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Political stability, regulation and investment in the African mobile markets

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POLITICAL STABILITY, REGULATION AND INVESTMENT IN THE AFRICAN MOBILE MARKETS

Submitted for 25th European Regional Conference of the International Telecommunication Society,
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This study attempted to analyze the effect of regulation and political stability in allocation of mobile telecommunication investments in the African continent between year 2001 and 2011. In order to better understand the dynamics of investment in telecommunications, a framework was developed to understand the factors that determine investments in telecom industry at country and industry level, particularly: institutions, market size/demand level, market structure and investing cost.

The results show that investments in the telecommunications industry are positively dependent on liberalization that opened the market to private sector; however, no statistical evidence was found on the effect of political stability measured by the democratic process. Further, the study has shown that market structure especially competition, and market size and cost of investing in a country are important factors for investments allocation in mobile telecommunications industry among African countries.

Key words: mobile telecommunication, investment, political stability, liberalization, African countries

JEL Classification: L51, L1, C23, C26, D43

1: Introduction

The advancement of mobile telecommunications industry in Africa has been the most successful technology catch-up ever in the continent. For example, mobile penetration increased from 2% in 2000 to 45% in 2010. The earlier undeveloped telecommunications industry in developing countries during the state-dominated era, mostly prior the year 2000, was not due to lack of demand rather insufficient supply as the state-owned incumbent fixed-line operators could not sufficiently invest in the telecommunication infrastructure, limiting access only in cities (Ros, 1999). Towards the year 2000, most African countries embraced telecommunications policy reforms, particularly market liberalization and sector regulation, to spur development in the telecommunications sector.

As part of the telecommunications policy reform that took place, most countries established national telecommunication regulatory authorities as core of the new framework to liberalize and regulate the industry. These authorities are mandated to not only monitor and ensuring a level playing field in individual national markets, but also shaping up the markets and encourage development of the industry by introducing and monitoring competition in different market segments. By 2010, 77% of all countries in the African continent had established national regulatory authorities (NRA).

Following these policy reforms and large unmet demand, private annual investment in the African mobile telecommunications increased from USD 2.7 billion in 2000 to more than four-fold in a decade later. Since most African countries lack domestic capital, most of the investments in the sector have resulted from foreign capital flows. This is unlike the other regions such as Europe where major investments in the sector were from domestic sources especially through their legacy incumbent fixed-line operators (Hoernig, Bourreau, Cambini, 2014) which are now fully or partially privatized. In case of Africa, telecommunication markets have been pioneered by a handful of major pan African operators that operate in multiple countries. For example, in 2010, the South African-based MTN was operating in 16 African countries; and in the same year, seven largest pan African operators had control of more than 75 percent of all subscribers in 54 countries in the continent. These operators have been investing in mobile telecom infrastructure, delivering basic as well as advanced telecommunication services.

The pan African telecommunication operators with a portfolio of current and prospect markets assess the political stability (see Henisz and Zelter, 2001; and Duso and Seldeslachts, 2010) and regulatory environment (see Gasmi, Numba and Virto, 2010 and Kim et al., 2011), together with other factors such as market demand and competition – to decide on the destination of their initial and continuous investments. Given the fact that other factors that define the attractiveness of a country market such as physical and demographic attributes are stationary or slowly changing, countries are mainly competing in presence and quality of political and regulatory institutions in their home markets to attract investments in the sector.

Concurrently, even with the recent successes, the African countries face an increasing need for infrastructures investment in the telecommunication industry due to mainly three reasons. First, it has been established that investments in telecommunications infrastructure spur socio-economic

development (Röller and Waverman, 2001) especially in developing countries (World Bank, 2009); hence, African countries cannot afford to be left in the new economy. Second, due to the rapid technological advancement constantly happening in the telecommunications industry, countries are required to continuously invest in their network upgrade into modern technology, such as from 2G to 3G; as well as increasing network capacity and coverage especially to rural area where larger African population resides. Third, some countries need to urgently expand their mobile network coverage to increase access and penetration of telecommunication services. In fact, despite the overall growth in mobile penetration in African countries, some countries are still lagging (Moshi, 2013). For example, continent average mobile penetration reached 60 % in 2012; however, countries such as Ethiopia, Burundi and Eritrea had 24%, 22% and 7% respectively. It is therefore a paramount concern for African countries to attract more investments in the telecommunications sector to meet demand as well as promote development.

This study will attempt the research question: what is the empirical evidence for the influence of political stability and regulation on investments stock in the mobile telecommunications industry in Africa after 2000. This study contributes to the existing literature in several ways. First, unlike previous studies (Henisz and Zelner, 2001) which focused on fixed networks, this study is based on mobile telephony; particularly in African continent which is limited in the literature. Second, contrary to the period covered in Gasmi, Nombaand Virto (2010) study (1985 – 1999), the period covered in this study (2001 – 2011) constitutes a period of high level of mobile telecommunications infrastructure investments activity across African countries; hence it will better capture the effect of factors in question.

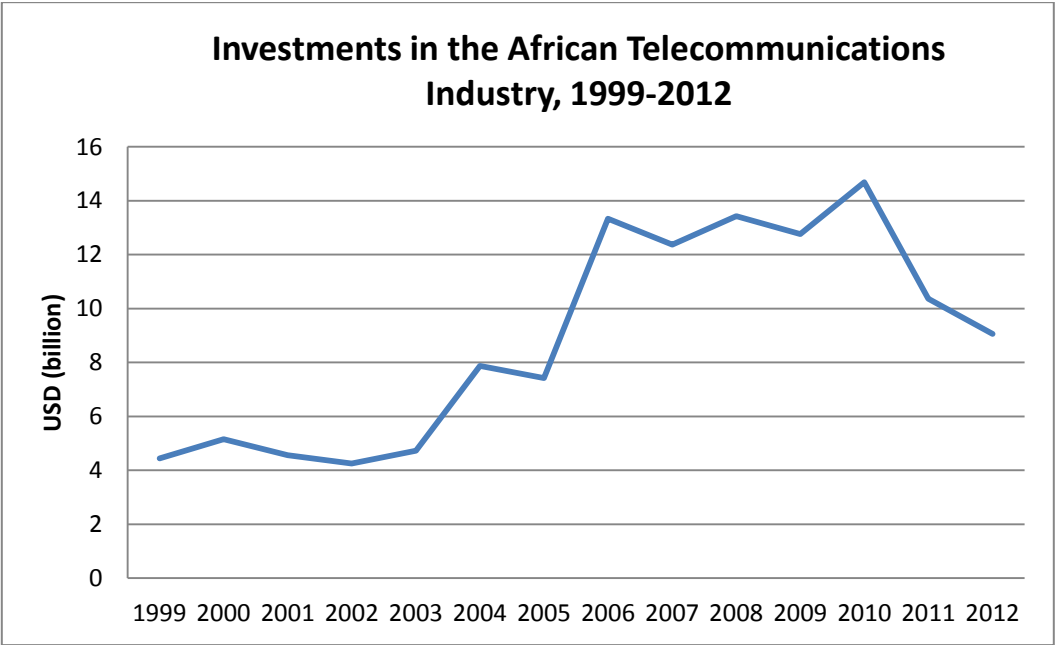
The rest of the paper proceeds as follows. Section 2 draws a detailed background and issues on investments in the African mobile telecommunication industry and its subsequent growth. The literature review is given in section 3, and section 4 describes data used and the econometric model specification. Section 5 reports the analysis results; and section 6 closes with conclusion.

2: An Overview of investment in the African Telecommunication Industry

2.1. The trend of telecom investments after the turn of the century

The rapid growth of mobile telephony in the last decade has been widely coined as successful outcome of telecommunication market reforms that have been taking place throughout the world in the last three decades. As the consequences of these sector reforms, the region witnessed high flows of foreign capital in the region mostly sourced from South Africa and currently Nigeria, as well as foreign investors out of the continent, markedly European and Indian operators. For example, from the beginning of 1990 when significant amounts of investments were directed to mobile telecommunication, Africa increased its share of international capital invested to mobile telecommunication from only four percent in the 1990's to 12 percent of the total accumulated investments for telecommunications in developing countries in 2008. For example, by 2008, Sub-Saharan Africa had accumulated about US\$ 49 billion in the telecommunications sector; most of the investments were in the deployment of mobile networks (Williams, Mayer and Minges, 2011). As

the figure below depicts, investments flow in the telecommunication sector in African continent has grown over time, reaching the peak in 2010. Most investment flows were during the latter half of the decade as strategic international operators increased their presence in multiple countries and upgraded their mobile network to third generation technologies.



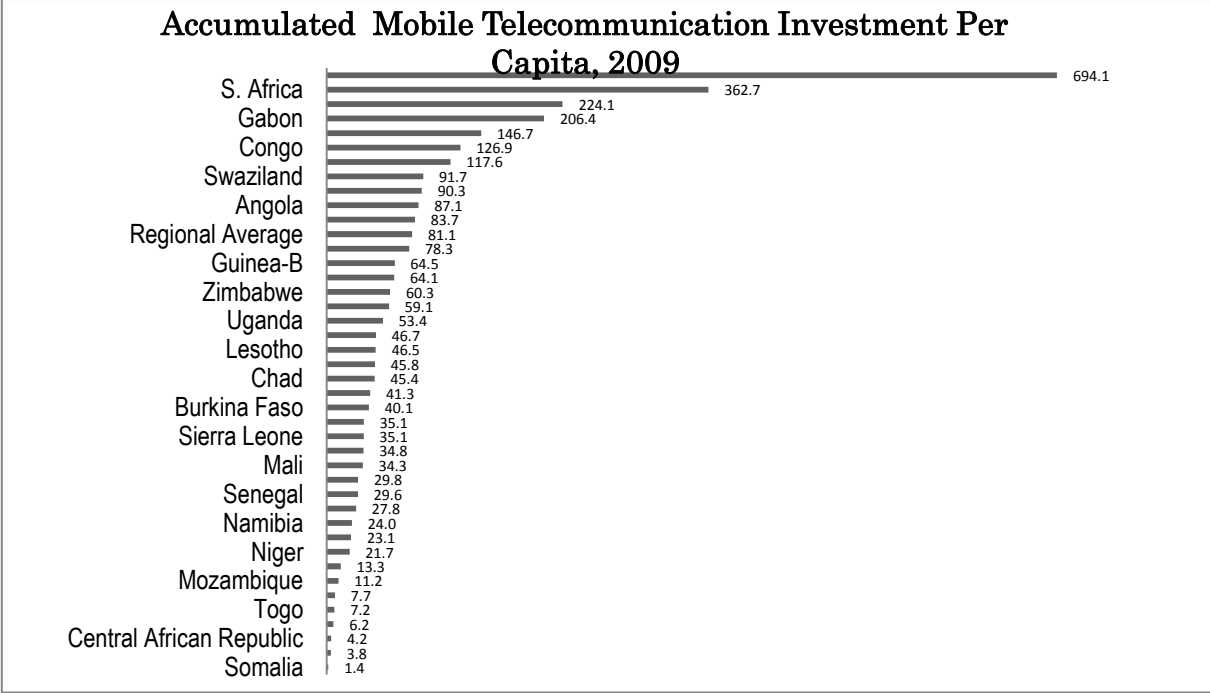
Source: World Bank 2014

Given that the significant portion of these investments are designated in deployment of network infrastructure, the increase of these investments in the continent rendered access to ICTs infrastructure; especially mobile signals to the majority of the African population. In particular, mobile signals coverage increased from just about 10 in 2000 to 61 percent of the population in 2009 respectively. In urban populations of Sub-Saharan Africa, mobile signals had reached 90 percent at the same time. As a result, mobile penetration increased significantly in the past decade, growing at a cumulative annual growth rate of 49.3 (Ernest and Young, 2009).

2.2 Disparity in telecommunication investments among countries

Despite the rising trend in the overall telecommunication infrastructure investment in the African continent, there is a huge disparity among countries. This wide disparity in telecommunication investments reflects the gap in telecommunications infrastructure availability and accessibility, and likely differences in penetration of telecommunication services. In fact, before there is digital divide among countries, there persist divide in telecommunications infrastructure investments. As an example, in 2009 the accumulated mobile telecommunication investment per capita in the continent

ranged from below USD 10 for Burundi and Eritrea; to above USD 200 observed by Gabon, Botswana and South Africa. The figure below depicts levels of accumulated mobile telecommunication investments among countries, in year 2009.



Source: World Bank Database

2.3 The need for further telecommunication investments in the continent

There is an apparent need for further investments to extend coverage of mobile signals in rural areas where coverage stands below 50 percent of the population which is primarily essential since only 40 percent of the population in Africa lived in urban settlement by 2010. Increasing access of ICTs through investments in networks deployment in rural areas is paramount in bridging the digital divide, and an important step to achieving further penetration of mobile telecommunication, as in urban places where penetration nears saturation. According to Williams , Mayer and Minges (2011), it was commercially viable for expansion of basic voice infrastructure network coverage using GSM standard – which is widely deployed in the region – to reach 92 percent of the population. However, it would have required Sub-Sahara to realize a total expenditure of US \$ 6.9 billion between 2007 and 2015. This is equivalent to an average of US \$ 1 billion every year for seven years to expand voice network infrastructure to populations without signals reach, mostly in rural areas.

Further, the more stressing need in terms of infrastructure investment is probably to upgrade of the current networks to support data rates at broadband standards. In 2013 the continent lags behind the rest of the world in broadband penetration as it stands only at 11 percent, with more than 95 percent being mobile broadband (ITU, 2013). While penetration of fixed broadband is staggering at 0.2

percent, more than 94 percent of the broadband connections are done through mobile networks (ITU, 2010). By 2010, over half the countries in Sub-Saharan Africa had already deployed 3G networks, at least in major urban centers making digital divide even higher for advanced telecom services. For example even advanced markets such as South Africa with 99.7 percent of its population covered by voice telecommunication mobile signals, only 54 percent of the population was covered by 3G signals in 2010. Tanzania, one of the first adopter of 3G networks, only 36 percent of the population lived under 3G signals. In both countries, 3G has been extremely concentrated in urban centers. While investments in 3G networks are still proceeding in various markets, some mature markets such as South Africa, Kenya and Nigeria have attempted 4G technical trials as the next phase of technology able to offer much higher data rates in mobile environment. Network infrastructure for 3G and 4G networks will tend to significantly differ from preceding second generation especially in their core network facilities such as data packet switches; as well as installation of high capacity bandwidth and new base station. Significant changes are likely to require huge investments, at least in the stage.

3. Literature Review

In the recent years, numerous studies have been dedicated in understanding the determinants of investment in the telecommunication sector, especially for new high speed networks in both developing and developed countries. While most models in earlier studies did not include the effect of institutions when analyzing investments in telecommunication sector (see Hardy, 1980; Roller and Waverman, 2001); following market reforms across countries, recent studies have been keen to incorporating the effect of country's institution.

On the sector level, the importance of telecommunication regulators performance on driving investment in telecommunication sector gain pace as scholars began to investigate the recent market reforms in telecommunication markets, most common of market reform being privatization, competition and regulation. For instance, Wallsten (2001) investigated whether privatization, competition and presence of an independent regulator affect the performance of telecommunication sector, with focus on mobile telecommunication in Latin America and African countries. His analysis showed the presence of an independent regulator positively and significantly affects performance of the telecommunication industry. Other studies such as Ros (1999), Fink, Mattoo, and Wallsten (2002) have investigated effects of regulation, however all of them have used dummy variables that indicate presence or absence of a regulatory body for telecommunication sector (Gutierrez, 2003a; Waverman, and Koutroumpis, 2011). While most countries have now established telecommunication regulators, in case of Africa 80 percent (ITU, 2008); mere presence of a regulator does not guarantee favorable environment for further investments; rather, quality and effectiveness of regulators which can be measured on how a regulator, for example, provide clear guidelines, engage the market participants in formation of regulations and ensure predictability in the market is likely to reduce sector risks on the operators and encourage further investment on the sector.

Cadman (2007) investigated the influence of telecom regulators performance on investment in European telecommunication markets using OECD's Regulatory Reform Index (RRI) and European Competitive Telecommunication Association (ECTA) regulatory scorecard in 17 European Union countries. Using data between 2003 and 2005, he found positive and significant relationship between efficient regulatory body and investment in telecommunication sector. Gutierrez, (2003b) using Gutierrez (2003a) index, and London School of Economics(2006) using OECD Regulatory Reform Index, conducted similar studies in Latin America and in European Union 15 respectively; both studies found similar results, showing regulatory performance positively influence investment in telecommunication sector.

On a broader scale, the quality of a country's institutions to managing and maintain proper and predictable economic, political and legal environment tend to be conducive for the flow private investment (Fatehi-Sedeh and Safizadeh, 1989), especially in foreign direct investments dependent sectors such as telecommunications in Africa. While a great deal of attention has been given to understand the how the presence and performance of a regulator affect telecom investments, very few studies have empirically addressed the role of macro institutional performance influence investment decision in telecommunication industries. Hinz and Zelner (2001) conducted a closer attempt to understand the institutional environment for telecommunications investment in 147 countries during the period 1960 – 1994. Authors measured investment by fixed lines per 10,000 inhabitants, and used the political constraint (POLCON) index as a measure of the country level institutional performance. Their analysis provided evidence on the positive relationship between political institutional performance and investment in telecommunication sector. While the study shed important insights on the role of institutional environment at a macro level on investment in telecommunication sector, it suffer some drawbacks since it does not capture market reforms and developments that have occurred recently, especially in developing countries.

The work of Gasmi, Numbaand Virto (2010) investigated the link between political accountability and telecommunications infrastructure regulation. Their study using time series for the period from 1985 to 1999 on 29 developing countries and 23 developed countries concluded that telecommunication infrastructure regulation cannot be effective independent of economy-wide institutional environment. This study introduces the peculiar characteristics of telecommunication sector in Africa, mainly as a region of 54 countries is supplied by eight suppliers with operations in multiple countries, collectively controlling 75 percent of the entire African market. Despite the fact that these countries need to stimulate additional investment to increase coverage and deployment of advanced telecom services, their initiatives in reducing macro and sector level risks faced by operators differ across the region The risks are likely to be critical determining factor in attracting telecommunication investment to individual countries. This paper provides an empirical study that incorporates NRA experience and the political stability as a way to understand the effect of economy-wide institutional environment, and well as sector specific institutional attributes in telecommunications investments in African countries.

4. Framework to analyze the determinants for investment among countries

Following the literature on investments in the telecommunications industry, various authors have developed frameworks to evaluate factors that influence investors' decisions. These frameworks guide researchers to clearly understand the investing environment and decision making process; hence create econometric models to estimate determinants of investment in the telecommunications sector. With focus on firm level analysis, Friedriszick, Grajek and Röller (2008) developed a framework with four main components that influence firms' decisions in telecommunications investment. The components identified are: demand, cost, competition and regulation.

The London School of Economics (2006) was perhaps the first to propose a comprehensive framework that includes economy-wide, industry-wide and firms characteristics to analyze telecommunications investments in a particular country. They show that in principle, level of investments in telecommunications as in any other industry is determined by level of expected returns as well as risk associated with expected returns. These two primary factors are not easily measured; nevertheless, they can be derived from secondary drivers identified in three categories; namely: economy-wide, industry-specific and company specific factors. The economy-wide factors include income, demographic characteristics, economic cycles and general regulation environment cutting-across sectors. On the industry level, they identified regulation by NRA, competition in the industry, technological progress and demand for telecommunications services. Lastly, cost of capital, credit ratings and debt levels, take-overs and mergers, and company performance amounts to firm's attributes. The combined analysis at all these categories of factors is expected to yield a complete understanding on the aggregate- and firms- based characteristics that determine telecommunications investment in a country.

Unlike the London School of Economics (2006), this study does not include firm-specific drivers, rather, limits its analysis on aggregate analysis, which is country- and industry- factors that derive investment in countries' telecommunications industry. This study adopting from Friedriszick, Grajek and Röller (2008), and the London School of Economics (2006)'s economy-wide and industry-specific factors, to propose a framework with four categories to explain aggregate factors that influence investment in the telecommunications industry. The categories in this framework include institutions; market size; market structure, and cost of investing. Table 1 lists each category together with its respective variables.

Table 1: Determinants of investments in the telecommunications sector

Category	Variables
<i>Institutions</i>	National Regulatory Authorities Political institution and actors
<i>Market size / Level of Demand</i>	Population Income Education
<i>Market Structure</i>	Competition(price)
<i>Cost of investing</i>	Country size Level of urbanization

The institutions component includes two variables of primary interest in this study, more specifically, regulatory authority and political stability. The national regulatory authorities indicate government commitment in marking necessary reforms to attract private sector participation aimed to yield more efficient operations. For developing countries, they also needed to attract investments for the highly needed telecommunications infrastructure (Fried, Lovell and Schmidt, 2008). As the results of liberalization, countries expect greater access and adoption of telecommunications services. Indeed, Gutierrez and Berg (2000) reported that, almost all studies have indicated that liberalization and presence of effective regulation leads to development of telecommunications industry.

Functionality and effectiveness of NRA is not entirely independent of the overall political environment prevailing in a country. Good political environment which include adherence to rule of law, level of democracy and the level of political figures interference to set rules and procedures, renders a suitable political environment which guarantees independency of regulatory authorities, and promotes private investment in a country (Drazen, 2000). Heimeshoff (2007) and Henisz and Zelner (2001) investigated the effects of quality of political institutions in telecommunications investments, both studies found positive and significant relationship. Further, Andonova and Diaz-Serrano (2007) and Gutierrez and Berg (2000) found similar results for penetration of telecommunications services.

According to Luiz and Stephan (2013), market size is onother of the important factors that attract telecommunications FDI. In this framework, market size is captured by income, population and education. Among these three variables, income of individuals has consistently shown its positive influence in attracting investments (see Henisz and Zelner, 2001, Gutierrez and Berg, 2000) as it indicates the ability of individual to consume the services. Similarly, population variable seeks to understand the actual number of individuals in a particular country. This is because, *ceteris paribus*,

a country with large population has a bigger market. Lastly, education indicates the quality of the population to absorb advanced and sophisticated telecommunications services.

Further, countries have different investing costs that determine the differences in investments required for telecommunications infrastructures deployment. Under this category for the case of mobile telecommunications, factors include: number of base stations and infrastructure equipment needed to rollout of backbone networks to sufficiently provide mobile signals to the population. Many studies have considered investing cost as a determinant for telecommunications investments (Cadman, 2007; Friedriszick, Grajek and Röller, 2008). This framework proposes use of country area size and percentage of urban population as variables for estimating investing cost in telecom infrastructure deployment. *Ceteris paribus*, it is expected that countries with large land masses will cost more to deploy telecom infrastructure hence discourage investments (Cadman, 2007). Similarly, based on the assumption that rural population is less dense compared to urban ones, countries with large percentage of urban populations are expected to require relatively low amounts of investments hence encourage investments (Jung, Gayle and Lehman, 2008).

Lastly, market structure has been identified as an important determinant of telecommunications infrastructure investment. More specifically, market concentration in terms of number of competitors as well as level of market competition among market participants provides incentives for investments in new technologies and innovations (Jung, Gayle and Lehman, 2008). The competitive forces are expected to force the market participants to increase their investment in various ways such as: expand the network to unsupplied markets, upgrade the network to offer new services, or deliver the high quality services.

5. Empirical Analysis

5.1 Data

The data used in this study is a panel of 42 countries observed yearly from 2001 to 2011. The data panel was built by consolidating data from various public databases. Unfortunately, due to missing data the study could not include all African countries¹. As pointed out by Curwen and Whalley (2013), given the complexity in international mobile and variation in quality and content of data available authors working on analysis in international settings should be cautious in using unreliable data which is likely to result to dubious results and subsequent policy recommendations. Depending on the variables, the data was verified against other databases, international reports and countries websites to ensure data reliability.

The primary source of investment in mobile industry is the World Bank's PPPI (Public Private Partnership Investment) database, while year of liberalization and number of competing firms are adopted from the database compiled by World Bank study on Africa's ICT Infrastructure (Williams ,

¹ It is important to note that Sudan which is included in this analysis as a single country was divided to two countries: the Republic of Sudan and South Sudan in 2011, the last year of the data panel. These changes are assumed to not affect the main results of the study; hence they were not reflected in the panel.

Mayer and Minges, 2011), then verified against ITU's World Telecommunication/ICT Indicators database and regulators' websites. Further, Political stability index is sourced from the Polity IV database. Lastly other variables, namely income, population, percentage of urban population and country geographical size are taken from the World Bank's World Development Indicator Database (WDI). The list of countries included in this study can be seen from the Appendix A.

Table 2 below provides description of variables and their primary statics.

Table 2: Descriptive Statistics

Variable	Description	Mean	Standard Deviation	Minimum	Maximum
<i>Dependent variable</i>					
lnMIS	Mobile investment stock	2.319	0.871	0.093	4.398
<i>Institutional variables</i>					
POLCON	Political stability index	0.236	0.196	0	0.661
LIB	Number of years since establishment of the national regulatory authority	7.33	4.924	0	20
COMP	Number of competing firms in the mobile industry	2.4	1.3	0	7
<i>Controlling variables</i>					
lnINCOME	Individual income measured by GDP per capital	2.858	0.477	1.976	4.011
lnINCOME(IV)	Individual income instrumental variable	3.124	0.097	2.889	3.271
lnPOP	Population in a country	6.943	0.632	4.909	8.215
URBAN	Percentage of people leaving in urban areas	38.402	16.314	8.472	86.148
lnAREA	Geographical area in kilometer squares	5.333	0.844	2.663	6.377

Note: Nominal variables are reported in 2000 constant US dollars.

Investment stock in mobile telecommunications industry in logarithmic values, *MIS* is used as a dependent variable. Investments covered are those intended to provide mobile telecommunications to the public. Uses of the investment funds includes: to acquire previously state-owned assets, deployment of new facilities or upgrade of existing mobile infrastructure. Further, it also covers investments for acquisition of rights to provide mobile services as well as use a particular radio spectrum. The ownership and hence financing mode of these investments is rather complex depending of regulations in each country. They range from operation and management contracts; joint venture between local, international private entities and governments; or sole equity based firms on greenfield and existing projects. Further, ownership and financing mechanism has been dynamic, changing from initial ownership arrangements as projects are partially or entirely sold from one owner to another. In this study, little emphasis is given on the ownership and financing arrangement. The focus is on the funds invested, and unfortunately small investments are not reported; hence not included.

As shown in the literature, a mere presence to regulatory authority as a measure of liberalization is still debatable due to its inability to measure regulator's effectiveness, as it was noted above, currently there is no a standard methodology to measure regulators effectiveness. However, it is widely accepted that countries that liberalized their telecommunications market earlier, such as Nigeria, have been able to attract more investments in the sector compared to their counterparts (Williams et al., 2011). Following this reasoning, the variable *LIB* represents experience of the regulator as number of years since its establishment. It is assumed that early established regulators have accumulated experience in regulatory experience to attract investments as well as develop clear rules and regulations that have been fine-tuned to cater to the country specific needs.

Political stability is represented by the variable *POL* represents the political conditions of a country to mitigate investors' uncertainty. Given its use in the previous telecommunications literature (Andonova and Diaz-Serrano, 2007; Gutierrez and Berg, 2000 and Henisz and Zelner (2001), the political stability index from Polity IV database have been adopted. It measures quality of democracy exercised the by the governing authority among countries particularly in the areas of quality of executive recruitment, constraints on executive authority and political competition in relation to adherence to rule of law. It is expected the political stability to be positively related to investment in the telecommunications sector.

COMP variable represents competition in the country market. The preferred measure of competition in the market in the literature has been Herfindahl–Hirschman Index (HHI) index (Kim, Kim, Gaston, Lestage, Kim and Flacher, 2011), and dummy variable to indicate presence or absence of competition. While the former is preferred indicator to measure the level of competition in the market, due to unavailability in yearly market share data necessary for computation of HHI index, this study adopts number of operators in a particular country as a measure of market concentration, hence competition. High level of competition in the telecommunication sector is expected to positively affect investment in telecommunication infrastructure.

INCOME presented in logarithmic form, measures average individuals' wealth in a country in US dollars at 2000 constant prices. It the first variable contributes to market size determining factors. Income tends to consistently relate positively to telecommunications investments. On the other hand, *POP* measures the number of people in a country as another variables that measures market size. Similar to *INCOME*, *POP* is expected to positively influence telecommunications investments. Despite the fact that level of education of the population is expected to influence the market demand for telecommunication infrastructure as shown in the framework, due to data unavailability, this variable was dropped.

URBANRATE and *AREA* stand for percentage of urban population and the land mass area of a country in kilometers square respectively. While the former is expected to positively influence positively investments in telecommunications, the latter is anticipated to discourage investors hence negatively impact of telecommunications investments.

5.2. Econometric Model Specification

In order to estimate the contribution of political stability and regulatory regimes on telecommunications investments, the following econometric model is specified,

$$MIS_{it} = \beta_1 + \beta_2 POLCON_{it} + \beta_3 LIB_{it} + \beta_4 COMP_{it} + \beta_5 INCOME_{it} + \beta_6 POP_{it} + \beta_7 URBANRATE_{it} + \beta_8 AREA_{it} + \varepsilon_{it}$$

Where i indicates country 1, ..., 42 and t represents year 2001, ..., 2011.

This model can technically be estimated using fixed effect, random effect or pooled ordinary least square technique. The initial decision to make is to choose the appropriate econometric technique to estimate efficient and unbiased estimates. Due to time invariant variables in the model such as country landmass size, and institutional variables which are stationary or slow changing, fixed effect model is likely to yield inefficient estimates because it tends to lose time invariant information. Therefore, Fixed Effect model is abandoned for the analysis. Further, to choose between pooled OLS and random effect model estimation techniques, the Breusch and Pagan Lagrangian Multiplier (LM) test was used to test for panel effects. The test results rejected the null hypothesis, that there are no variances across countries, at 1 percent. Therefore, the model is estimated by the Random Effect model via the Generalized Least Square (GLS) to explore within cluster correlations (Allison, 2011) to provide efficient estimates.

Another issue, most studies assessing determinants of telecommunications investments using econometric models suffer from possible endogeneity problem (Friedriszick, Grajek and Röller, 2008). Estimating an econometric model without treating for endogeneity problem is likely result in biased estimates. Endogeneity can mainly rise from: first, omitted variables, and second, reverse causality that causes a persistence feedback loop problem between dependent and independent variables, especially when income is used as an explaining variable. In order to solve for possible endogeneity from the former cause, the model follows a framework that emulates the entire investment paradigm introduced in section 4, attempting to include all necessary variables. The latter cause of endogeneity is solved by using an instrumental variable for income. For a variable to be statistically appropriate as an instrumental variable, it should highly be correlated with the variable it replaces without correlate with the error term of the estimated equation. In this study, the neighboring markets instrument variable (Dewenter and Haucap, 2007, Hausman, 2012) is used. In particular, income for neighboring countries in African countries is used as an instrument variable for the income variable.

6. Results

This study investigated the effect of political stability and sector-specific regulations in telecommunications industry in Africa. The results of the econometric analysis under different specifications, covering the period from year 2001 to 2011, are given in table 2. These different specifications used are designed to reveal the behavior of the model with presence or absence effect of income instrumental variable, and exclusion of liberalization or political stability variables.

Table 2: Empirical results for determinants of telecommunication investment at country level

	Model 1	Model 2	Model 3 (LIB excluded)	Model 4 (POLCON excluded)
Political Stability (POLCON)	-0.111 (-1.22)	-0.120 (-1.27)	-0.091 (-0.94)	-
Liberalization (POL)	0.042* (8.24)	0.043* (5.07)		0.042* (5.00)
Competition (COMP)	0.080* (5.68)	0.067* (4.51)	0.061* (3.99)	0.066* (4.44)
Income (INCOME)	1.124* (9.75)	-	-	-
Income_neighbors IV (INCOMEIV)	-	1.031* (3.81)	2.181* (14.34)	1.041* (3.85)
Population (POP)	1.378* (11.27)	1.210* (7.26)	1.331* (7.99)	1.196* (7.18)
%Urban population (URBANRATE)	0.002 (0.62)	0.024* (5.50)	0.027* (6.15)	0.023* (5.43)
Country size (AREA)	-0.372* (-4.35)	-0.409* (-3.37)	-0.384* (-3.13)	-0.401* (-3.29)
R-square	0.77	0.55	0.55	0.56
NT	462	462	462	462

Note: numbers in the bracket are z-statistics, and p-values represent statistical significance as * at 1%, ** at 5% and *** at 10%.

Model 1 show results of the analysis when the endogeneity problem is ignored, by not using the income instrumental variable. In this specification, surprisingly the coefficient of political stability variable (POLCON) shows negative sign; however, it is not statistically significant. On the other hand, the coefficient for liberalizations variables (LIB) shows a positive relation and statistically significant at 1 percent as expected. Further, the coefficient for market size variables: wealthy (INCOME) and population (POP), and market structure variables: competition (COMP) have resulted in positive sign and statistically significant as expected. The coefficient of investing cost, country size (AREA) and percentage of urban population (URBANRATE) resulted in positive and negative signs respectively. However, while country size is statistically significant at 1 percent, the percentage of urban populations is not statistically significant. The entire model 1 has R-square value of 0.77, indicating about three-quarters ability to explain the variations in telecommunications investment across African countries. With exception of political stability coefficient, other variables coefficients have behaved in accordance with our common sense and previous literature.

In order to treat the possible endogeneity problem in the model, the model 2 specification introduces the income instrumental variable. Instrumental variables estimation is able to treat endogeneity bias as well as reduce spurious regression effects (Robinson and Gerolimetto, 2006). The coefficients of all variables retain the same signs as in model 1, and the coefficient for the percentage of urban populations becomes statistically significant. Under these specifications, the

coefficient of political stability remains negative and statistically insignificant as in model 1 previously. Further, this specification model yields R-square value of 0.54; perhaps the higher R-square in the model 1 is spurious effect which has been reduced by introduction of instrumental variable.

Model 3 show the results of the specification that focuses on the behavior of political stability variable in the absence of liberalization variable; while model 4 study the behavior of liberalization variable in the absence of political stability variable in the model. In both model 3 and model 4, endogeneity is treated, and the results of all control variables retain their signs at statistical significance of 0.01 precision. As in model 1 and 2, in model 3, the sign of the coefficient for political stability variable remains negative and statistically insignificant while that of the liberalization variable remains positive and statistically significant, even after the omission of political stability variable in model 4 specification. While the results with respect to political stability are contrary to the earlier hypothesis and the general understanding, these results are concurrent with the Holden and Pagel (2012) study which investigated the relationship between country fragility and flow of foreign direct investment. Similar to this study, they did not find and statistically significant relationship between country's political stability and foreign direct investments in developing countries.

Model 2 models is adopted as the most appropriate one since it account for endogeneity and set of variables are present as suggested by the framework. The specifications in model 1, 3 and 4 are presented to test the robustness of the analysis.

7. Conclusion

This study attempted to analyze the effect of regulation and political stability in telecommunication investments in the African continent between year 2001 and 2011. Political stability stressed on the efficiency of the democratic process particularly recruitment of individuals for political positions, execution of power by the governing class and transfer of power exercise. Regulation based on the length in years a country has established telecommunications regulatory authority. In order to better understand the dynamics of investment in telecommunications, a framework was developed to understand the factors that determine investments in telecom industry at country and industry level, particularly: institutions, market size/demand level, market structure and investing cost.

Consistently, it is found that experience of NRA to regulate the market has been the main institutional force behind increase in investment in the African continent. The study could not establish the claim, political stability in Africa, measured by its democratic process, influenced telecommunications investments, nevertheless, those countries that were early in liberalizing their telecommunications market have benefited from increased telecommunications investment. The results from the econometric analysis stresses the point that, the decision of the governing powers in the timing for liberalizing the telecommunications market and adopt regulated market policies, played a central pillar in attracting telecommunications investments in these countries. In addition

to institutional factors, countries with large market size, competitive market structure and low investing costs have experienced high level of investments in the telecommunication sector.

The study has few policy recommendations; given the market size and investing cost such as population, country area, or percentage of urban population are more or less fixed or changing relatively slow beyond policy makers' control, they can focus of sector specific institutional attributes and market structure factors to speed-up the process of attracting investors in the telecommunications market. More specifically, the study has shown that a quality of regulator, in this particular experience, and competition in the market increases investments in the sector. It is also a policy recommendation countries which are yet to liberalize their telecommunications market, such as Ethiopia, to do so for the development of its industry and society.

In conclusion, the study provides an important note on the dynamics of telecommunications investment in African countries in relation to mainly its institutions, particularly political stability. However, this study is not without some limitations. As a challenge to the research community, there should be improvement in measuring institutional variables. More specifically, it should be noted that political stability is not only a function of the quality of the democratic process as assumed in this study (and others studies as well as pointed in the literature). Political stability is rather complex, ranging from various forms for political shocks such as occasional fights in parts of a country or election disorders during elections that usually cause short-term effects, to sustained civil wars which massively undermines the functioning the society for considerable number of years . Incorporating different sources of political instability will provide a better understanding of the effect of political stability on telecommunication investments, and ultimately to development of telecommunication industry in the continent. Such remain to be the task for future research.

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Appendix A: The list of African countries included in the study	
Algeria	Madagascar
Angola	Malawi
Benin	Mauritania
Botswana	Mauritius
Burkina Faso	Morocco
Burundi	Mozambique
Cameroon	Namibia
Cape Verde	Niger
Central African Republic	Nigeria
Chad	Rwanda
Congo	Senegal
Congo, Dem. Rep.	Seychelles
Cote d'Ivoire	Sierra Leone
Egypt, Arab Rep.	South Africa
Eritrea	Sudan
Gabon	Swaziland
Gambia, The	Tanzania
Ghana	Togo
Guinea	Uganda
Kenya	Zambia
Lesotho	Zimbabwe