Chapter 1: Introduction
The telecommunications industry is one of the most dynamic industries in the world because of the progressive growth and structural changes brought in by innovation and improvement in technology over the past decades especially in the mobile sector. Before now, the telecommunication industry most especially the fixed line sector and the mobile sector were characterized by monopoly markets. Though liberalization was uneven, it contributed to the expansion of the industry and equally encouraged competition in almost all the countries that were dominated by national monopolies until the mid-1990s with some of them being
privatized (Djiofack-Zebaze & Keck, 2009). Increasing demand equally encouraged competition (Polykalas & Prezerakos, 2015). Almost all OECD countries were characterised by oligopoly markets by 2008 except New Zealand and Norway (Li, 2011). According to Peitz, Valletti, and Wright (2004) summary, in order to limit competition in the low user market (that is a market where demand is low) while increasing competition in the high demand market, firms could set higher access charges in the high demand market without a corresponding fall in price in the low demand market. In addition, the global change in the telecommunication industry was more present in the mobile sector than in the fixed line sector with regulatory authorities created in some countries to monitor the industry’s development. This industry is important because it contributes enormously to economic development by reducing the level of unemployment, creating income as well as being an input used to produce other goods and service (Djiofack-Zebaze & Keck, 2009).

In the past, fixed line was the most widely used means of communication, but today is substituted for the mobile communication network with mobile subscription outnumbering fixed line subscription partly because of competition, spectrum license decisions (Gruber & Verboven, 2001). Furthermore, there are numerous factors which might affect mobile call prices among which population, population density, income, competition. Competition in the mobile telecommunication market has also been influenced by liberalization, privatization of some existing firms and the entering of new firms which has encouraged innovation. The fall in outgoing and incoming call prices in almost all countries in the world is attributed to technological progress because more network infrastructure could be set up at a lower cost. This fall in prices was equally a result of measures like mobile number portability, decrease in mobile termination rates, the entrance of new operators (mobile virtual network operators) in the market (ITU, 2014).

According to (Djiofack-Zebaze & Keck, 2009) though there is increasing competition in the mobile communications market, mobile call prices are still high compared to other regions of the world especially in Africa. This argument can be supported by the telecommunications mobile service price data which equally shows that over the years phone call prices have continuously been falling in terms of USD, purchasing power parity (PPP) or as a percentage of Gross National Income per capita (GNI p.c.). For example between 2013 and 2014 the mobile cellular prices have continuously been falling both in relative and absolute terms in developed countries from an average of 1.5 per cent of GNI p.c. to 1.4 per cent, in developing countries from 11.6 per cent of GNI p.c. to 5.6 per cent and in the least developed countries (LDC) from 29 per cent to 14 per cent for the year 2008 and 2014 respectively (ITU, 2015).

Figure 1 below shows the evolution of mobile telecommunications service prices as a percentage of Goss National Income per capita from 2008 to 2014 with countries classified by level of development based on the United Nations classification. Prices are expressed as a percentage to properly show affordability of mobile call services by country. From the graph, LDCs and developing countries have been paying higher call prices compared to developed countries.

Figure 1: Mobile cellular basket in USD, 2008-2014

This different view on prices comes with the question ‘Does mobile telecommunications competition affect mobile call prices?’ Is competition the most important determinant of telecommunications service prices? The main objective of this study is to assess how competition in the mobile sector affects mobile call prices using other control variables and control for inflation. I also evaluate the relative effect of increasing competition on prices in developed and developing countries. The hypothesis tested includes;

H0: mobile telecommunications competition does not significantly affect mobile calls prices
H1: mobile telecommunications communications significantly affects mobile call prices

This paper looks at the determinants of telecommunications prices because prices in part determine usage and usage is shown by (Lam & Shiu, 2010) to influence economic growth. Also the graph below indicates developed countries have the highest mobile penetration and mobile cellular subscription (see Appendix). Theoretically, prices will be determined in part by the determinants of demand and marginal cost. On the demand side we have population density, income and on the cost side we have input factors like the cost of operating telecom services. But prices will also in part be determined by the market structure. As shown in the next section, the level of firm competition in the market will determine equilibrium market and quantities.

Thus to identify which is the most important factor(s), data was collected from Wikipedia, International
Telecommunication Union (ITU) and the World Bank on a panel of 180 countries in the world for a period of 5 years from 2010 to 2014. It is hoped that the findings of this research will be a contribution to the previous works done as its attempts to assess the impact of mobile competition on call prices in the telecommunications industry.

This study is divided into five chapters; this chapter introduces the topic, identifies the research question, the research’s objectives and states the hypothesis being tested: chapter two which is the literature review consists of some theories and empirical review: chapter three identifies the method of data collection, method of data analysis, specifies the method of estimation, the validation technique and limitations of the study: chapter four discusses the results and chapter five concludes.

Chapter 2: Literature Review

This section will review some relevant theories and literature. Some conventional wisdom on competition is that of the classical and the neoclassical theories of competition. Smith, Ricardo, J.S. Mill developed the classical theory of competition in which competition is viewed as a mechanism coordinating the conflicting self-interest of individuals and directing them to the attainment of equilibrium (the attainment of natural prices). In other words, competition is a process which leads to an equal price in the short run, different profit rates between firms in the industry and different prices between industries which will tend all tend to be equal in the long run. J.S. Mill believed that natural prices and income could be determined in a strict way. They were criticised for not being clear on the requirements of a competitive behaviour and how it was affected by the number of participants; for not distinguishing clearly intra industry competition and inter industry competition (Tsoulfidis, 2011).

On the other hand, the neo-classicist theory of perfect competition assumes demand for a good is homogenous for all the industries; perfect knowledge or information about the market by consumers in terms of product characteristics and prices; utility maximization; profit maximization and perfect mobility of factors of production; large market size; free entry and exit of firms. Thus this theory assumes that with all the above conditions put together producers and cannot influence the price of a product and the firm chooses the level of output which maximizes profit achieved where price equals the marginal cost of the product. At this point welfare society and consumer utility is maximized. This theory was used by Chamberlin in his formal theory of monopolistic competition but later rejected by him on the grounds that free enterprise has too long been loosely related to pure or perfect competition and is ‘in no sense an ideal’ (S. D. Hunt, 2010). The theory of perfect competition was criticized by (Shelby D. Hunt & Morgan, 1995) for not explaining why market based economies had superior quality goods compared to command economies which their comparative advantage did though they suggested more empirical and conceptual work be done to test, explore and further explain its implications.

Chamberlin was a neo-classicist who developed the theory of monopolistic competition and argued that product differentiation (in terms of higher quality) leads to higher prices and output rates not at the lowest point of a firm’s long run average cost curve(Shelby D. Hunt & Morgan, 1995). This theory was based on the assumptions that a general category of product is differentiated; demand and supply are heterogeneous; static equilibrium be used in economic analysis with reliance on geometric and mathematic reasoning; perfect competition should be used to judge monopolistic competition(S. D. Hunt, 2010). He advocated for perfect competition to be replaced by monopolistic competition because it deviated from the present economic life while other neo classicist (Friedman, Stigler and Harberger) argued that perfect competition was the approximate result of the work of capitalism and monopolistic competition was a more complex approach. His theory of monopolistic competition was equally criticized for encouraging government intervention which according to him was necessary because competition was imperfect. In addition to that, Chamberlin’s informal theory of monopolistic competition was not acknowledged by both the Chicago and Harvard school as a legitimate as it regarded perfect competition not to be an ideal for welfare economics.

The main difference between these two schools of thought is that the classical viewed competition as a rivalry which never ends because firms strive to increase their market shares compared to the neo-classicists view of it as an end state (Tsoulfidis, 2011).

Furthermore, we have the classic models of oligopoly which consist of the Cournot model, the Bertrand model. The Cournot model of oligopoly is a static game of complete information where firms compete over quantities and the Cournot equilibrium is the Nash equilibrium of quantities (which is a pair of output such
that neither firm can increase its profits by unilaterally deviating). It is based on the assumptions that firms produce homogenous products, compete with each other once and decide what quantity to produce at the same time and choose the output level. Here the firm have market power (because prices exceed marginal cost) measured by the Herfindahl-Hirschman Index. The theory of oligopoly assumes there is a positive relationship between market power and concentration. This market power reduces with the number of firms competing in the market. This model was criticised by Joseph Bertrand on the basis that firms compete over prices and not quantities. According to Bertrand’s model of competition, firms compete over prices and the Nash equilibrium price (which are a pair of prices such that given the Nash equilibrium price of its rival the firm will have no incentive to unilaterally deviate) is attained where price equals marginal cost \((P=MC)\) with zero profit. It is the based on the assumptions that firms produce the same goods, simultaneously choose their price and no other producer can enter the market. The Bertrand model equally considers the situation where products are differentiated and concludes that firms equally compete over prices than quantities.

These two models considered a duopoly market (Church & Ware, 2000). According to Church and Ware (2000), in the basic Cournot model with \(N\) firms where,

\[
P = A - bQ \text{ and } C(q_i),\]  

Cournot equilibrium output and price is given by

\[
Q = \frac{N[(A-c)/(b(N+1))]}, \text{ and } P = (A+Mc)/(N+1),
\]

\[
P(q_i,q_{-i}) + dP(q_i,q_{-i})/dQ q_i = MC_i(q_i)
\]

\[
P(q_i)/(P(q_i,q_{-i})) - MC_i(q_i) = dP(q_i,q_{-i})/dQ q_i = 1/\sum_{i=1}^{N}s_i
\]

\[
P(q_i,q_{-i})/P(q_i,q_{-i}) - MC_i(q_i) = 1/\sum_{i=1}^{N}s_i^2 = HHI
\]

\[
P(q_1,q_{-i}) = \text{Cournot equilibrium price}
\]

For the past decades competition in the telecommunications industry has attracted a lot of attention in the academic research field among which the relationship between mobile network and the fixed line network. According to Rodini, Ward, and Woroch (2003), mobile service moderately replaces the fixed line and this substitution will continuously increase overtime. Vagliasindi, G’ney, and Taubman (2006) looked at fixed and mobile competition in transition economies and results showed that competition led to a substitution effect between mobile and fixed line subscription on Eastern Europe countries and the rest of Soviet Union. This substitution effect was equally acknowledged by Garbacz and Thompson (2007) whom examined the relationship between economic development, public policy and telecommunications technology through telephone demand models and the use of price equation developed in Garbacz and Thompson (2005). This mobile and fixed demand model incorporated a new variable price. The hypothesis of whether mobile phones and wire line phones were substitutes or complements was tested. Three equations were formed; the first one not controlling for price endogeneity, the last two which controlled for price endogeneity their estimated prices were used as actual prices in the demand model for mobile phones and fixed lines with one of the equations including density. Privatization, competition and independent regulators dummy variables were used as instruments to control for endogeneity. The models were estimated through two stage ordinary least square with fixed effects for 53 countries over an 8 year period. Data was in log form so as to interpret the estimates as elasticities. The results showed that fixed line service monthly price is statistically insignificant in the fixed line demand model but significant in mobile demand model while mobile service prices are statistically significant in both the fixed line and mobile demand model. Also, the mobile model estimates suggested that mobile phones and fixed lines are substitutes in the mobile market but complements in the fixed line market. Thus he suggested a reassessment of universal services and competitive market initiatives. Kalmus and Wiethaus (2010) used a two stage Cournot model to investigate to what extent mobile virtual network operators (MVNO) exerted a competitive constraint on mobile network operators (MNO). The first stage assumed that mobile network operators decided on the amount of capacity (or wholesale minutes) to allocate to their retail businesses and wholesales (to MVNO) and in the second stage mobile virtual network operators decided on the amount of minute calls to purchase while they both competed in the retail market. The sample was made up of two MNOs and \(n\) number of MVNO. The results revealed that the entrance of mobile virtual network operators in to the market does not increase the level of competition in the retail market nor does it induce a decrease in price. In addition, based on their results they think less wholesale
capacity will be offered by the mobile network operators to prevent mobile virtual network operators to compete with them in the retail market and no capacity will be offered at all if their products are substitutes. Also, Cricelli, Grimaldi, and Ghiron (2011) looked at competition amongst mobile network operators (MNOs), mobile virtual network operator (MVNOs) and hosting network operators (HNOs) and concluded that collaboration between the incumbent and MVNO is the best strategy in terms of profit margin and market shares.

Other researchers tried to assess regulatory reforms and performance in the telecommunication sector. Maiorano and Stern (2007) assessment of the relationship between regulation and performance in the mobile sector showed a significant positive effect of regulatory reforms on mobile telecommunication diffusion and gross domestic product per capita. Liberalization in the telecommunications sector associated with competition led to economic growth, increased sectorial performance, quality of service rendered and equally caused prices to fall (Djiofack-Zebaze & Keck, 2009). In the same direction, Fink, Mattoo, and Rathindran (2003) estimated the impact of telecommunications regulatory reforms (competition and privatisation) on performance for developing countries with data collected from the ITU for more than 100 countries. In his study he tried to find out if sequential implementation of these policies was important in boosting mainline penetration. He controlled for serial correlation and heteroskedasticity. The estimated results suggested that introducing competition and privatisation at the same time was more effective in boosting or increasing performance than if competition was introduced after privatisation. The test for sequential implementation showed that privatisation had a positive and significant effect on mainline penetration when implemented alone while competition was not significant when implemented alone. On the other hand, Garrone and Zaccagnino (2015) found no precise relation between competition and market reforms while examining the relationship between competition and telecommunication investment for 29 OECD countries where they first checked for breakpoints in investments at country level for 18 OECD countries for (33 years) and if these breakpoints could be associated with market reforms such as the liberalization of the mainline markets and unbundling obligations. Secondly, they conducted a bivariate analysis to see if market competition influenced incumbent fixed investment with the use of a unit root test for 29 OECD countries from 1993 to 2008. One of the limitations in their analysis is that they didn’t distinguish between investment in the mobile and fixed line sector.

The assessment of key variables affecting the mobile telecommunications was also one of the main issues addressed by some studies. In that light, Gruber and Verboven (2001) assessed the role of technology, regulatory decisions and competition in the diffusion of mobile telecommunications on a panel consisting of European Union members using a logistic model of technology diffusion. The final result showed that transition from the analogue to the digital technology and increase in spectrum capacity, had a major impact on the diffusion of mobile telecommunications. He suggested more works be done with the price variable. Furthermore, Gruber (1999) studying investment issues affecting the mobile telecommunications sector concluded that public action can become an important stabilising element in involving private investors with otherwise shorter time horizons.

Nucciarelli, Gastaldi, and Levialdi (2009) examined the determinants of pricing in the international telecom market and concluded that the market structure determined tariff in a bilateral market. Pearcy and Savage (2015) empirically evaluated the impact of international simple resale on actual and potential competition and price in the United States international telecommunications market and found out a limited effect on competition and a fall in prices by employing a reduced form equation model on a 9 year data. Hausman and Ros (2013) assessed telecommunication prices and consumer surplus in Mexico with the use of a panel data which consists of countries similar to Mexico. Their objective was to show that telecom prices (mobile and fixed line prices) in Mexico are lower compared to other OECD countries despite the fact this market is considered more concentrated than the telecom markets in other countries using demand models for both fixed and mobile and found out that prices actual call prices in Mexico were smaller compared to countries similar to Mexico.

Also, the International Telecommunication Union (ITU, 2014) examined the relationship between competition, regulation and telecommunications prices on a panel data. They used price measured in current US dollars (converted using the international Monetary Fund international exchange rate) as their dependent and few control variables on a five year period. They found out that competition and the regulatory environment
significantly influenced prices of mobile calls. Most of the literature cited analysed competition in the telecommunications industry from various angles. But to the best of my knowledge there are not many research papers providing empirical evidence of the direct relationship between competition and mobile call prices in the mobile market. This might be attributed to the fact that data on mobile call prices are not readily available and difficult to measure because mobile network operators sometimes set prices based on the different bundles or services offered to consumers. Thus this instability in prices makes it difficult to measure as a standard unit.

This paper will contribute to the existing literature (and the work of the ITU) by assessing if mobile network competition is the most important determinant of mobile call prices on a larger set of countries by using recent price data compiled by the international telecommunication union (ITU) and adjusting them for inflation. Price measured as a percentage of Gross Domestic Product per capita will be used rather than monetary cost. Other control variables different from that of the ITU will be used and I will also find out if the effect of mobile network operators competition on the affordability of mobile calls greater for developed or developing countries.

Chapter 3: Methodology

This section describes how the data has been collected and the econometrics method and model used to assess the effect of competition on mobile call prices. The data used for this study is an unbalanced panel data because some countries do not provide data on call prices and the market shares of the various mobile network operators in their respective countries for all the years. The dependent variable ‘Price’_it is the price of a standard mobile monthly usage of 30 outgoing calls plus 100 messages in country ‘i’ at time ‘t’ in current US Dollars. These prices are prepaid call prices except for some countries where post-paid prices were instead recorded because prepaid subscription according to ITU (2014) accounted for less than 2% of mobile cellular subscriptions. I later converted them to constant 2005 US dollars to control for inflation using the World Bank Consumer Price Index. A summary of the data variables used and their description can be found in Table 1.

To assess the effect of mobile telecommunications industry on mobile call prices, I estimate a linear panel regression model which consists of the mobile call prices for all the countries in the world. The model estimated is:

\[
\text{‘Price’}_\text{it} = \beta_0 + \beta_1 ‘\text{HHI’}_\text{it} + \beta_2 ‘\text{PEN’}_\text{it} + \beta_3 ‘\text{GDPpc’}_\text{it} + \beta_4 ‘\text{POP’}_\text{it} + \beta_5 ‘\text{DENSITY’}_\text{it} + \epsilon_k
\]

Equation (1)

In order to determine if the effect on price of increasing the HHI is greater on developed or developing countries, equation (2) is estimated;

\[
\text{‘Price’}_\text{it} = \beta_0 + \beta_1 ‘\text{HHI’}_\text{it} + \beta_2 ‘\text{PEN’}_\text{it} + \beta_3 ‘\text{GDPpc’}_\text{it} + \beta_4 ‘\text{POP’}_\text{it} + \beta_5 ‘\text{DENSITY’}_\text{it} + \beta_6 ‘\text{HHIdev’}_\text{it} + \epsilon_k
\]

Equation (2)

These models are estimated using Ordinary Least Square method with fixed country and time effects using panel data on 180 countries based on the availability of price data for a period of five years (from 2010 to 2014). Panel data regression incorporating fixed country effects enables to control for factors that vary across countries but not time, that if omitted could lead to omitted variable bias and that cannot be measured while panel regression incorporating both fixed country and time effects control for variables that vary both across countries and time. R software is used to run the panel regressions.

The HHI which is a common measure of market concentration and the level of competition is obtained by summing the squares of the market shares of various mobile network operators collected from each country. The formula used is:

\[
\text{HHI} = (i=1)^N s_i^2
\]

Where,

N: represents the number of firms in the industry
s_i: is the market share of firm i in the market.

This HHI ranges from zero to one expressed as a fraction and computation of the HHI was done using excel spread sheets. To estimate equation (2), a new variable ‘HHIdev’_it is added which accounts for the effect of HHI between developed and developing countries. Countries included in the sample are separated into developed and developing countries based on the Gross Domestic Product per capita (GDP p.c.) in constant 2005 US dollars. Countries with a Gross Domestic Product of more than 10000 in constant 2005 US dollars will be classified as developed countries and countries with a GDP p.c. of less than 10000 constant 2005 US dollars
will be classified as developing countries. The dummy variable (Dev.) will equally be used; 1 will represent
developed countries and 0 will represent developing countries. Table 1 below defines the variables included in
the model and the summary statistics. The model estimated is similar to the demand model of some
researchers like Madden et al. (2004) who examined the mobile demand growth and factors influencing it,
using mobile phone subscription as the dependent variable. Hakim and Neaime (2014) who examined growth
in the mobile sector using data from the Middle East and North African countries and mobile subscription per
100 inhabitants as the dependent variable.
The hypothesis tested here include
$H_0$: Mobile market competition does not significantly affect mobile call prices
$H_1$: Mobile market competition significantly affects mobile call prices
That is, the hypothesis stated tests mobile call prices as a function of the level of competition with other
control variables included. The basic equation is

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Variable Definitions Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price$_{(i,t)}$</td>
<td>Standard monthly usage price of 30 outgoing calls plus 100 messages (plus on net and off net) measured in constant 2005 US Dollars</td>
</tr>
<tr>
<td>HHI$_{(i,t)}$</td>
<td>Herfindahl-Hirschman Index used to measure the level of competition measured as a fraction</td>
</tr>
<tr>
<td>Pen$_{(i,t)}$</td>
<td>Mobile cellular subscriptions per hundred inhabitants (mobile market penetration) measured as a %.</td>
</tr>
<tr>
<td>'GDPp/c'$_{(i,t)}$</td>
<td>Log Gross Domestic Product per capita measured in constant 2005 US Dollars</td>
</tr>
<tr>
<td>Pop$_{(i,t)}$</td>
<td>Log of Population (measured by the total number of people regardless of their legal status)</td>
</tr>
<tr>
<td>Density$_{(i,t)}$</td>
<td>Log of Population density (measured in number of people per square km)</td>
</tr>
<tr>
<td>Dev$_{(i,t)}$</td>
<td>A dummy variable equal to 1 if the country has a GDP per capita greater than 10000 and 0 if it’s less 10000 measured in constant 2005 US dollars ITU</td>
</tr>
</tbody>
</table>

Regulator website (see appendix for details)

World Bank

World Bank

World Bank

World Bank

World Bank

World Bank

'Price'$_{(i,t)}$ it is converted to Price per Goss Domestic Product per capita as the dependent variable because it describes mobile call prices in terms of affordability and yields more significant results.

The Herfindahl-Hirschman Index (HHI) which is used to measure the level of market concentration and competition is the main independent variable and is expected to have a positive relationship with price. According to the United States Department of Justice and FTC it ranges from 0 to 10,000 where markets are classified with an HHI below 1500 as un-concentrated markets; HHI between 1500 and 2500 as moderately concentrated markets; and HHI above 2500 as highly concentrated markets. The higher the level of concentration, the lower the level of competition (indicating monopoly) and the lower the concentration the higher the competition (indicating perfect competitive markets).Shelby D. Hunt and Morgan (1995) define competition as the constant struggle among firms to gain a comparative advantage in resources that enables a firm to have a competitive advantage over the others thereby leading to higher financial performance. For this study the Herfindahl-Hirschman Index will be measured as percentages. It is expected that the HHI will be positive.

Gross Domestic Product per capita, log (population), log (population density), are the control variables added in the regression. Logarithm transformation is used for the data to have a more normal distribution if there are outliers. PEN (market penetration rate) measures the availability of mobile telecommunications services in a country 'i' at a particular time period 't'. Gross Domestic Product per capita is in constant 2005 US dollars and is used as an approximation for income and also controls for differences in the level of economic
development because according to the International Telecommunication Union (ITU) telecommunications prices may differ depending on the level of economic development of countries. Density (population density) which is the number of people per square kilometre is included as a proxy for cost. An interaction term (HHIdev) is used to capture the effect of an increase in HHI on developed and developing countries. Moreover, data on the variables used are obtained from various sources: data on mobile call prices were obtained from the International Telecommunication Union (ITU) reports; mobile network operators market shares from the telecommunications regulatory authorities’ websites of various countries, communications statistics websites, Wikipedia and operators’ websites; data on the rest of the variables were obtained from the World Bank. This secondary source data is used to address the research objectives and question. The T-test will be used to test the hypothesis of the study and the F-test to test for the overall significance of the results. R² will be also be used to test for the goodness of fit, that is, how much variations in the dependent variable are explained by variations in the independent variables.

The main weakness of this thesis is that though the sample size is large, data is not available for all the countries and all the years making it difficult to have accurate estimates of the results.

Table 2: Descriptive statistics

<table>
<thead>
<tr>
<th>Statistic</th>
<th>N</th>
<th>Mean</th>
<th>St. Dev.</th>
<th>Min</th>
<th>Max</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>799</td>
<td>12.6</td>
<td>9.6</td>
<td>0.0</td>
<td>56.0</td>
</tr>
<tr>
<td>HHI</td>
<td>244</td>
<td>0.4</td>
<td>0.1</td>
<td>0.1</td>
<td>1.0</td>
</tr>
<tr>
<td>Pen</td>
<td>895</td>
<td>1.0</td>
<td>0.4</td>
<td>0.03</td>
<td>3.2</td>
</tr>
<tr>
<td>Pop</td>
<td>900</td>
<td>38,447,568.0</td>
<td>141,684,467.0</td>
<td>30,690</td>
<td>1,364,270,000</td>
</tr>
<tr>
<td>Density</td>
<td>900</td>
<td>431.1</td>
<td>2,075.1</td>
<td>1.7</td>
<td>19,073.1</td>
</tr>
<tr>
<td>GDP</td>
<td>861</td>
<td>10,981.6</td>
<td>15,612.7</td>
<td>147.1</td>
<td>82,960.1</td>
</tr>
<tr>
<td>Dev.</td>
<td>895</td>
<td>0.3</td>
<td>0.5</td>
<td>0.1</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Source: author

N.B: The number of observations varies because of missing data for some years and countries. Thus the number of observations above is not necessarily used in the regression because incomplete observations are not counted. Prices, GDP per capita are all measured in constant $2005.

Chapter 4: Empirical Results

This will section discuss the results of the panel regression with fixed country effects and time effects. The objective of this paper was to determine if competition among mobile network operators leads to a fall in prices in the mobile telecommunications industry and if the effect of an increase in the HHI on mobile call prices was greater for developed or developing countries. The results of the regression are summarized in Table 3 below with each column showing the regression estimates with their standard errors and row the variables used. The F statistic and P-value on time effects are equally shown in the table. The Hausman test was performed and the results suggested fixed effects should be used for this panel regression. The result of this test is available in the appendix. I equally tested for year effects and the results were significant.

TABLE 3 Regression Analysis of the Effect of Mobile telecommunications Competition on Mobile call prices

<table>
<thead>
<tr>
<th>Dependent variable priceperGDP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regressor (1) (2) (3) (4) (5)</td>
</tr>
<tr>
<td>HHI 0.031** 0.033** 0.049**** 0.046*** 0.045****</td>
</tr>
<tr>
<td>(0.012) (0.013) (0.012) (0.012) (0.012)</td>
</tr>
<tr>
<td>Pen 0.006 0.005 -0.004 -0.003 -0.003</td>
</tr>
<tr>
<td>(0.004) (0.004) (0.004) (0.004) (0.004)</td>
</tr>
<tr>
<td>Pop -0.293 -0.314* -0.734 10.214* 9.387</td>
</tr>
<tr>
<td>(0.179) (0.175) (3.191) (5.723) (5.714)</td>
</tr>
<tr>
<td>Density 0.223 0.208 0.633 -10.384* -9.562</td>
</tr>
<tr>
<td>(0.151) (0.135) (3.175) (5.767) (5.751)</td>
</tr>
<tr>
<td>HHIdev -0.023** -0.027** -0.028**</td>
</tr>
<tr>
<td>(0.012) (0.011) (0.011)</td>
</tr>
<tr>
<td>GDP 0.009</td>
</tr>
</tbody>
</table>

State effects?

Time effects?
The regression results above were obtained using a panel data of 180 countries from 2010 to 2014. Standard errors are in brackets under the estimated coefficients and p values are in brackets under the F-statistics.

* Significant at 10% level
**significant at 5% level
***significant at 1% level
****significant at 0.1% level

Column (1) regression in Table 3 regresses price per Gross Domestic Product per capita measured in constant 2005 US dollars on HHI (which ranges from 0 to 1), market penetration rate, population and population density using fixed country effects. The coefficient estimate on HHI is positive (0.031) and statistically significant at 5% level. This estimate shows that increase in HHI equally increases mobile call prices. Regression2 in column (2) estimates the same variables as in column (1) but controls for both fixed country effects and time effects and has a lower adjusted R-square of 20.3%. The estimated coefficient on HHI shows a positive increase (from 0.031 to 0.033) and significant relationship with mobile call prices at 5% level. According to this estimate, the higher the HHI (which means increase in monopoly power) the higher mobile cellular call prices and the lower the HHI (competition) the lower the price of mobile calls. Thus a unit increase in HHI leads to a 0.033 dollars increase in mobile call prices. Given the aim of this study which was equally to check for the systematic difference between developed and developing countries a dummy variable Dev. was created which takes the value 1 if the country is a developed country and the value 0 if it’s a developing country. This dummy variable was interacted with the HHI to capture this difference (HHIdev). The results are shown in column (3) regression for country fixed effects where the estimated coefficient on HHI is higher (at 0.049) and strongly significant at 0.1% level showing that a 1 unit increase in HHI increases mobile call prices by approximately 0.05 dollars. The coefficient on the interaction term (HHIdev) is negative (-0.023) and statistically significant at 5% level indicating that the effect of increasing the HHI on call prices is lower for developed countries than developing countries. This means that if the HHI increases by one unit, mobile call prices will increase by approximately 0.023 dollars in developed countries lesser than the amount in developing countries.

Column (4) regression incorporates both country fixed effects and time fixed effects. The HHI is still positive (0.046) and statistically significant at 1% level. This result is similar to the one obtained in column (3) regression. The relationship between population and call prices is different from the results obtained in column (2); the result indicates a significant positive relation at 10 % level between population and prices. Using country fixed effects and time effects still show that the effect of an increase in HHI on mobile call
Column (5) regression results shows no significant difference in the estimated coefficients when Gross Domestic Product per capita is included. The only difference is that the effect of population and population density in mobile call prices is no more significant. GDP p.c. and mobile prices have a positive relation though it effect on price is low and statistically insignificant. The adjusted R square equally does not change much (30.3%). From the Cournot oligopoly model increases in the HHI increases the market power of firms resulting to an increase in prices for services. If the number of firms in the industry increases, the HHI reduces, the output produced by each firm reduces because of the entrance of the firm in the market but overall output in the market increases leading to a fall in prices. Thus HHI and the number of firms have an inverse relationship. Table3 regression results presented above used heteroskedasticity robust standard errors to avoid threats to internal validity. But one of the potential threats to the internal validity of my study is measurement error (data quality) because some variables data collected especially the market shares of some mobile network operators collected from Wikipedia did not have valid sources. Also, only countries which had data on mobile call prices were included in the analysis and this can lead to sample selection bias. The estimated coefficient of HHI (0.031) which is positive, obtained in column (1) regression and HHI (0.049) obtained in column (3) regression is also economically significant because it is in conformity with the Cournot oligopoly theory where higher HHI (indicating monopoly) leads to higher prices and lower HHI (indicating more competition) reduces firms market power and thus prices. In addition this assessment is similar to the one obtained by the International Telecommunications Union (ITU, 2014). Both this analysis and that of the International Telecommunication Union found a positive and significant relationship (at 5%level) between mobile call prices and HHI meaning that the higher the HHI the higher mobile call prices and the lower the HHI the lower mobile call prices. Thus increasing competition over past years has led to a fall in mobile telecommunications prices. The similarity between these two results suggests that this study is externally valid (that is can be generalised to all countries). The difference between these two analyses is that I controlled for other variables like population density, population and market penetration as plausible factors influencing mobile call prices compared to the International Telecommunication Union. Moreover, contrary to the ITU I adjusted data on mobile prices to correct for inflation and used price as a percentage of Gross Domestic Product per capita as my dependent variable. I equally checked for the difference between the developed and developing countries of the effect of a higher HHI on prices. The main advantage of this analysis is that using fixed country effects and time fixed effects helps to control for variables that vary across countries and time and mitigates the effects of omitted variable bias. Thus these results suggest that mobile telecommunications competition significantly contributes in reducing mobile call prices which rejects the null hypothesis (H0) and accepts the alternative (H1). Chapter 5: Conclusion With the increasing introduction of more advanced technology in the society today, affordability of mobile calls in some countries is still low compared to other countries (see appendix) even though the number of firms in the industry has been increasing. This research paper assessed how mobile telecommunications competition affects mobile call prices. The objective was to find out if competition was the most important determinant of mobile call prices and if the effect of HHI on price was different for developed and developing countries. The results of the analysis obtained using R suggested that mobile telecommunications competition significantly affect affordability of mobile calls at 1% level and population at 10% significance level. In addition to that, developed countries were found to have lower effect of HHI on mobile call prices than developing countries and the coefficient (-0.027) was significant at 5% level implying that when call prices increase as a result of an increase in the HHI the amount increases by 0.027 dollars lesser in developed countries. The number of firms equally influence the price in the market because more firms implies a decrease in the market share and market power of the other firms but an overall increase in the total output leading to a fall in price (Church & Ware, 2000). The difference between this paper and earlier study is the use of other control variables in the analysis and a larger data set. Availability of data on the market shares of various operators used in computing the HHI was the main problem encountered; prices on mobile calls was equally not available for some countries included in the sample for all the period under study resulting to an unbalanced panel. Thus the overall results suggest that prices are influenced by the structure of the market.
and more efforts should be considered by telecommunications regulatory agencies in developing countries to promote competition in the mobile market.

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