (1991) and Levine and Renelt (1992) to examine the effects of telecommunications infrastructure on economic growth. In a dynamic panel model built upon Islam (1995), they controlled for lagged real gross domestic product (GDP) per capita to test for convergence while testing separately the direction of causality between the teledensity and economic growth using the first-lagged values of teledensity.

While previous studies attested the fact that telecommunications infrastructure investment is positively correlated with economic growth, far fewer studies have investigated how *mobile* telecommunications specifically have played a role in economic growth, especially in a region where a disproportionate rate of growth of mobile telecommunications is present relative to the level of land-line telephony. The growth of mobile telephony in Africa, especially in sub-Saharan Africa, epitomizes such a case. Due to the highly investment-intensive nature of land-line telecommunications infrastructure deployment, Africa accounted for less than two percent of the main telephone lines worldwide in 2006 while Asia had a 48 percent share (International Telecommunication Union (ITU), 2007). However, the breakthroughs in mobile phone technology in the last decade, combined with relatively cheap mobile phone infrastructure, have led Africa to achieve a significant annual growth in mobile telephone penetration. For instance, the number of mobile subscribers in Africa passed the number of land-lines in 2001 (Gray, 2006) and the number of mobile subscribers in the region increased by 46.2 percent between 2001 and 2005 (ITU, 2007). In addition, mobile penetration in Africa by the end of 2006 was 22.0 subscribers per 100 persons while Asia had 29.3, and Africa was the only region where mobile telephone services generated more revenues than land-line telephone services in 2005, accounting for more than 60 percent of total telecommunications revenues in the region (ITU, 2007). The growth in mobile telephone subscriptions in sub-Saharan countries is shown in Figure 1.

In the countries of sub-Saharan Africa, mobile telecommunications services emerged as practical means of communication recently, relative to land-line telecommunications. Such marked asymmetry in the deployment of mobile and land-line telephones[2] in the region thus requires the use of more efficient econometric corrections as the observations in the region produces a panel data of both mobile and land-line telecommunication variables with only a few time periods and a large number of sample countries. This study draws upon recent developments in estimation methods such as a linear generalized method of moments (GMM) estimator designed for fixed-effects as well as potentially endogenous regressors in situations with small time periods and large individuals (Roodman, 2006).

To reiterate, this paper departs from the existing studies in the literature in the following ways. First, we focus on the sub-Saharan countries - where cellular phones have expanded quickly, while the number of land-lines has remained low - and investigate any causal links between these two different types of phones and economic growth in the region. Second,

[2] Throughout the rest of the paper, we opt for more commonly used terminology such as cellular phones and land-line phones, rather than the more formal but cumbersome "mobile telecommunications services" and "land-line telecommunications services."

controlling for cellular and land-line phones separately, we attempt to examine the extent to which the effect on economic growth of cellular phones is pronounced when countries have relatively few land-lines. Third, for methodological improvement, this study employs the linear generalized method of moments (GMM) estimator of Arellano-Bover (1995) and Blundell-Bond (1998) that has become increasingly popular in situations where panel data is made up of few time periods and large number of individuals.

The rest of this paper is organized as follows. In Section 2, we introduce a macroeconomic growth model that accounts separately for the effects of cellular phones and land-lines. In section 3 we explain the data and estimation procedure. We discuss the econometric approach, a two-step difference generalized method of moments (GMM) estimator. In section 4 we report the estimation results. We conclude with a discussion of the results and their policy implications.

2. A Macroeconomic Growth Model

In this study we closely follow the cross-country growth framework of Datta and Agrwal (2004), which was built upon Barro (1991) and Levine and Renelt (1992) as follows:

$$\mathrm{GDPPCGR}_{it} = \alpha \mathrm{GDPPCGR}_{it-1} + \mathbf{X}_{it}^{\prime}\boldsymbol{\beta} + \mu_i + \upsilon_{it},$$

where $\mathbf{X}_{it}^{\prime} = [\mathrm{GDPPC}_{it-1}, \mathrm{TRADE/GDP}_{it}, \mathrm{GDI/GDP}_{it}, \mathrm{GC/GDP}_{it},$

$\mathrm{POPGR}_{it}, \mathrm{LANDPHONES100}_{it}, \mathrm{CELLPHONES100}_{it},$

$\mathrm{LANDPHONES100}_{it} \cdot \mathrm{CELLPHONES100}_{it}],$

and

$$E[\mu_i] = E[\upsilon_{it}] = E[\mu_i \upsilon_{it}] = 0 .$$

In the above growth equation, μ_i and ν_{it} are the unobserved country-specific effects and idiosyncratic shocks, respectively. GDPPC is GDP per capita, and GDPPCGR is the growth rate of GDP per capita. Assuming a dynamic process in which the current value of the dependent variable may be influenced by past ones, the lagged value of GDPPCGR is controlled for on the right-hand side. As a standard measure to test for convergence, the lagged value of GDPPC is also included. TRADE/GDP is a country's trade volume as a share of its GDP and is a proxy for the degree of openness of a country's economy. POPGR is the growth rate of population and GDI/GDP is gross domestic investment as a share of GDP. GC/GDP is a government consumption expenditure for goods and services as a share of GDP. GC/GDP is included to estimate the effect on economic growth of the proportion of government consumption expenditure relative to GDP. As widely evidenced in the economic growth literature, negative coefficients are expected for POPGR, the lagged values of GDPPCGR, and GDPPC while positive coefficients for TRADE/GDP and GDI/GDP. LANDPHONES100 is the number of main telephone lines per 100 people and serves as an indicator of the penetration of conventional land-line telephony. Similarly, CELLPHONES100 is defined as the number of mobile phone subscribers per 100 people. Both LANDPHONES100 and CELLPHONES100 are expected to be positively correlated with economic growth. Lastly, we include an interaction term between LANDPHONES100 and CELLPHONES100. The interaction term is included in order to allow the marginal impact of cellular phones to vary with the level of land-lines that are already in place. In a region like sub-Saharan Africa where cellular phone penetration far exceeds that of land-lines, a negative coefficient is expected. This implies that the impact on economic growth of mobile telecommunications is more pronounced when the penetration of land-lines is relatively low.

3. The Data and Estimation Procedure

Examining the relationship between the telecommunications infrastructure investments and economic growth, this study focuses on 44 sub-Saharan countries as marked asymmetry has been witnessed between the conventional land-line penetration and mobile phone service expansion in the region. All the data are from the *World Development Indicators* 2008 of the World Bank. The data cover 44 sub-Saharan countries over the years 1975-2006. The sample countries in the sub-Saharan Africa are listed in Table 1 and the descriptive statistics of the panel data used in this study are summarized in Table 2.

An issue of the uttermost pertinence is whether there is a causal relationship between telecommunications infrastructure and economic growth. Although many early-cited time-series studies of causality found evidence of a one-way or two-way causation between telecommunications investment and economic growth, such evidence does not necessarily imply that a change in telecommunications investment will cause a subsequent change in the rate of economic growth and vice versa. Some studies attempted to identify a causal link by controlling for either the initial year's stock of land-line phones (Norton, 1992) or the previous year's teledensity as a proxy for telecommunications investment (Datta and Agarwal, 2004).

In order to address the issue of reverse-causality, this study uses the two-step difference generalized method of moments (GMM) estimator of Arellano-Bover (1995)/Blundell-Bond (1998). The Arellano-Bover (1995)/Blundell-Bond (1998) difference GMM estimator allows the modification of several key assumptions of panel data approach.[3] First, the estimator is designed

[3] Roodman (2006) provides with a full discussion on the derivation of the Arellano-Bover (1995)/Blundell-Bond (1998) difference GMM estimator. Our discussions on the modification of key assumptions about panel data approach draws heavily upon Roodman (2006).

to accommodate not only (potentially) endogenous independent variables but also independent variables that are not strictly exogenous. In fact, this study assumes that all telecommunications variables are potentially endogenous, meaning that higher economic growth can be the result of higher telecommunications infrastructure investments and vice versa. In the Arellano-Bover (1995)/Blundell-Bond (1998) difference GMM estimator, (potentially) endogenous independent variables are treated as follows. Applying the first-difference transform to the previous cross-country growth framework, we obtain

$$\Delta \text{GDPPCGR}_{it} = \alpha \Delta \text{GDPPCGR}_{i\,t-1} + \Delta \mathbf{X}_{it}^{\prime} \boldsymbol{\beta} + \Delta \upsilon_{it}.$$

Let x^j_{it}, the j-th variable in **X**, be an endogenous regressor. While the first-difference purges out the fixed-effects, x^j_{it} in $\Delta x^j_{it}=x^j_{it}-x^j_{i\,t-1}$ still correlates with υ_{it} in $\Delta\upsilon_{it}=\upsilon_{it}-\upsilon_{i\,t-1}$. To work around this dynamic panel bias, the Arellano-Bover (1995)/Blundell-Bond (1998) two-step difference GMM estimator instruments levels with differences. Thus, for an endogenous variable x^j_{it}, $\Delta x^j_{i\,t-2}$ can be used as an instrument if υ_{it} is not serially correlated of order 1 since $\Delta x^j_{i\,t-2}=x^j_{i\,t-2}-x^j_{i\,t-3}$ is not correlated with $\Delta\upsilon_{it}= \upsilon_{it}- \upsilon_{i\,t-1}$. If, however, υ_{it} is serially correlated of order 1, $\Delta x^j_{i\,t-2}$ is no longer a valid instrument and thus a proper instrument needs to be restricted to the third lagged values or more ($\Delta x^j_{i\,t-s}$ for $s\geq3$). In this study, we assume that telecommunications variables are potentially endogenous and thus valid instruments are determined according to the Arellano-Bond (1991) test for autocorrelation.

Furthermore, this study differs from the previous studies in the literature that typically impose the assumption of strict exogeneity on other independent variables such as the growth rate of population, gross domestic investment, and gross government consumption expenditure. Instead this study assumes that those commonly-assumed-to-be-exogenous independent variables are correlated with past realizations of the error term. Let x^k_{it} be an independent variable that may not be strictly exogenous. Then $E[x_{it}\nu_{is}]\neq 0$ for s<t while $E[x_{it}\nu_{is}]=0$ for $s\geq t$ (Stata, 2005). For instance, the error term $\upsilon_{i\,t-1}$ might have some impact on the subsequent realization of x^k_{it} but not vice versa. Thus, following the standard treatment in the Arellano-Bover (1995)/Blundell-Bond (1998) difference GMM estimator, we use $\Delta x^k_{i\,t-1}= x^k_{i\,t-1}- x^k_{i\,t-2}$ as instruments since $x^k_{i\,t-1}$ in $\Delta x^k_{i\,t-1}= x^k_{i\,t-1}- x^k_{i\,t-2}$ is potentially correlated only with errors $\upsilon_{i\,t-s}$ for $s\geq 2$, but not with $\Delta\upsilon_{it}=\upsilon_{it}-\upsilon_{i\,t-1}$.

4. Estimation Results

Table 3 reports two sets of the Arellano-Bover (1995)/Blundell-Bond (1998) two-step difference GMM dynamic panel data estimation results. Although the panel data in use was constructed for 1975-2006, as an asymmetric pattern in growth between the conventional land-line penetration and mobile phone service expansion has become most conspicuous in the 2000s, we estimated the cross-country economic growth model for the entire observation period of 1975-2006 and for the cropped data from 2000 to 2006, respectively.

As a principal issue of this study, we first focus on the estimation results of the telecommunications variables. In Regression (1) for the observations from 1975 to 2006, the Arellano-Bond autocorrelation test statistic indicates that there is a first-order autocorrelation in the idiosyncratic error term (ν_{it}). Thus, following the standard treatment in the Arellano-Bover (1995)/Blundell-Bond (1998) difference GMM estimator, we instrumented the third lagged values of all potentially endogenous telecommunications variables. Among the telecommunications variables, LANDPHONES100 (the number of main telephone lines per 100 persons) is positively correlated with the growth rate of GDP per capita and the estimated coefficient is statistically significant. The estimated coefficient of CELLPHONES100 (the number of mobile phone subscribers per 100 persons) is positive as expected but statistically insignificant. This finding, as Regression (2) will show, is attributable to the fact that differences in the number of cellular phones were miniscule in much of the rest of the world, and especially in the sub-Saharan Africa, before the turn of the millennium. It appears that the impact of these small, seemingly random, changes in the telecomm variables were overwhelmed by the more powerful forces at work in the region such as the amount of gross domestic investment as a share of GDP (GDI/GDPP), the degree of openness of a country's economy (TRADE/GDP), and large presence of the government expenditure relative to a country's GDP (GC/GDP).

In contrast to Regression (1), the Arellano-Bond test for AR(1) in Regression (2) suggests that we do not reject the null hypothesis of no first-order autocorrelation in the first-differenced residuals, validating the second lagged values of all telecommunications variables as the instruments. The estimated coefficients and statistical significance of LANDPHONES100 and CELLPHONES100 in Regression (2) suggest quite different evidence. When the same empirical specification is estimated using a cropped panel data from 2000 to 2006, land-line telephone penetration no longer has a significant impact on economic growth and its estimated coefficient is much smaller than in Regression (1). On the other hand, cellular phone penetration appears to have more evident impact on economic growth, both economically and statistically. The estimated coefficient of CELLPHONES100 in Regression (2) is much larger than one in Regression (1). This finding is consistent with the fact that cellular phone technology is less capital-intensive than land-line telecommunications, and thus its direct impact on economic growth has become more significant in the 2000s as the deployment of the mobile telecommunications infrastructure is relatively easy to fund. Furthermore, the indirect benefits of cellular phone penetration to economic growth could be quite substantial as it has recently emerged as practical means of communication in the region partly due to affordable handsets and competitive cellular telecommunications markets in the region (ITU, 2007). Another interesting finding is that the impact on economic growth of mobile telephone penetration is more pronounced when land-line telephone expansion is low. The negative coefficient of the interaction term confirms the finding.

Among other determinants of economic growth, the coefficient of lagged GDP per capita is negative and significant at the 1% significance level in both regressions, supporting the convergence hypothesis that GDP per capita tends to grow at a slow rate in countries with higher level of GDP per capita. The share of trade in GDP (TRADE/GDP) as a proxy for the level of openness of a country's economy is positively correlated with the growth rate of GDP per capita and its coefficient is significant at the 10% level in both regressions. The results indicate that countries with greater global interaction achieve higher growth rate of GDP per capita. The coefficient of gross domestic investment as a share of GDP (GDI/GDP) is positive and significant at the 5% level in Regression (1), but insignificant in Regression (2). The impact on economic growth of the share of gross domestic investment in GDP appears to be insignificant as the sample data is cropped to 2000-2006 time periods. Compared to other regions in the world, the countries in the sub-Sahara region have long experienced the lack of capital for domestic investment. The estimated coefficient of the share of government consumption expenditure in GDP (GC/GDP) is negative and significant at the 10% level in Regression (1), but insignificant in Regression (2), suggesting that the government consumption expenditure is no longer a significant factor promoting a country's economic growth in the region. The growth rate of population (POPGR) does not appear to have a significant association with the growth rate of GDP per capita in either regression.[4]

5. Conclusions and Policy Implications

Traditionally, development economists paid much attention to the usefulness of infrastructure as proper roads and electrical grids are considered a prerequisite to strong economic growth. After all, one must be able to produce the goods and bring them to the market. Since Hardy's seminal paper (1980), development economists have broadened their view to include telecommunications infrastructure among the variables conducive to growth. The efficiency of a market, and thus its rate of growth, depends upon the minimization of trading costs, including those associated with the use of, and knowledge of, the relevant market prices. Where should an African fisherman sell his fish today, up-coast or in-land? Growth rates in average incomes in Africa, and everywhere, depend crucially upon whether people have access to such information.

The most recent development studies have treated all phones - cellular and land-line phones - as equal, as they both serve to connect people to market information. But cellular phones are different in several important aspects. First, the up-front infrastructure costs are substantially different. Cellular phones are significantly less costly to install, as opposed to stringing together physical telephone wires. So, a dollar invested in cellular phone infrastructure yields many more phones, and much more information, than a dollar invested in land-lines.

[4] As is standard in GMM estimation, the joint validity of the instruments is tested. The Hansen test of overindentifying restrictions is satisfactory for both regressions. Also, in both regressions, the Arellano-Bond test suggests that we do not reject the null hypothesis of no second-order autocorrelation in the first-differenced residuals.

Second, cellular phones are portable, so remote villagers can use them, and just as importantly, they can use them while *en route* to markets.

Our paper differs from others in that we treat cellular phones and land-line phones as separate, though not completely dissimilar technologies. More importantly, we explicitly model the degree of substitutability between cellular phones and land-line phones by including an interaction term. This allows the marginal contributions of cellular phones on growth to vary with the level of land-line phones already in place.

Our final improvement is methodological. Previous studies have focused on the potential endogeneity of telecommunications and GDP growth along Granger-causal lines. But this is done at the cost of having to treat all other variables as strictly exogenous. We, on the other hand, allow for our variables not to be strictly exogenous, by employing the Arellano-Bover (1995) and Blundell-Bond (1998) GMM estimator.

We find the current importance of traditional land-line phones for economic growth to be negligible in the sub-Saharan region. On the other hand, the contribution of cellular phones to economic growth has been growing in importance. While it is obvious that cellular phone use has been growing, we document that the impact itself of a single cellular phone has also been growing. Moreover, we find that the marginal impact of cellular phones is greater wherever land-line phones are rare. Combining these two results with the fact that cellular phone infrastructure is comparatively cheap, and the policy implication is clear – more cellular phone infrastructure should be encouraged in the sub-Saharan region, as it is the more cost-effective and beneficial technology.

Figure 1

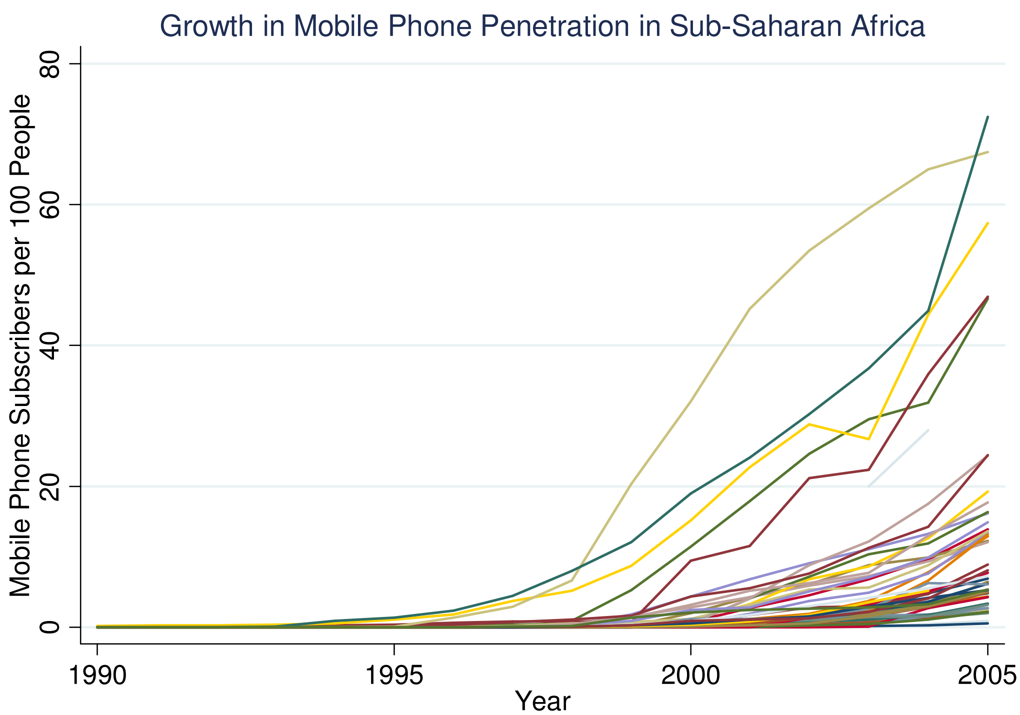

Table 1 List of the Sample Countries

Angola	Congo (Rep.)	Lesotho	Senegal
Benin	Cote d'Ivoire	Madagascar	Seychelles
Botswana	Equatorial Guinea	Malawi	Sierra Leone
Burkina Faso	Eritrea	Mali	South Africa
Burundi	Ethiopia	Mauritania	Sudan
Cameroon	Gabon	Mauritius	Swaziland
Cape Verde	Gambia	Mozambique	Tanzania
Central African Rep.	Ghana	Namibia	Togo
Chad	Guinea	Niger	Uganda
Comoros	Guinea-Bissau	Nigeria	Zambia
Congo (Dem. Rep.)	Kenya	Rwanda	Zimbabwe

Table 2 Descriptive Statistics

Variable		Mean	Standard deviation	Observations
GDPPCGR	overall	0.75	7.35	1361
	between		2.62	47
	within		6.96	
GDPPC	overall	2352.51	2733.22	1320
	between		2539.80	44
	within		1018.34	
TRADE/GDP	overall	71.76	38.77	1330
	between		34.50	46
	within		17.82	
GDI/GDP	overall	19.69	10.43	1236
	between		8.17	46
	within		7.25	
GC/GDP	overall	16.14	7.90	1294
	between		7.17	46
	within		4.93	
POPGR	overall	2.57	1.27	1500
	between		0.51	48
	within		1.17	
LANDPHONES100	overall	15.73	36.21	1348
	between		28.33	47
	within		21.80	
CELLPHONES100	overall	14.90	60.76	1446
	between		39.65	48
	within		55.72	

Table 3 Two-step Difference GMM Estimation Results

Variable	**Regression (1)** (1975-2006)	**Regression (2)** (2000-2006)
$GDPPCGR_{t-1}$	0.0462 (0.1006)	-0.1931 (0.1335)
$GDPPC_{t-1}$	-0.0022*** (0.0006)	-0.0025*** (0.0003)
TRADE/GDP	0.0376* (0.0225)	0.0539* (0.0328)
GDI/GDP	0.1254** (0.0535)	0.0731 (0.0727)
GC/GDP	-0.2406* (0.1281)	-0.1122 (0.1207)
POPGR	-0.1627 (0.4570)	0.2298 (0.7973)
LANDPHONES100	0.0540*** (0.0187)	0.0324 (0.0557)
CELLPHONES100	0.0064 (0.0113)	0.0191*** (0.0058)
LANDPHONES100·CELLPHONES100	-0.00004 (0.00006)	-0.0001* (0.00005)
Number of observations	1037	229
Number of groups	44	43
Wald Chi^2 (9)	45.38	178.59
Hansen test of overidentification	Chi^2 (1010)=39.94	Chi^2 (220)=32.84
Arellano-Bond test for AR(1)	Z=-2.80 (Pr>Z=0.005)	Z=-1.38 (Pr>Z=0.166)
Arellano-Bond test for AR(2)	Z=-1.43 (Pr>Z=0.154)	Z=-0.80 (Pr>Z=0.423)

Windmeijer finite-sample corrected standard errors are reported in parentheses.
*, **, and *** indicate significance at 10%, 5%, and 1% levels, respectively.

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