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Institutions Political Regime and Access to Telecommunications Infrastructure in Africa

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Abstract

Recent analysis of infrastructure development has focused on the influence of political and institutional factors in both developed and developing countries. However, very little has been conducted on the basis of Africa alone since the mid 1980's when noticeable attempts began to be made regarding telephone development in the region. This study uses panel data techniques to provide a comprehensive explanation for telecommunications penetration in 37 African countries over the period 1985-97. It explores the effects of specific institutional, political, cultural and economic factors on the performance of basic telephony in Africa. The results from the empirical analysis suggest that high per capita GDP is associated with improved telephone penetration but, by itself, is not as strong as one might expect on the basis of other cross-national studies. In addition, a strong institutional framework can enhance investment in telephone infrastructure. Such a framework involves a respect for property rights, which yield perceptions of contractual security and reduced likelihood of expropriation. Contrary to expectations, countries with similar institutional quality are likely to have higher access to telephones if they utilize the French legal system, rather than the English common law code. Finally, a more democratic country is likely to have lower access to telephone network than a less democratic country with similar characteristics.

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1. INTRODUCTION

Empirical evidence regarding the effect of institutions and political regime exists, but little is empirically established for developing economies in Africa. Most analyses of telecommunications reform in Africa are found in case studies and country reports, such as those by Chance, Booz, Allen and Hamilton, Inc. (1998), Laidlaw and Parkinson (1995), Frempong and Atubra (2001) and Onwumechili (2001). Policy inferences for the African telecommunications sector have relied on research done in other developing regions, such as Latin America and the Caribbean¹, and conclusions are sometimes drawn from studies that lump Africa with countries from dissimilar regions.

A study specific to Africa is warranted because of the continent's diverse cultural, ethnic, economic and political institutions, its persistent internal conflicts and its lack of development relative to other regions. By considering Africa alone, we reduce the chance of drawing conclusions that might be true in one developing region but not another. It is also easier to account for heterogeneity across countries in a single region than for countries in different regions.

Research such as that by Sachs and Warner (1997) concludes that the slower growth observed in Africa is not explained any differently than growth in other regions. More recently, however, Block (2001) found important differences in Africa compared to other countries. For instance, he found that lack of openness to trade affects growth more adversely in Africa than in other low- and middle-income countries. By extension, this finding supports the circumscribed study of Africa, so that policy prescriptions may be based on relations that are particularly applicable to Africa, as opposed to generic prescriptions that may not be appropriate.

Cross-national studies on African telecommunications development have been difficult because of data limitations, since serious reform began only in the mid- to late 1980s. With data from 37 African countries during 1985-91, this study helps fill a gap in research on Africa by using panel data techniques to perform a cross-national evaluation on the effects of institutions, political systems and cultural issues (proxied by legal systems) on telephone penetration rates.

The results from the empirical analysis suggest that high per capita GDP is associated with improved telephone penetration but, by itself, is not as strong as one might expect on the basis of other cross-national studies. In addition, a strong institutional framework can enhance investment in telephone infrastructure. Such a framework involves a respect for property rights, which yields perceptions of contractual security and reduced likelihood of expropriation. Contrary to expectations, countries with similar institutional quality are likely to have higher access to telephones under the French legal system rather than the English common law code. Finally, a more democratic country is likely to have lower access to telephone network than a less democratic country with similar characteristics.

The results are important, both from the perspective of the private investor as well as the public operator. Consideration of demography and affordability on penetration rates is essential for the analysis of the cost effectiveness and potential profitability of investing in the region. From a policy perspective, it is important for the decision maker to understand the relation between the institutional environment, polity, culture and telecom investment in order to implement policies that create an environment conducive to telecommunications investment, as well as a regulatory system that is beneficial to both providers and users of basic telephone service.

Classifying the institutional and political issues sets the background for an exploration of infrastructure development in Africa from a more technical perspective. Such issues include the role of growing mobile access in countries with relatively low penetration rates. I analyzed this issue in Hamilton (2001) by modeling the endogeneity between main line and mobile telephones.

Despite the influx of new telecommunications services like mobile technology, voice mail, call waiting, as well as increased access to fixed-line telephony, access to basic telecommunications² in Africa is still very limited (Kerf and Smith, 1996). Investment in basic telephony in Africa is far below the level in Latin America, the Caribbean and Asian Pacific regions. In 1985, Africa's penetration rate was, on average, 10.45 per 1,000 people, more than times lower than that of Latin America and the Caribbean. By

¹ Some cross-national studies of developing areas, such as Singh (2000), Guitierrez and Berg (2000) and Wallsten (1999), either do not include data on Africa or they lump Africa with other emerging economies.

1997, despite a growth rate of 147 percent, Africa's access rate remained more than five times lower than in Latin America and the Caribbean.

Teledensity in Africa has been low partly because of relatively low income levels. Between 1980 and 1990, Africa suffered a decline in its already low income levels. Between 1985 and 1997, per capita income in Africa was, on average, US \$915, compared to more than US \$2,000 in Latin America and the Caribbean and US \$5,000 in Asia. Although low, teledensity has been increasing in Africa and reached 25.82 per 1,000 people in 1997. This average (unweighted by population) is skewed upward since many countries have much weaker performance. If Seychelles, with an access rate of 203.64, Mauritius with 227.65 and South Africa with 144.60 were deleted from the sample, average access in Africa would be only 15.66 in 1997. So despite recent innovations in the sector and general economic growth, access to telecommunications in Africa is still limited. As in most developing regions, telephone lines are concentrated in the cities, with only limited access for rural areas. Nevertheless, despite the poor quality of infrastructure compared to other developing countries, the opportunities for telecommunications development in Africa are immense.

While there has been a tremendous amount of investment and reform elsewhere in the world, Africa was largely ignored until recently. The sector is currently predominantly state-owned, but some governments have embarked on reform programs, most of which involve two elements: gradual commercialization by separating operational management from government ministries and the transfer of responsibility for regulation away from government ministries to independent agencies. Privatization options being considered include public offers for sale to financial institutions, sale to private investors and employees, private sale to strategic investors, or divestiture and management contracts with foreign operators.

The change occurring in the region is often obscured by political constraints that limit a government's desire or ability to make policy commitments to promote the development of the sector

² Basic telecommunications, telephony, telephone access, penetration and network access refer to both mobile and main line telephones unless otherwise specified.

(Mustafa et al. 1997). Analysts like Kerf and Smith (1996) argue that special attention must be given to establishing stable and independent regulatory agencies that can provide credibility for investors, legitimacy for consumers, and more efficient sector performance. The creation of suitable regulatory systems is important because the success of the restructuring process depends heavily on the credibility and consistency of that reform.

After surveying recent studies, I outline several hypotheses and then briefly review the state of telecommunications in Africa. The basic data are examined in Section 5, followed by the model development and estimation. The concluding section summarizes the results.

2. RECENT RESEARCH

Research concerning the influence of political stability on investments has a long history. Three decades ago, Bennett and Green (1972) sought to identify the role of politics by testing the hypothesis of a negative relation between the allocation of U. S. marketing investment throughout the world and the level of national political instability in different countries. They also tested whether such a negative relation existed only in less developed countries. They found that political instability does not discourage investment in marketing activities. If this finding were applicable to infrastructure investments, then political factors could be viewed as playing only a minor role in utility sectors; however, irreversible fixed costs makes these capital-intensive sectors sensitive to political instability.

Studies of infrastructure since 1972 have found that political conditions do, in fact, influence the level of investment that takes place abroad (Haan and Siermaan 1995, Bergaria [Bergara in refs.] et al. 1998, Henisz 2000, Svensson 1998). Research has shown that (telecommunication) investments will be larger when there are strong political constraints on government officials [so it's clear that business executives aren't what you mean].³

³The framework for utility investment is more consistent and predictable when there are more independent checks on government's executive power. According to Svensson (1998), political factors affect infrastructure development, but the effect is indirect in that the political environment merely provides the channel through which private investment flows. He found that private investment is restricted when those in power lack incentives to undertake legal reforms that protect property rights and encourage investment. Weak property rights lead to the reallocation of resources away from taxable activities, which reduces future governments' tax revenues and ability

Knack and Keefer (1995,1997), Guitierrez and Berg (2000), Henisz (2000) and Singh (2000) are among studies finding a relation between the institutional environment, economic growth and infrastructure investment. They have shown that the greater the policy uncertainty, the smaller the level of investment. Among poorer countries, those with stronger institutional bodies that enforce law and protect property rights have better prospects for private investment and increased payoff for public infrastructure investment.

Considerations other than political and institutional ones have been identified as determinates of infrastructure investment, including economic indicators that capture the standard of living and other features of the economy. Higher income levels make foreign investment more attractive, as does expected growth and predictability of that growth. Alesina and Perotti (1996) looked at the more complicated question of how the distribution of income may determine the level of investment. Using data from 1960 to 1985, they found that income inequality increases sociopolitical instability by fueling discontent. This in turn creates uncertainty in the political and economic environment, which reduces investment.

Applying the “catch up” theory of growth, Antonelli (1993) provided an explanation for the ability of some poor countries to catch up. By taking advantage of technology in advanced countries, latecomers can experience rapid growth in telecommunications development. He concluded that new investment plays a significant role in the diffusion of advanced telecommunications in countries with high rates of growth in GDP and telecommunications infrastructure.

to spend. In not reforming the legal system, the current government affects future governments. By protecting its current constituency, the government neglects the provision of a favorable environment for investment. Haan and Siermaan (1995) stressed that, although the relation between democracy and economic growth is not robust, high levels of economic growth cannot take place in an environment where democratic rights are repressed. Since investment contributes significantly to the rate of economic growth, the same relation might be expected between investment and democracy.

3. HYPOTHESES

Institutions and Network Access

A positive correlation is expected between network access and institutions. Institutions are the formal and informal rules that guide human interactions, whether they are social, political or economic (North 1990). They reduce uncertainty by establishing a stable framework for human relationships. Institutions involve not only rules but also enforcement, which usually involve the state. Investment is likely to be encouraged in an environment where participants understand the rules of the game and where the risk of losses is minimized (North, 1986). Rules and regulations that guide the telecommunication sector protect both the private operator and the public manager. Private investors appreciate strong institutions that discourage governments from renegeing on promises. Investment in telecommunications involves the commitment of large sunk costs, and private investors are exposed to the risk of expropriation of their property (Levy and Spiller 1994).

The same point applies to government investment. Ministries responsible for investment are less likely to be able to raise capital (from the national budget or through the issuance of project-specific bonds) if political instability is high. Why go to all the effort of planning and coordinating major new initiatives when the next government might reverse the process or give the construction contract to a political supporter? Shifting patronage and civil strife do not provide a firm foundation for long-term government investment. Furthermore, if prices are below cost, additional subscribers just mean a larger deficit. Theories of political economy suggest that the political and institutional environment in Africa has not been conducive to telecom investment (Goldsmith 2001).

Governments that tend to be unstable characterize Africa for the most part, and government policies are often unstable as well. South Africa is an example of how stronger institutions can affect telecommunications investment. Since 1990 and the establishment of political freedom and stability in South Africa, many parts of the nation that previously had minimal access to telephones now have relatively good access. The state-owned operator is committed to privatization of the industry and to increased access for citizens (ITU 1998).

The transformation in South Africa highlights the interdependence of institutions and organizations. As discussed by North (1990), economies perform differently over time not just because of institutions and organizations themselves, but also because of their interactions, which determine the direction of institutional change. A significant improvement in the development of Africa's telecom infrastructure is therefore conditional on strong credible political institutions that protect against rent seeking and create safe and healthy environments for investment.

Political Systems and Network Access

To control for the effect of political structures and party system, I introduce a proxy for democracy taken from the Polity III Democracy Index⁴ described in Section 5. Theory suggests a direct relationship between democracy and investment. According to this view, the democratic process and the existence of civil liberties generate conditions most suitable to economic development. In a democracy, political actions are accountable to the press and the public; therefore, a government's ability to manipulate policies to suit political ends may be limited (Haan and Siermann 1995). This argument is particularly applicable to investments in telecommunications, which cannot be easily redeployed. In countries with a non-democratic system of government, the risk associated with investment is high unless the government can make a credible commitment not to expropriate capital assets or unduly limit returns.⁵ Over the sample period, state-owned firms provided most telecommunication services in Africa.

Cultural Considerations and Network Access

Although people and regions in Africa are diverse, a common history of colonization is unifying. Colonization remains a legacy in the form of cultural, social and political influences of foreign powers that help to define these countries today. Often the laws and norms of a country draw on those of the

⁴ The democracy score of the Polity III index is based on five components: The competitiveness of political participation, weighted 0.3; the regulation of political participation, competitiveness and openness of executive recruitment, each weighted 0.1; and constraints on the chief executive, weighted 0.4 (Jagers and Gurr 1995).

⁵ Goldsmith (2001) found that African countries with less political risk tend to have more open governments and low levels of political corruption. This results in better functioning of the democratic process and encourages leaders to pursue policies which are less shortsighted.

former colonial power. According to cultural theories of institutions, a society's behavior, its actions and governments are shaped by its beliefs and shared values.

The efficient functioning of a society requires that individuals (economic agents) believe that their institutions are credible and efficient (La Porta et al. 1999). One aspect of the cultural norms of a country is its legal system. Countries that have an interventionist legal system restrict the ability of investors to buy, sell and engage in efficient contracting, which affects risks and the return on investments. The view of the new institutional economics supports an economic environment in which the government is relatively non-interventionist, providing a promising environment for investment (Knack and Keefer 1995).

Using these theories, I hypothesize that the impact of the institutional variables in the model will vary, depending on the legal system in each country. With this in mind, the data were divided according to legal code.⁶ Incorporating the legal system as a variable allows the countries in the sample to be divided according to the traditional tendencies of the government regarding intervention. LaPorta et al. (1999) argue that French civil law tends to be used by the state as a means of expanding its power and offers relatively less protection for individuals than British common law. Governments that utilize the French civil code are therefore expected to be more reluctant to reduce their control in the telecom sector, which may be regarded as a key area that has to be guarded closely.⁷ Because British common law traditionally offers more protection for individuals and limits the powers of governments, a country with French legal traditions are expected to have lower access to telephones inasmuch as control hampers investment and lowers the efficiency of sector performance.

4. THE STATE OF TELECOMMUNICATIONS IN AFRICA

Tables 1a and 1b trace the development of telecommunications in Africa from 1985 to 1997. Many African countries are now concerned with telecom infrastructure for the same reasons that they

⁶ Specifically, I divide the countries into three groups. (1) countries that utilize the English common law legal system, (2) those that utilize the French civil code and (3) all other countries.

limited foreign and private ownership in the past. Telecom investment is strategic and can contribute to a country's economic development. Most African countries, however, still require a substantial increase in investment in telecom infrastructure to even catch up with other developing regions.

Table 1a. Network Access: Africa's Place Relative to Other Developing Regions (1985-1997)

Region	1985	1991	1997
Africa	10.4	15.0	25.8
Latin America and the Caribbean	51.4	68.2	135.8
Asia	83.5	111.6	234.7

Table 1b. Growth in Network Access: Africa Relative to LAC and Asia (1985-1997)

Region	1985-91	1992-97	1985-97
Africa	4.6 (44%)	10.0 (63%)	14.6 (145%)
Latin America and the Caribbean	16.8 (33%)	61.2 (82%)	84.4 (146%)
Asia	28.1 (34%)	111.0 (90%)	151.2 (181%)

Note: The first number in each cell represents growth in telephone access per 1,000 individuals; the percentage change is in parentheses.

Over the period 1985-97, Africa consistently displays lower network access than Asia and Latin America and the Caribbean. In 1997, access in Africa was more than five times less than in Latin America and the Caribbean and more than nine times less than in Asia. Despite growth at an increasing rate over the years, Africa has failed to catch up with Latin America and the Caribbean and Asia, where access has also grown. However, the rate of growth indicates that Africa has recognized the importance of developing its telecom sector with both mobile and wire line provision. As part of their commitment to increase telephone access in Africa, some countries have agreed to allow some degree of private participation in wire line provision.⁸ Table 2 reflects this change, showing that it is no longer a foregone conclusion in Africa that telecommunications must be operated by government in order to meet national objectives. An asterisk indicates those countries that have made a commitment to privatize even though ownership remains with the state thus far.

⁷ So far, there is no evidence that countries with French civil legal systems are less likely to privatize their telecommunications network. Up to 1997 the number of countries with a tradition of French civil legal background that had privatized (or promised to privatize) exceeded those of English common law background by one country.

⁸ Even those countries reluctant to give up control of wire line provision have allowed some degree of private participation in cellular provision. For more on cellular privatization and competition, see Hamilton 2001, which analyzes the role of mobile competition in the development of fixed line telephony.

Table 2: Ownership of Wire Line Service in Africa

Country	Ownership (Amount and year privatized)	Country	Ownership (Amount and year privatized)
Algeria	100% state-owned	Morocco*	100% state-owned
Botswana*	100% state-owned	Niger*	100% state-owned
Cameroon	100% state-owned	Nigeria	100% state-owned
Congo*	100% state-owned	Rwanda	100% state-owned
Cote d'Ivoire	Privatized (51%, 1997)	Sierra Leone	100% state-owned
Egypt*	100% state-owned	South Africa	Privatized (30%, 1997)
Gabon	Privatized (39% by 1998)	Tanzania	Privatized (___ by 1998)
Ghana	Privatized (30%, 1996)	Togo	100% state-owned
Kenya*	100% state-owned	Tunisia	100% state-owned
Madagascar	Privatized (34%, 1995)	Uganda*	100% state-owned
Malawi	100% state-owned	Zambia*	100% state-owned
Mali*	100% state-owned	Zimbabwe*	100% state-owned

* indicates countries that have committed to privatize in the near future.

Source: Leblanch-Woher, and Lewington (2000).

Many socialized entities have not performed well. The extent of investment required in developing countries is usually too large and expensive for the government to manage on its own, which is one reason infrastructure (telecommunications) development in Africa has been slow and sometimes nonexistent. Indeed, there is evidence of strong performance following privatization in many developing nations, including those in Latin America and the Caribbean (Guitierrez and Berg 2000).

Once privatization is accomplished, modernization and development can increase the efficiency and availability of service. Although telecommunication infrastructure is largely state-owned in Africa, some countries are in the process of reforming the sector, following world trends as well as demands by international lending agencies. Joint ventures are a typical first step employed by African countries to change the market structure of the sector. The extent to which governments commit to privatization and sector development depends on economic and political considerations, as well as the risk environment of the country. The increased commitment to private investment shown in Table 2 indicates that African countries have come to accept that there are benefits from privatization. Some of these include increased services and quality of service, as well as improved access at lower cost and the availability of additional

capital and management skills.⁹ Even when the privatized entities are essentially monopolies, consumers can benefit from reduced prices with proper regulation of monopolistic power. This is because monopoly profits are not essential to induce investment [meaning unclear] (Noll 1999). The threat of potential competition may be enough to induce telecom investment.

5. THE DATA

The 1985-97 study period was determined by constraints on the data available for some of the variables. Definitions of variables and sources of the data used in the model are given in Table 3.

Table 3: Data Definitions and Sources

Variable and definition	Source
NETWORK is the dependent variable. It is the (# of main telephone lines/population)*1000 (# of cellular subscriptions/population)*1000	World Bank's World Development Indicators (1999)
The economic and demographic variables are:	
LOGGDPC The natural logarithm of a country's per capita gross domestic product (GDP) lagged one period. The base year is 1990.	World Bank's World Development Indicators (1999).
LTRADE Imports plus exports as a fraction of GDP lagged one period.	World Bank's World Development Indicators (1999).
URBAN Urban population/total population. That is, the percentage of the total population that resides in urban areas.	World Bank's World Development Indicators (1999)
The institutional variables are:	
CORRUP Corruption within the political system on a scale of 0 to 6. Larger values indicate less corruption	IRIS-3 file of International Country Risk Guide (ICRG) data, 1982-97, constructed by Stephen Knack and the IRIS Center, University of Maryland.
LAW Index of law-and-order tradition. It measures the degree to which citizens of a country are willing to support established institutions to make and implement laws and adjudicate disputes. The index ranges from 0 to 6. A high point indicates a strong law-and-order tradition.	IRIS-3 file of International Country Risk Guide (ICRG) data, 1982-97, constructed by Stephen Knack and the IRIS Center, University of Maryland.
BUREAU Index of bureaucratic quality on a scale ranging from 0 to 6. It measures the extent to which a country's bureaucracy is able to govern without drastic changes in policy, or interruption in government services. High index values indicate a strong bureaucracy.	IRIS-3 file of International Country Risk Guide (ICRG) data, 1982-97, constructed by Stephen Knack and the IRIS Center, University of Maryland.

⁹ For instance, Ghana has experienced noticeable improvements in telecom penetration since liberalization and privatization in the mid- to late 1990s. The number of direct lines increased by 26% in 1997 alone, compared to growth of 2-3 %in the early 1990s (Frempong and Atubra 2001).

CONTRACT	The risk to foreign businesses, contractors and consultants that government will modify a contract in the form of repudiation, postponement or scaling down. The index ranges from 0 to 10. A high point index signifies less likelihood that a contract will be modified.	IRIS-3 file of International Country Risk Guide (ICRG) data, 1982-97, constructed by Stephen Knack and the IRIS Center, University of Maryland.
EXPROP	The risk of expropriation of private investments in terms of outright confiscation or forced nationalization. The index is rated from 0 to 10. Higher index points signify less likelihood of investment expropriation.	IRIS-3 file of International Country Risk Guide (ICRG) data, 1982-97, constructed by Stephen Knack and the IRIS Center, University of Maryland.
ICRG	Following Knack and Keefer (1995), I created a 50-point index from five of the ICRG variables. CORRUP, LAW and BUREAU were converted to a 10-point scale by multiplying each by 5/3. These were summed with CONTRACT and EXPROP.	IRIS-3 file of International Country Risk Guide (ICRG) data, 1982-97, constructed by Stephen Knack and the IRIS Center, University of Maryland.
Variables indicating party system (freedom measures) and legal legacy		
DEMOC	Democracy, an indicator of regime type on a scale of 0 to 10. This data is assumed to be constant between 1994 and 1997.	Polity III: Regime type and political authority, 1800-1994, Jaggers and Gurr (1996)
DEMOC-AUTO	A single summary measure of political regime, this variable is calculated by subtracting the index of autocracy score from the democracy index score. It is measured on a scale of -10 to 10, where, 0 to -10 indicates autocratic regimes and 1-10 indicates democracies.	Polity III: Regime type and political authority, 1800-1994, Keith Jaggers and Ted Robert Gurr (1996)
POLRIGHT	From the Freedom in the World Survey, 1998-99. POLRIGHT is an index that measures the extent to which people participate freely in the political process or the rights of all adults to vote and compete for public office. The index is measured on a scale of 1 to 7. Smaller numbers represent greater freedom.	From the Freedom in the World Survey, 1998-99.
ENGINST	ENG*ICRG, where ENG is a dummy variable equal to 1 if the country has an English common law tradition and 0 otherwise.	Legal system is taken from CIA World Factbook, 1999.
OINST	OTHER*ICRG, where OTHER is a dummy variable equal to 1 if the country does not utilize English or French legal systems and 0 otherwise.	Legal system is taken from CIA World Factbook, 1999.
ENGPOL	ENG*DEMOC-AUTO.	Legal system is taken from CIA World Factbook, 1999.
OPOL	OTHER*DEMOC-AUTO	Legal system is taken from CIA World Factbook, 1999.

Descriptive Results

Table 4 summarizes the variables used in the models. The differences in means vary across the samples. Confirming the hypothesis that countries with a history of the French civil code tend to be more interventionist, potentially restricting the ease of investments, indicators of political freedom are stronger when the legal system is based on English rather than French law. The negative sign on the difference in POLRIGHT indicates stronger political freedom in the English nations, which overall tend to have a stronger institutional framework (based on ICRG), but not significantly so. Of the ICRG measures, only LAW and BUREAU have significantly different means across the sub-samples.

Table 4: Sample Descriptive Statistics, 1985-97

Variable	Mean and standard Deviation: Full sample (481)	Mean and standard deviation: English common law countries (169)	Mean and standard deviation: French civil code countries (182)	Difference between legal systems
NETWORK	13.573 (20.128)	14.669 (25.294)	12.150 (15.203)	2.519
LOGGDPC	6.210 (0.987)	5.978 (0.844)	6.508 (0.882)	-0.530*
LTRADE	60.501 (27.373)	56.251 (25.124)	61.088 (23.828)	-4.837***
URBAN	34.276 (15.720)	30.129 (10.730)	38.733 (16.491)	-8.604*
CORRUP	2.827 (1.105)	2.914 (1.010)	2.928 (0.851)	-0.014
LAW	2.679 (1.168)	2.764 (1.070)	2.796 (0.877)	-0.032
BUREAU	2.629 (1.118)	2.715 (1.269)	2.758 (0.939)	-0.043
CONTRACT	5.098 (1.784)	5.342 (1.756)	5.360 (1.541)	-0.018
EXPROP	6.081 (1.901)	6.491 (1.781)	6.227 (1.676)	0.264
ICRG	24.737 (7.171)	25.822 (6.922)	25.725 (4.851)	0.097
POLRIGHT	5.325 (1.577)	5.231 (1.516)	5.335 (1.368)	-0.104
DEMOC	0.353 (10.812)	1.982 (3.123)	1.115 (2.180)	0.867
DEMOC-AUTO	-2.933 (5.429)	-2.663 (5.805)	-3.972 (4.489)	1.309***

Standard deviations are in parentheses; * = significant at 1%, ** = significant at 5%, *** = significant at 10%.

Mean network access (unweighted by population) is only 1.2 times greater in nations utilizing English common law, which is not statistically different from the French countries. The results in Table 4 suggest that the difference in institutional factors across regions is not enough to create a difference in telephone access. LOGGDPC, LTRADE and URBAN are all significantly higher in nations utilizing the French civil code. Taking this into consideration along with the information on institutions, I view the raw data as suggesting that countries with stronger institutions tend to have higher access to telephones, even when their economies are less open and they have lower per capita income and a relatively small urban population. The difference in institutional quality (ICRG) is, however, not big enough to create any significant differences in network access.

Table 5 provides summary statistics based on differences in legal tradition and institutional quality. An ICRG index above the sample average of 24.74 defines high institutional quality, while countries scoring below this average are considered to have low institutional quality. The numbers in parentheses indicate percentage growth in network access between 1985 and 1997.

Table 5: Regional Differences, Institutional Quality and Network Access. 1985-1997

Legal system	Institutional Quality		
	High	Low	Overall
English Common Law	21.30, (128)	8.01, (44)	14.66, (118)
English minus South Africa	10.99, (153)	8.01, (44)	8.09, (126)
French Civil Code	13.45, (172)	9.94, (83)	12.20, (146)
French minus Arab Nations	7.19, (134)	3.82, (63)	5.93, (124)
All Countries	16.99, (133)	5.49, (78)	13.57, (112)

As expected, countries with stronger institutions on average have higher access to telephones. In this sample, countries with high institutional quality have 3.7 times greater access than countries with low ICRG scores. This result conforms to expectations, unlike the observations across English and French legal origins. According to Chong and Zanforlin (2000), countries with a system based on the French civil code appear to have lower institutional quality. This suggests that countries of French origin in our sample should have lower access to telephones. However, the data Table 5 suggest that this is not true for the sample of countries used in this analysis when [unless?] institutional quality is low.

Growth in telephone access is also higher in French nations, even when [although?] countries of English common law origin have higher penetration levels. The implication of Chong and Zanforlin (2000) can be extended only when institutional quality is high. In this case, countries with an English common law tradition have higher network access than countries using the French civil code. This suggests that legal origins may influence institutional quality, but the legal system itself has less of an influence on telephone access than institutional quality. Countries with strong institutions have higher access than those with weaker institutions, regardless of their legal system.

The difference in access across legal origins is at most 9 per 1,000 individuals when institutional quality is either high or low, but the difference across institutional qualities is a little over 11 per 1,000. When South Africa is excluded, the growth rate in the English common law countries increased so that the difference between the two groups of countries was negligible. This suggests that the countries with low access, relative to South Africa, will eventually achieve comparable access levels.

Table 6 compares access on the basis of differences in countries' legal tradition and polity. The entire sample period, 1985-97, is used when necessary, but the last five years, 1992-97, is used when this better reflects the political tendencies of a country, since many countries that were autocratic in earlier years are adjusting to a polity with more democratic characteristics. In addition, a significant amount of the development in telecom happened during the last five years of the sample period.

Following Jagers and Gurr (1995), countries are defined as democratic if the autocratic index subtracted from the democratic index is greater than or equal to 1. Otherwise, the political system is defined as autocratic. Countries scoring 1-6 are primarily democratic but put some limits on political participation and civil liberties (e.g., Zambia and Ghana). Scores above 6 represent highly democratic nations, such as Botswana, Madagascar, and South Africa. Countries scoring 0 to -6 are autocratic in nature but allow some degree of political freedom (e.g., Egypt and Zimbabwe) while those scoring -7 and lower are fully autocratic (e.g., Cameroon). Many African countries fall in this penultimate category.

Table 6: Regional Differences, Political Systems and Network Access

Legal legacy	Political System		
	Democratic	Non-democratic	All
English Common Law	24.23, (127)	8.67, (104)	14.66, (118)
English without South Africa	6.91, (198)	8.67, (104)	8.09, (126)
French Civil Code	10.62, (105)	12.76, (143)	12.20, (146)
French without Arab Nations	4.55, (130)	6.41, (81)	5.93, (124)
All Countries	13.93, (126)	10.83, (129)	13.57, (112)

Note: Numbers in parentheses are percentage growth in network access between 1985 and 1997.

In general, democratic nations tend to have higher access than non-democratic ones, but the difference in growth is very small. This is attributable entirely to countries using the English common law code. The slightly higher growth in non-democratic countries results from a higher growth rate in nations using the French civil code. When the government is democratic, countries under an English legal system have significantly higher access than those under the French system. The opposite is true when the political system is not democratic. One implication of this is that countries under the French civil code may have less experience working under democratic systems. Indeed, leaders can make more efficient decisions regarding telecom development under a system that is more authoritarian, and the benefits from investing in telecommunications are more likely to accrue to the politician (Goldsmith 2001). The role of legal systems is further explored in the estimation of the model.

6. THE MODEL

NETWORK (per 1,000 people) is the dependent variable used to estimate the effects of institutions, political regime and legal origin on investment in basic telecommunications in Africa. Although data on dollar investment in telecommunications is sometimes directly available, I decided to use telephone lines per capita as the dependent variable because per-capita dollar investment can be a misleading indicator of the degree of accessibility. For example, a \$100 investment in a country with rugged terrain is likely to generate fewer telephones than in a country where it is easier to lay telephone cables. Since the data set consists of countries with different (and often unique) characteristics, this

measure would be more useful if the research focus was on cost effectiveness rather than on access.

NETWORK per capita is therefore a more suitable measure .

Because the data used in this study spans the period 1985-97, there are multiple observations on each country and the explanatory variables are time-series related. That is, they vary over time. To take account of this time-series component while maintaining the cross-section, both components are pooled to develop a data set consisting of 37 countries over the period 1985-97. The advantage of pooling the data is that it generates a larger number of data points, which increases the degrees of freedom and may reduce colinearity among independent variables (Hsiao 1986). Cross-sectional estimation provides information relevant to a single time period, but this study is more concerned with cross variation over time. By pooling the data and applying panel data techniques, I am able to make references about cross-variation of variables over time. Equation 1 is specified to accommodate the pooled data as follows:

$$(1) \text{ NETWORK}_{CT} = \alpha + \beta_k X_{CT} + \varepsilon_{CT},$$

where X_{CT} is a vector of independent variables for country C in year T. These variables are LOGGDPC, LTRADE, URBAN, CORRUP, LAW, BUREAU, CONTRACT, EXPROP, GOVOP, DISCTAX, and DEMOC. All these variables are defined in Table 3 [except for DISCTAX, which is not previously mentioned anywhere]; ε is a random error term.

Omitted Variables

Since the data represent a panel of different countries, it is highly likely that unobserved differences across countries will affect telephone investment. If these unobserved variables are not accounted for, the interpretation and use of the estimated equation may be unreliable (Studemund 1992). Omitted variables will cause a bias in the estimated coefficients of the other explanatory variables. For example, the coefficient of LTRADE in Equation 1, represents the change in NETWORK caused by a one-unit change in LTRADE, when the values of all other right-hand-side variables are held constant. If a variable is omitted, it is not included as an independent variable and is not held constant for the calculation and interpretation of the coefficient of LTRADE_{CT} . Thus, some of the variation in the omitted

variable will be incorrectly attributed to LTRADE. The efficiency and experience of multi-national operators assisting the local companies is an example of omitted variables. A more experienced operator is likely to provide better training to managers, technicians and engineers as reform of the sector takes place (Henisz and Delios, forthcoming 2002).

Privatization and regulatory reform are other variables that could be included in the model. Privatization of wire line provision, however, started only in the mid- to late 1990s for the countries that have committed to privatize. Agencies dedicated to the regulation of telecommunications in the context of privatizations were only in the formative stages for most countries toward the end of the sample period. As a result, enough observations of privatization and regulatory reform did not exist throughout the sample period. A country-specific constant α_C is introduced to account for the effects of those omitted variables that are specific to individual countries.

It is also possible for effects that differ across countries to exhibit variation through time. For example, telephone penetration in each country may be affected by the unobservable worker quality (ability), which may vary from country to country. Countries with a more efficient or able workforce or provider are better able to make telephones accessible than less efficient ones. Worker ability is also likely to vary through time. Worker quality may improve through education, for instance, or through learning by doing. The trend through time is thus likely to affect penetration. Year effects (δ_T) are introduced to account for such trends through time. The new equations are [equation is?]:

$$(2) \text{ NETWORK}_{CT} = \alpha_C + \beta_K X_{CT} + \delta_T + \varepsilon_{CT},$$

The fixed-effect model is estimated by using deviations from the group mean. In so doing, Equations 2 [1?] and 2 will pick up any constant differences occurring on a country-specific level. Finally, the standard errors are adjusted to account for the systematic correlation across units in the same group.

Alternative Specifications

Equation 2 is estimated by using two specifications of institutional variables and three alternatives to measure political freedom in order to check the sensitivity of the results to alternative

specifications. Equation 2 is first estimated with the components of the ICRG index (CORRUP, LAW, BUREAU, CONTRACT, EXPROP) as individual independent variables. They are then treated as a single variable by using the average of the five components and thus aggregating the index to avoid possible problems of correlation between the individual components. The aggregate ICRG index, however, assumes that some factors that affect the institutional environment are more important than others, and so must be weighted more heavily. The problem with this approach is that different conditions across countries may warrant component weights that vary from the ones imposed by the index. The implicit weights may also vary through time, so the aggregate ICRG index may contain considerable measurement error. Using the individual components of the index provides a check against potential biases that may result from the use of subjective component weighting in the aggregated index.

Equation 2 is also estimated with three different political variables. First, DEMOC is used to capture the degree of political freedom enjoyed by a country. This is then replaced with POLRIGHT so results can be compared to check whether the measure of freedom used makes a difference. While the two sets of variables are constructed to measure the freedom of a country, there may be noticeable differences in what is captured in reality. The POLRIGHT index does not rate governments, but rather the rights and freedoms enjoyed by individuals in each country. The DEMOC index rates governments by measuring factors such as constraints on the chief executive and the openness of executive recruitment. Differences in the construction of the two measures of freedom make it likely that the economic freedom measure contains some information that is not in POLRIGHT.

DEMOC-AUTO is the third measure of political freedom. The first measure (DEMOC) is rated on a scale of 0 -10, where 0 denotes limited democracy and 10 denotes a high level of democracy. In this use of the democracy index, a low level of democracy implies. Yet, if low democracy correlated perfectly with high autocracy, then Ghana, with a democracy score of 3, should have autocracy score of around 7, rather than 2. This kind of separate measurement of democracy (DEMOC) and autocracy (AUTO) is difficult to interpret when democracy is not a close inverse of autocracy, so I follow the Jagers and Gurr

(1995) approach and adopt a single summary measure of political regime (DEMOC-AUTO) to replace DEMOC.

Finally, to explore the argument that the legal tradition of a country may affect telephone development through its institutional framework, I introduce four new variables: ENGINST, OINST, ENGPOL and OPOL. These are defined in Table 3. Equation 2 is re-estimated using these variables in all the specifications discussed above.

Country Effect and Sample Selectivity

It is possible that some countries in the sample individually influence the results in a way that may not be true for other countries in the sample. For instance, South Africa stands apart from other countries in the sample because of its comparatively developed telecommunications sector (CIA World Factbook 1999). South Africa has the highest telephone penetration in the sample, and arguably sets the pace for sector development in the region. South Africa was among the first African nations to start the process of telecommunications reform in terms of modernizing and expanding services, introducing private participation and setting up regulatory bodies. South Africa has received much attention from the rest of the world as an example for other African countries. If other African nations view South Africa in a similar manner, then South Africa may be influencing the rest of the countries in the sample and thereby the regression estimates.¹⁰

In addition, because the sample consists of only 37 of the 55 countries in Africa, the results may not be representative of the 18 excluded countries. To check for sample selectivity, I compared the countries in the sample with those excluded on observable factors such as network access and per capita GDP. Table A3 provides a summary of the comparison. Noticeable difference exist between the two

¹⁰ To account for this possibility, I re-estimated Equation 2 without South Africa and then sequentially removed every country (one at a time) to see if there was any influence on the results. The results where changes did occur are reported in Table A2 in the Appendix and show that Algeria, Burkina Faso, Democratic Republic Congo, Cote d'Ivoire, Guinea, Guinea Bissau, Morocco, Mozambique, Uganda, South Africa and Zimbabwe may be individually affecting the Network regressions in that LGDPC became insignificant. In the case of Morocco, EXPROP also became insignificant. All specifications are re-estimated without these countries (reduced sample).

groups of countries in network access per capita GDP as well as trade. The first two columns of Table A3 suggest systematic differences between the countries.

Most of the excluded countries are low-income countries with relatively low network access, but a few countries such as Seychelles and Mauritius have much higher income levels than most countries in the sample. Access rates in these two countries exceed that of every country in the sample. If we exclude these outliers, the difference in network access (between excluded and included countries) is just over 4 per 1,000 individuals. The difference in per capita GDP remains noticeable and falls in the lower income range for both included and excluded countries.

I also compared regression results from the excluded countries with the entire group of all countries in Africa. Table A4 shows that the results are quantitatively the same except that LTRADE is not significant in the smaller sample. On the basis of these rough sensitivity analyses, I feel that the qualitative results of the sample can be extended to the eighteen excluded countries, at least in a general manner, and that most of Africa can be described accurately with the results of the estimations.

7. ESTIMATED RESULTS

Table 7 shows the main effects of institutional factors on network development. Bureaucratic quality is significantly correlated with network development with an unexpected sign. The bureaucratic quality index may not be differentiating between the rules that define how the game is played and the players (the bureaucrats). Analysts often assume that the objective of bureaucrats is to make decisions that maximize their own individual utilities. Unless there are strong incentives for them to improve industry performance, they may not encourage it. Personnel in a strong bureaucracy recognize how certain decisions will affect them personally, while less efficient bureaucracies may not. In this case the index may be reflecting protection of the bureaucrats' position rather than the ability to protect contract and property rights. Stronger bureaucratic quality in this instance denotes greater personal protection.

Generally, the results show that well-defined and credible institutions are positively and significantly correlated with network development regardless of the definition of institutions used. If a

country such as Niger at the average level of adherence to the rule of law (LAW) were to increase this quality by 2 units to arrive at the level held by Botswana, then network development would increase from 1.6 telephones per 1,000 people to almost 2.2. This corresponds to an elasticity of 0.34 at the mean. A reduction in the risk associated with contract repudiation in Cote d'Ivoire to South African levels would increase network access in Cote d'Ivoire from 11.65 telephones per 1,000 inhabitants to 16.42.

Table 7: Panel Fixed-Effect Regression Controlling for Country-Level Differences

Variable	ICRG components: Institutional factors measured by the individual components of ICRG	ICRG index: The sum of CORRUP, LAW, BUREAU, CONTRACT and EXPROP is used as the institutional variable	POLRIGHT: An index of political rights used to measure place of democracy	DEMOC-AUTO: Single summary measure of political regime, which is the difference between the index of democracy and the index of autocracy
LOGGDPC	3.345 (1.527)	4.424*** (1.865)	3.304 (1.558)	1.098 (0.893)
LTRADE	-0.108* (-6.328)	-0.115* (-6.131)	-0.100* (-6.351)	-0.098* (6.229)
URBAN	0.697* (7.068)	1.053* (8.550)	0.739* (7.508)	0.813* (8.133)
CORRUP	-0.012 (-0.024)		0.027 (0.053)	0.070 (0.137)
LAW	1.693* (2.769)		1.732* (2.922)	1.717* (2.820)
BUREAU	-3.666* (-3.169)		-3.732* (-3.191)	-3.595* (-3.099)
CONTRACT	2.170* (5.086)		1.984* (4.867)	1.967* (4.497)
EXPROP	0.334 (0.996)		0.437 (1.306)	0.546 (1.582)
DEMOC	-0.043** (-2.059)	-0.036*** (-1.630)		
ICRG		0.613* (7.094)		
DEMOC- AUTO				-0.248* (4.565)
POLRIGHT			0.538*** (1.884)	
N	421	421	421	421
R ² (adjusted)	0.95	0.93	0.95	0.95
F-Stat	24.15	27.60	27.07	26.82

Note: The dependent variable is NETWORK, access to telephone lines per 1,000 people. The sample is 37 African nations over the period 1985-97. Since a test of the significance of a time trend could not be rejected, the time trend was excluded from estimations.

* = significant at 1%, ** = significant at 5%, *** = significant at 10%.

The results with the ICRG index explain less of the variation in NETWORK access (the R^2 is lower), and the coefficients tend to be different from the original regression (ICRG components). The results are, however, similar in that they indicate that strong institutions are important for NETWORK development.

Per capita GDP is not always significant but other economic and demographic variables (LTRADE and URBAN) are significantly correlated with network development. The trade variable, however, has an unexpectedly negative sign, indicating that the state may not respond to economic forces in the way private individuals would. Bleaney and Greenway (2001) examined the impact of exchange rate volatility and terms of trade on investment and growth in sub-Saharan Africa and found that growth is adversely affected if a country specializes in the export of primary products. If this finding is applicable to infrastructure investments, it could explain the negative sign on LTRADE.

The highly significant result on URBAN suggests that cost considerations with respect to location may be important for some countries. Greater access to telephones in the city may have a lot to do with its being cheaper to connect telephones to a network in urban as opposed to rural areas. This idea is less easy to understand in the context of cellular service provision, which entails less cumbersome and risky investments than wire line investments. Although cellular service is increasing in Africa, the bulk of the growth is in urban areas.

The regressions with the POLINST index of political rights and DEMOC-AUTO provide results similar to those for the ICRG components estimation, indicating that political institutions will have an impact on telecom development in the region. Contrary to our prediction, however, the coefficient on measures of democracy is usually negative (positive for POLRIGHT). The negative (positive for POLRIGHT) correlation makes sense if we assume the perspective outlined by Haan and Siermann(1995). The existence of checks and balances on executives can hamper development as politicians take actions to placate pressure groups at the expense of investment in infrastructure. In addition, most democracies in Africa are transitional and thus fragile.

Table 8 shows the results when ENGINST, OINST, ENGPOL, and OPOL are included in the models. The results are qualitatively the same, except that LOGGDPC and EXPROP are always significant. POLRIGHT is no longer significant. The marginal effect of greater institutional quality on network access is increased when the countries involved have a tradition of French civil law compared to English common law code and other legal systems. This differs from expectations, but supports the results from the summary statistics when institutional quality is low to begin with.

This result might also be picking up the effect of something else that was not captured in the model. It is difficult to define countries according to only three types of legal systems, since most countries often utilize some other major system, such as customary or tribal laws. While countries fall clearly in one or the other of the categories used in the analysis, it fails to capture these other aspects of the legal system. While the level of political freedom is important to network development, there is no evidence that it has different effects according to origin of the legal system (OPOL is significant only in one specification). In conditions like these, the demands of pressure groups may be met by succumbing to a “pork barrel” regime that generates popularity at the expense of increased productivity. This kind of behavior can undermine (telecom) investment, especially when the majority of investments involve public undertakings.

Table 8: Panel Fixed-Effect Regression Controlling for Country-Level Differences and Accounting for Legal Traditions

Variable	ICRG components: Institutional factors measured by the individual components of ICRG.	ICRG index: The sum of CORRUP, LAW, BUREAU, CONTRACT and EXPROP is used as the institutional variable.	POLRIGHT: An index of political rights used to measure place of democracy.	DEMOC-AUTO: Single summary measure of political regime, which is the difference between the index of democracy and the index of autocracy
LOGGDPC	5.040** (2.106)	5.139** (1.999)	4.816** (2.055)	4.177*** (1.845)
LTRADE	-0.103* (5.662)	-0.106* (-5.377)	-0.095* (-5.722)	-0.090* (-5.382)
URBAN	0.614* (5.935)	0.970* (7.466)	0.649* (6.327)	0.739* (7.131)
CORRUP	0.521 (0.990)		0.518 (0.988)	0.636 (1.232)
LAW	2.068* (3.633)		2.046* (3.640)	2.085* (3.707)
BUREAU	-2.639*** (-1.855)		-2.798** (-2.023)	-2.761*** (-1.929)
CONTRACT	2.418* (5.588)		2.268* (5.526)	2.220* (4.939)
EXPROP	0.953* (2.639)		0.965* (2.722)	1.091* (3.003)
DEMOC	-0.042** (-1.957)	-0.039*** (-1.730)		
ICRG		1.132* (7.189)		
DEMOC-AUTO				-0.271* (4.796)
POLRIGHT			0.385 (1.378)	
ENGINST	-0.487** (-2.442)	-0.695* (-3.566)	-0.447** (-2.342)	-0.445** (-2.228)
OINST	-0.568** (-2.511)	-0.764* (-3.542)	-0.499** (-2.307)	-0.516** (-2.423)
ENGPOL	-0.014 (-0.959)	0.010 (-0.587)	-0.008 (-0.606)	0.005 (0.332)
OPOL	0.025 (1.457)	0.001 (0.013)	0.026 (1.526)	0.048* (2.677)
N	421	421	421	421
R ² (adjusted)	0.95	0.93	0.95	0.95
F-Stat	20.71	20.91	21.60	22.30

Note: * = significant at 1%. ** = significant at 5%, *** = significant at 10%. Since a test of the significance of a time trend could not be rejected., the time trend was excluded from estimations. Again, the dependent variable is access to telephone network per 1,000 people (NETWORK) with data from 37 African countries in the 1985-97 period.

Tables 9 and 10 show the results of the NETWORK regression when eleven countries (listed in footnote 10) are excluded from the sample. The results for the most part are as expected. LOGGDPC and EXPROP are now significant in every specification. The sensitivity test of country exclusion had shown that the inclusion of these eleven countries influenced the relationship between LOGGDPC and NETWORK to make it unexpectedly insignificant.

With an estimated real GDP growth of 6.5% in 1999, Botswana has become one of the fastest growing nations in Africa, while most other African countries are experiencing little, if any, growth. For Botswana, GDP and telecom development have been progressing together, and so are expected to be correlated. Other countries have also been modernizing and expanding their telecom infrastructure despite an unimpressive growth in GDP. South Africa for instance, has the most modern infrastructure in the region, yet its growth in GDP has not been as impressive as Botswana's. In 1999, South Africa's estimated GDP growth was only 0.6 percent. The slow growth in GDP at the same time that network access is expanding could mean that the two are not closely related. This may be one reason that the influence of South Africa was making LOGGDPC insignificant.

Although the size of the coefficients varied from those in the full sample, the results are qualitatively the same after taking into considering the exclusion of some countries. An exception is CORRUP and LAW, which changed significance in some specifications of the reduced sample.

Table 9: Panel Fixed-Effect Regression Controlling for Country-Level Differences, Reduced Sample

Variable	ICRG components: Institutional factors measured by the individual components of ICRG.	ICRG index: The sum of CORRUP, LAW, BUREAU, CONTRACT and EXPROP is used as the institutional variable.	POLRIGHT: An index of political rights used to measure place of democracy.	DEMOC-AUTO: Single summary measure of political regime, which is the difference between the index of democracy and the index of autocracy
LOGGDPC	17.338* (6.021)	15.788* (5.214)	16.652* (6.043)	15.404* (5.497)
LTRADE	-0.100* (-5.442)	-0.089* (4.888)	-0.085* (5.119)	-0.079* (-4.972)
URBAN	0.788* (7.433)	1.061* (9.411)	0.876* (8.425)	0.908* (8.250)
CORRUP	0.678 (1.573)		0.843** (1.963)	0.839*** (1.931)
LAW	0.284 (0.491)		0.250 (0.458)	0.434 (0.743)
BUREAU	-2.021* (-2.982)		-2.005* (-3.169)	-2.205* (-3.423)
CONTRACT	1.033** (2.409)		0.723*** (1.787)	0.692*** (1.606)
EXPROP	1.283* (3.588)		1.479* (4.105)	1.637* (4.493)
DEMOC	-0.051** (2.038)	-0.052** (-2.114)		
ICRG		0.452* (5.098)		
DEMOC-AUTO				-0.305* (5.648)
POLRIGHT			1.096* (6.032)	
N	280	280	280	280
R ² (adjusted)	0.93	0.922	0.94	0.94
F-Stat	21.80	31.77	23.86	23.88

Note: * = significant at 1%. ** = significant at 5%, *** = significant at 10%. The dependent variable is access to telephone network per 1,000 people (NETWORK) during 1985-97. Since a test of the significance of a time trend could not be rejected, the time trend was excluded from estimations.

Table 10: Panel Fixed-Effect Regression Controlling for Country-Level Differences and Accounting for Legal Traditions, Reduced Sample

Variable	ICRG components: Institutional factors measured by the individual components of ICRG.	ICRG index: The sum of CORRUP, LAW, BUREAU, CONTRACT and EXPROP is used as the institutional variable.	POLRIGHT: An index of political rights used to measure place of democracy.	DEMOC-AUTO: Single summary measure of political regime, which is the difference between the index of democracy and the index of autocracy
LOGGDPC	18.013* (6.341)	16.743* (5.514)	17.415* (6.326)	16.160* (5.775)
LTRADE	-0.097* (-5.142)	-0.085* (-5.659)	-0.086* (-4.973)	-0.080* (-4.629)
URBAN	0.698* (6.432)	1.003* (8.947)	0.793* (7.364)	0.816* (7.302)
CORRUP	1.487* (3.024)		1.575* (3.323)	1.565* (3.309)
LAW	0.597 (1.048)		0.464 (0.841)	0.087 (1.422)
BUREAU	-0.868 (-1.412)		-1.101*** (-1.726)	-1.312** (-2.155)
CONTRACT	1.815* (3.541)		1.438* (2.849)	1.388* (2.638)
EXPROP	1.813* (4.399)		1.880* (4.677)	2.048* (5.016)
DEMOC	-0.047*** (-1.814)	-0.051** (1.982)		
ICRG		0.851* (4.357)		
DEMOC-AUTO				-0.298* (-5.068)
POLRIGHT			0.991* (5.213)	
ENGINST	-0.694* (-3.253)	-0.511** (-2.313)	-0.566* (-2.778)	-0.562* (2.770)
OINST	-0.454** (-2.154)	-0.383 (-1.576)	-0.302 (-1.489)	-0.423* (-2.053)
ENGPOL	-0.028 (-1.527)	-0.036** (-2.344)	-0.009 (0.715)	0.003 (-0.188)
OPOL	0.038*** (1.715)	0.032 (1.562)	0.043** (1.963)	0.059** (2.514)
N	280	280	280	280
R ² (adjusted)	0.94	0.92	0.94	0.94
F-Stat	18.06	19.58	20.30	19.61

Note: * = significant at 1%. ** = significant at 5%, *** = significant at 10%. The dependent variable is access to telephone network per 1,000 people (NETWORK) during 1985-97. Since a test of the significance of a time trend could not be rejected, the time trend was excluded from estimations.

8. CONCLUSION

Previous studies have examined other developing regions, including Asia, Latin America and the Caribbean. It is important consider Africa as well and not depend solely on conclusions based on empirical work for other developing regions.

The empirical results support the theory that credible institutions, including stable political structures, are important driving forces behind the surge of modernization in Africa's telecommunications sector. The strong institutional results should serve as a signal to governments of the importance of creating and maintaining well-functioning political and regulatory institutions. To benefit from new technological innovations and competition, the institutional framework needs to adjust. Significant political reform will be required in African countries with fragile and new democracies to mitigate such risks [unclear what risks you mean – how about, “Significant political reform will be required to mitigate risks to fragile and new democracies in Africa.”]

The results also show that the origin of a country's legal system is correlated with network development. Controlling for other factors, countries with similar institutional quality tend to have higher access to telephones if their system is derived from the French civil code rather than English common law and other legal traditions.

More populated urban areas are associated with higher access to basic telephony. There may or may not be economies of density to be gained from providing service in a highly populated area. Generally, the existing low penetration levels, along with the generally small elasticities, suggest that African nations require huge adjustments in their investment climate to achieve access levels comparable to other developing countries in a short period of time. Nevertheless, with the present drive toward competition and privatization, changes can already be observed.

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Appendix

Table A1: Countries included in the sample

Country	Legal System	Official Language
Algeria	French, Islamic	Arabic
Angola	Portuguese Civil	Portuguese
Botswana	Roman-Dutch	English
Burkina Faso	French Civil	French
Cameroon	French Civil	French
Congo, Dem. Rep.	Belgian Civil	French
Congo, Rep.	French Civil	French
Cote d'Ivoire	French Civil	French
Egypt	English, Islamic	Arabic
Ethiopia	Transitional (regional and national courts)	English
Gabon	French Civil	French
The Gambia	English Common	English
Ghana	English Common	English
Guinea	French Civil	French
Guinea Bissau	N/A	Portuguese
Kenya	English Common	English
Liberia	Anglo American and Customary	English
Libya	Italian Civil and Islamic	Arabic/English
Madagascar	French Civil	French
Malawi	English Common	English
Mali	French Civil	French
Morocco	Islamic, French, Spanish	Arabic
Mozambique	Portuguese Civil	Portuguese
Namibia	Roman-Dutch	English
Niger	French Civil	French
Nigeria	English Common	English
Senegal	Portuguese Civil	French
Sierra Leone	English Common	English
Somalia	N/A	Arabic/English
South Africa	English, Roman-Dutch	English
Sudan	English Common	Arabic/English
Tanzania	English Common	English
Togo	French Civil	French
Tunisia	French Civil	French
Uganda	English Common	English
Zambia	English Common	English
Zimbabwe	English Common, Roman-Dutch	English

Source: *CIA World Factbook, 1999.*

Table A2: Panel Fixed-Effects Regressions with One Country Excluded (Dependent Variable: Network Access Per 1000 Inhabitants)

Country Excluded	Explanatory Variables										
	LOGGDPC	LTRADE	URBAN	CORRUP	LAW	BUREAU	CONTRACT	EXPROP	DEMOC	Adjusted R ²	F-Stat
Algeria	3.923*** (1.779)	-0.104* (-6.128)	0.658* (6.650)	-0.715 (0.140)	1.853* (2.990)	-4.269* (-3.420)	2.166* (4.988)	0.331 (0.949)	-0.045** (-2.100)	0.94	22.38
Burkina Faso	4.200*** (1.881)	-0.110* (-6.432)	0.704* (7.141)	-0.180 (-0.349)	1.884* (2.949)	-3.925* (-3.293)	1.901* (4.216)	0.486 (1.391)	-0.045** (-2.101)	0.95	24.40
Congo, Dem. Rep.	6.038** (2.169)	-0.105* (-6.092)	0.687* (7.044)	0.027 (0.053)	1.654* (2.707)	-3.845* (-3.281)	2.256* (5.130)	0.302 (0.883)	-0.049** (-2.237)	0.95	25.18
Cote d'Ivoire	3.598*** (1.630)	-0.111* (-6.396)	0.677* (-6.711)	0.060 (0.115)	1.729* (2.764)	-3.732* (-3.213)	2.177* (5.095)	0.354 (1.053)	-0.045** (-2.155)	0.95	24.11
Guinea	3.882*** (1.738)	-0.117* (-6.648)	0.717* (7.283)	0.155 (0.303)	1.556** (2.548)	-3.625* (-3.140)	2.132* (5.001)	0.472 (1.387)	-0.046** (-2.124)	0.95	24.83
Guinea-Bissau	3.738*** (1.661)	-0.112* (-6.411)	0.703* (7.106)	0.002 (0.003)	1.664* (2.720)	-3.639* (-3.150)	2.103* (4.896)	0.411 (1.190)	-0.044** (-2.068)	0.95	24.26
Morocco	3.930*** (1.826)	-0.107* (-6.418)	0.662* (6.697)	-0.027 (-0.052)	1.114*** (1.680)	-3.262** (-2.485)	1.859* (4.468)	0.674** (2.178)	-0.036*** (-1.773)	0.95	19.38
Mozambique	4.727** (2.055)	-0.103* (-5.398)	0.766* (7.496)	0.066 (0.131)	1.716* (2.672)	-3.749* (-3.205)	1.947 (4.595)	0.449 (1.319)	-0.035*** (-1.747)	0.95	25.55
South Africa	4.204** (2.023)	-0.099* (-5.950)	0.706* (7.175)	0.067 (0.169)	0.810*** (1.606)	-1.689* (-3.212)	2.386 (5.640)	0.150 (0.435)	-0.045** (-2.145)	0.92	23.34
Uganda	4.292*** (1.954)	-0.109* (-6.348)	0.697* (7.046)	-0.118 (-0.223)	1.952* (3.018)	-3.597* (-3.102)	2.109* (4.818)	0.343 (1.017)	-0.046** (-2.199)	0.95	24.88
Zimbabwe	3.811*** (1.709)	-0.106* (-6.119)	0.704* (7.079)	0.118 (0.230)	1.767* (2.826)	-3.804 (-3.245)	2.004* (4.543)	0.452 (1.322)	-0.043** (-2.036)	0.95	24.20

Note: * = significant at 1%. ** = significant at 5%, *** = significant at 10%.

Table A3: Comparison of Countries Based on Means

	Countries Included in Sample	Countries Excluded from Sample	Countries Excluded minus Seychelles and Mauritius.
NETWORK	13.573	22.700	8.823
PER CAITA GDP	860.257	1039.379	499.221
LTRADE	60.501	89.085	83.711
URBAN	34.276	33.68	31.696

Table A4: Comparison of Network Regression on observable variables.

	All Countries	All Countries minus Seychelles and Mauritius	Countries Excluded from Sample	Countries Excluded minus Seychelles and Mauritius.
PER CAITA GDP	32.232* (4.089)	7.815* (4.152)	72.057* (3.301)	6.934* (2.664)
LTRADE	-0.057*** (-1.902)	-0.044* (-3.643)	-1.108 (-1.091)	0.006 (0.254)
URBAN	1.530* (8.839)	1.258* (10.269)	1.588* (4.086)	1.070* (3.819)
N	614	588	188	162