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# Determinants of Internet Usage: Relevance of Financial Development in the Case of Emerging Markets?

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**Abstract:** This study investigated the determinants of internet usage in emerging markets using panel data ranging from 2000 to 2017. It also explored whether the complementarity between financial and human capital development is one of the determinants of internet adoption in emerging markets. The study noted that the lag of internet, financial development, the complementarity between financial and human capital development, access to electricity, economic growth and foreign direct investment had a significant positive impact on the adoption of internet in emerging markets. The influence of import of internet goods on the adoption of internet to a larger extent was found to be significantly negative in emerging markets. On the other hand, the impact of urbanization on the usage of internet in emerging markets was found to be mixed to a greater extent. The study therefore urges emerging markets to implement policies aimed at boosting financial development, access to electricity, foreign direct investment, economic growth in order to increase the adoption of internet. Future related research should focus on determining the threshold levels of explanatory variables before they have a significant influence on internet.

**Keywords:** Internet; Financial Sector; Human Capital; Emerging markets; Panel Data

**JEL Classification**: B26

## 1. Introduction

Introduction and background of the study, novelty of the study and structure of the whole study are main aspects covered in this first section of the paper.

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**Background of the study:** Many developmental oriented policymakers, financial and economic analysts have recently been very much interested in the role of internet in the economy. Theoretical studies have shown that internet not only enhance decision making, information sharing, product quality, coordination, distribution and responsiveness but also reduces information processing, communication and coordination costs during the course of doing business and performing economic transactions (Mitchell and Kovach. 2016; Perez-Arostegui et al. 2015; Rouleau et al. 2015). Empirical studies done by Nasab and Aghaei (2009), Vidas-Bubanja and Bubanja (2015), Jorgenson and Vu (2016), Albiman and Sulong (2016) and Niebel (2018) produced results which strongly supported the view that internet has a positive influence on economic growth. The positive impact of internet on economic growth is no longer something contestable in economics, finance and development. It is now a well agreed, conclusive and a closed argument.

What is quite clear though is that the crafting of relevant internet policies that enhances economic growth is still a subject which is not yet conclusive. Such a project cannot be effectively executed if the determinants of internet are either still unknown or not yet agreed upon. There is no common list of factors that determines the adoption of internet, consistent with Farooqi et al (2020). It is against this background that this study examined the determinants of internet usage in emerging markets.

Quite a number of empirical studies investigated the determinants of internet usage (refer to section 3). What is very clear though is that majority of these empirical researchers on the adoption of internet focused on firm level data whilst empirical research on macroeconomic determinants of internet adoption are quite scant. To the best of the author's knowledge, they have only been done by Farooqi et al (2020) and Kruger and Rhiel (2016) whose studies used panel data analysis and cross-country regression analysis respectively. This study seeks to contribute towards literature by expanding the investigation of the macroeconomic determinants of internet adoption, an area which has so far been scantly focused on.

Earlier similar research work done by Farooqi et al (2020) and Kruger and Rhiel (2016) have several methodological weaknesses. These include (1) failure to capture the dynamic characteristics of internet adoption data, (2) failure to capture and address the endogeneity aspect of the relationship between internet and its explanatory variables, (3) failure to acknowledge without vagueness that the relationship between internet usage and its determinants is non-linear in nature. The similar empirical research also used outdated data, did not exclusively focus on emerging markets as a unit of analysis and also the impact of a complementarity variable on the adoption of internet was not explored. This study filled in all these gaps.

**Novelty/Contribution of the study:** The study contributes to the body of literature in six different ways. Firstly, majority of empirical literature on the determinants of internet adoption focused on firm level data. This study investigated the determinants of internet usage in emerging markets using macroeconomic annual data. Secondly, this study is the first according to the author's best knowledge to investigate macroeconomic determinants of internet in emerging markets. Thirdly, unlike previous empirical research on a similar subject matter, this study assumed that the relationship between internet adoption and its explanatory variables is non-linear. Fourthly, to the author's best knowledge, this study is the first of its kind to investigate the impact of the complementarity between financial and human capital development on the adoption of internet. Fifthly, most recent data was used in this study.

**Organization of the rest of the paper:** The rest of the paper is divided into six sections. Section 2 focus on the determinants of internet from a theoretical point of view. Section 3 discusses the empirical literature on the determinants of internet. Section 4 is the research methodological framework. Section 5 analyses the data, describes and interprets the results. Section 6 summarizes the study. Section 7 is a list of references used in the study.

## 2. Theories on Internet Adoption

Internet (ICT) systems are generally used in organizations and the implementation of these systems always entail both organizational and individual changes (Korpelainen, 2011). The most relevant theories for this study are the technology acceptance model, the diffusion of innovations and the unified theory of acceptance and use of technology.

The technology acceptance model (TAM) is an information systems theory that models how users come to accept and use technology (see Figure 1).
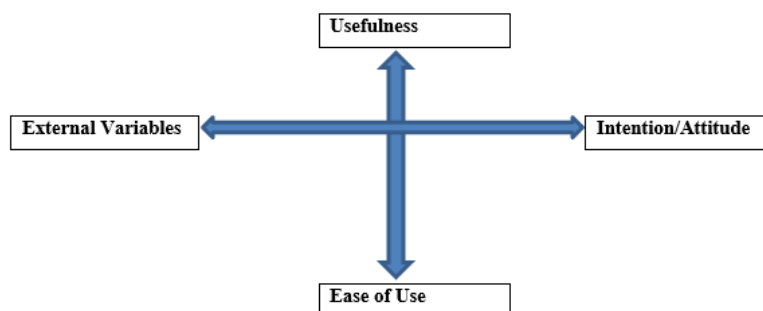


**Figure 1. Technology Acceptance Model**

*Source: Cloete & Courtney, 2002, p. 2.*

Diffusion of Innovations (DOI) is a general theory of how new ideas are spread and adopted in a community, and it seeks to explain how communication channels and opinion leaders shape adoption (Dearing and Cox, 2018). Sahin (2006) describes the DOI theory as a widely used theoretical framework in the area of technology diffusion and adoption.

The Unified Theory of Acceptance and Use of Technology (UTAUT) is a model considers four constructs as direct determinants of user acceptance and usage behaviour, namely performance expectancy, effort expectancy, social influence, and facilitating conditions. There are four key moderating variables: gender, age, experience, and voluntariness of use (Puspitasari et al. 2019).

## 3. Internet usage Determinants – Theory

**Table 1. Theoretical Literature on the Determinants of Internet Usage**

| Variable | Proxy | Theoretical explanation | A priori expectation |
|---|---|---|---|
| Foreign direct investment (FDI) | Net foreign direct investment inflows (% of GDP) | Foreign investors bring in and introduces new technology in the economy (Farooqi et al. 2020). It is against this background that an increase in foreign direct investment is strongly related to the adoption of internet, in line with Kruger and Rhiel (2016). | + |
| Economic growth (GROWTH) | GDP per capita | It is argued that economies whose gross domestic product per capita income are financially in a better position to invest financial resources into research and development. This puts them in a much better position not only to discover but to adopt new information and commucation technology (Baliamoune-Lutz. 2003). The same study noted that computer ownership and internet usage is higher in countries whose GDP per capita is higher because people can easily afford. Consistent with Kruger and Rhiel (2016), GDP per income inequality in the country leads to | +/- |

| | | | |
|---|---|---|---|
| | | a negative information and technology diffusion. | |
| Urbanization (URBAN) | Urban population (% of total population) | Kruger and Rhiel (2016) argued that people living in the urban areas and urban firms are more likely to use internet for easy of communication and doing business. | + |
| Financial sector development (FIN) | Domestic credit to private sector (% of GDP) | Consistent with Farooqi et al (2020) and Guerrieri et al ( 2011), developed financial markets are more likely to avail resources required to acquire new and more recent internet for the domestic economy. Developed financial sector is more likely to avail cheaper student loans to enable the tertiary students to acquire internet infrastructure required to execute the learning process, consistent with Goyal et al (2010). | + |
| Development of human capital (HCD) | Human capital development index | Consistent with Guerrieri et al (2011), educated and more skilled labour-force can easily and quickly learn how to use new and complicated internet. On the more recent empirical front, human capital development was found to have had a non-significant positive influence on the rate of internet adoption. | + |
| Access to electricity (ACCESS) | Access to electricity (% of population) | Consistent with Farooqi et al (2020), higher access to electricity by the people increases the usage of internet gadgets. The latter uses electrical power to function hence people | + |

| | | who resides in areas without reliable electricity have been found to be very slow in the adoption of internet on the empirical front. | |
|---|---|---|---|
| Import of internet goods (REG) | Property rights and rule-based governance rating (1=low to 6=high) | Guerrieri et al ( 2011) argued that a country whose legal system is developed and strong is more willing and able to invest in technological innovation linked projects. | + |
| Internet (ICT) goods imports (IMPORTS) | ICT goods imports (% of total goods imports) | Consistent with Farooqi et al (2020), the more ICT goods are imported into the country, the more internet is available to majority of the people at affordable prices and the more likely usage of internet happens. | + |

*Source: Author compilation*

The subject of determinants of internet adoption has so far not been discussed from a theoretical point of view as a stand-alone, exhaustive and consolidated manner. The theoretical literature which includes a consolidated list of macroeconomic determinants of internet adoption is missing. This paper is all about trying to fill in that gap.

## 4. Empirical Research on Internet Usage Determinants

### Table 2. Recent Empirical Literature - Determinants of Internet Adoption

| Author | Unit of analysis | Period | Methodology | Results |
|---|---|---|---|---|
| Khalifa (2016) | Tunisian firms | Survey data (September 2010 and April 2011) | Descriptive statistics | Firm size had a significant positive impact on internet adoption. The environment in which the firm operates was found to have had no influence at all on the usage of internet. |
| Wang and Feeney (2014) | United States of America Municipalities | 2012 survey data | Descriptive statistics | External stakeholder influence and governmental stakeholder influence were found to have had a significant positive impact on internet usage. |

| Seifu (2020) | Askum University, Ethiopia | Survey data | Descriptive statistics | Insufficient technical and administrative support, curriculum's restrictive nature, electricity power shortage reduced the usage of internet. |
|---|---|---|---|---|
| Farooqi et al (2020) | Developing countries | 2000-2018 | Panel data analysis | Access to electricity, government effectiveness and imports of internet were found to be significant positive determinants of information and communication usage in developing countries. |
| Agbo (2015) | Nigeria's Ebonyi State | Survey data | Descriptive statistics | Enabling school and home environment accelerated the usage the use of information and communication usage in the Ebonyi State of Nigeria. |
| Kyalo and Nzuki (2014) | Literature review | Literature review | Literature analysis | Internet availability and management strength were found to be the key factors which influenced the adoption of internet. |
| Joshua and Musau (2020) | Churches in Nairobi, Kenya | Survey data | Multiregression analysis | Church size, ethical considerations, leadership perception and attributes of the congregation were the paramount variables which determined the rate of internet adoption by religious institutions in Nairobi, Kenya. |
| Goyal et al (2010) | India | Survey data | Descriptive statistics | Internet infrastructure availability, skills levels, availability of financial resources, openness to the international community, in summary are some of the factors which were seen to be positive determinants of adoption of internet. |
| Kruger and Rhiel (2016) | 100 countries world-wide | 2002-2012 | Cross country regression analysis | Economic growth, urbanization and electricity availability and institutional environmental quality were found to have had a significant positive effect on internet adoption. |

| Sekabira et al (2012) | Mayuge District, Uganda | Survey data (2010, 2011) | Logit regression analysis | Family size, size of the land being farmed, trading experience, age of the farmers, proximity of the town, poverty level, availability of electricity, quality of internet network coverage and expertise among farmers were the most important factors which played a key role in determining internet usage in Mayuge District, Uganda. |
|---|---|---|---|---|
| Kossai et al (2020) | Tunisia electrical sector | Survey data | Probit regression analysis | Firm size, exports intensities, imports intensities and firm's human capital were the factors which to a large extent influenced the adoption of internet adoption in the Tunisian's electrical sector. |
| Muathe (2010) | Small to Medium Scale Enterprises, Nairobi, Kenya | Survey data | Logit regression analysis | Age of the firm, senior management's knowledge of the internet systems, information intensity, readiness of the firm, firm's relative advantage and government's policy on internet applications played a major in determining the usage of internet. |
| Eze et al (2013) | State owned universities, Nigeria | Survey data | Descriptive statistics | Insufficient financial capacity, shortage of expertise, poor regulatory policies, lack of government support, energy supply irregularities, high level of corruption and poor internet connectivity were the factors which hindered the adoption of internet. |
| Abdullahi et al (2021) | Small scale agribusiness in Somalia | Survey data | Descriptive statistics | External and financial support were found to have had an insignificant positive effect on the usage of internet. On the other hand, motivation and insight played a key role in positively encouraging the usage of internet in the small-scale agribusiness in Somalia. |
| Hassan et al (2012) | Village administrators in Malaysia | Survey data | Descriptive statistics | Perceived ease of use, attitude towards usage of internet, internet job relevance and self-efficacy |

|  |  |  |  | towards internet usage. These factors had a significant positive influence on the adoption of internet in Malaysia. |
|---|---|---|---|---|
| Haller and Siedschiag (2011) | Irish manufacturing firms | Firm level data (2001-2004) | Descriptive statistics and regression analysis | Higher skills level within the firm, firms located within the capital city and firms operating in the internet sector were the three main factors which accelerated the rate at which firms adopted internet. |
| Yu et al (2017) | University sector | Survey data | Structural equation modelling | Digital skills and information literacy were found to have enhanced the adoption of internet. |
| Ngidi (2019) | Small to medium scale enterprises in Pietermaritzburg, South Africa | Survey data | Structural equation modelling and descriptive statistics | Technology and organizational context were the two main variables which had a very high positive and significant impact on internet. |
| Niyigena et al (2020) | University students in East Africa | Survey data | Logistic regression analysis | Factors which were found to have had a significant positive influence on internet fluency among students include the origin (rural/urban) of the student, ownership of the computer, experience in using the computer, year of studies and degree programme major. |
| Mugobi and Mlozi (2020) | World Heritage sites - Tanzania | Survey data | Descriptive statistics and regression analysis | High technical skills, high level of internet infrastructure, high relative advantage of using internet and less complexity in using internet were the factors which were found to have had a significant positive effect on the usage of internet. |
| Benard et al (2021) | Fish farmers in Southern Highlands of Tanzania | Survey data | Inferential and descriptive statistics | Perceived ease of use, high income, positive attitude, bigger size of the household, perceived usefulness of internet gadgets, more quantity of fish produced were the factors which were observed to have a significant |

| | | | | positive impact on the adoption of internet. |
|---|---|---|---|---|
| | | | | |

*Source: Author compilation*

The empirical literature summarized in Table 2 produced results which are divergent, mixed and in complete disagreement. Majority of the empirical research on this subject matter focused on firm level data and not the macroeconomic determinants of internet usage. This study fills in the gap by investigating the macroeconomic determinants of internet usage in emerging markets. They don't agree on a single common list of determinants of internet adoption, an indication that space for contributing on the subject matter still exists.

## 5. Research Methodological Framework

This section describes (1) the nature and stature of the data, (2) mean trend analysis, (3) general model specification and the econometric model framework used in this study.

### 5.1 Data description

This study investigated the determinants of internet adoption in emerging markets using panel data ranging from 2000 to 2017. Individuals using the internet (% of the population) and mobile cellular subscriptions (per 100 people) are the proxies of information and technology adoption used in this study. World Development Indicators, International Financial Statistics, United Nations Development Programmes and International Monetary Fund are the international databases from where the data was extracted. The benefits of using such databases are that (1) they are international in stature, (2) reputable, (3) data is publicly available and (4) easily verifiable. The list of emerging markets in line with International Monetary Fund (2015) included in this study are Argentina, China, Brazil, South Africa, Peru, Czech Republic, Portugal, Colombia, Mexico, Poland, Hong Kong, India, Russia, Singapore, Republic of Korea, Greece, Philippines and Thailand.

### 5.2. Trend analysis (2000-2017)

The results of the mean trend analysis (2000-2017) are presented in Table 3. Internet, human capital development, financial development, access to electricity, urbanization, imports of internet goods, economic growth and foreign direct investment are the variables used in this study. In this trend analysis, the measure of internet adoption used is the individuals using internet (% of population).

**Table 3. Trend Analysis (2000-2017)**

|  | ICT | HCD | FIN | ACCESS | URBAN | IMPORTS | GROWTH | FDI |
|---|---|---|---|---|---|---|---|---|
| Argentina | 37.34 | 0.82 | 14.24 | 97.95 | 90.55 | 9.21 | 9 571.66 | 1.85 |
| Brazil | 34.95 | 0.76 | 46.68 | 98.20 | 83.85 | 9.79 | 7 713.49 | 3.05 |
| China | 26.41 | 0.72 | 125.17 | 98.92 | 47.07 | 22.18 | 4 204.99 | 3.22 |
| Colombia | 29.80 | 0.73 | 32.24 | 96.78 | 77.32 | 9.97 | 5 015.58 | 3.74 |
| Czech Republic | 54.04 | 0.87 | 41.18 | 100.00 | 73.52 | 13.73 | 16 032.65 | 4.77 |
| Greece | 40.37 | 0.88 | 88.40 | 100.00 | 75.71 | 5.35 | 21 674.21 | 0.88 |
| Hong Kong | 64.99 | 0.90 | 173.99 | 100.00 | 100.00 | 39.70 | 32 638.98 | 29.09 |
| India | 9.02 | 0.58 | 43.99 | 73.10 | 30.48 | 7.05 | 1 111.10 | 1.62 |
| Mexico | 29.63 | 0.77 | 22.57 | 98.72 | 77.34 | 17.11 | 8 546.54 | 2.76 |
| Peru | 27.52 | 0.74 | 29.92 | 84.24 | 75.80 | 8.41 | 4 331.86 | 4.01 |
| Philippines | 21.72 | 0.69 | 33.24 | 84.01 | 45.86 | 34.08 | 1 950.31 | 1.55 |
| Poland | 48.51 | 0.84 | 39.28 | 100.00 | 61.03 | 8.59 | 10 400.49 | 3.37 |
| Portugal | 46.18 | 0.85 | 131.83 | 100.00 | 59.62 | 6.73 | 19 439.53 | 3.95 |
| Republic of Korea | 77.42 | 0.89 | 122.40 | 100.00 | 81.30 | 14.51 | 21 221.68 | 0.89 |
| Russia | 36.52 | 0.78 | 37.23 | 99.75 | 73.67 | 7.26 | 8 272.59 | 2.37 |
| Thailand | 22.41 | 0.73 | 119.53 | 95.80 | 41.17 | 16.21 | 4 278.17 | 2.83 |
| Singapore | 66.13 | 0.89 | 105.51 | 100.00 | 100.00 | 28.07 | 41 085.60 | 18.51 |
| South Africa | 24.00 | 0.65 | 136.99 | 81.32 | 61.39 | 9.35 | 5 532.71 | 1.59 |
| **Overall mean** | **38.72** | **0.78** | **74.69** | **94.93** | **69.76** | **14.85** | **12 390.12** | **5.00** |

*Source: Author compilation*

From Table 3, it is quite evident that countries such as Czech Republic, Hong Kong, Greece, Portugal, Poland, Singapore and Republic of Korea had internet adoption mean levels greater than the overall mean level of 38.72% of the population. The remaining countries' mean levels of adoption of internet were lower than the overall mean of 38.72% of population. It is also clear that countries such as Philippines, Czech Republic, Hong Kong, India, Republic of Korea, Singapore and South Africa are outliers because their mean levels of internet adoption deviated far much away from the overall mean level of 38.72% of the population.

There are only eight countries characterized by mean human capital development index above the overall mean human capital index of 0.78 and these are Czech Republic (0.87), Argentina (0.82), Greece (0.88), Hong Kong (0.90), Poland (0.84), Portugal (0.85), Republic of Korea (0.89) and Singapore (0.89). India (0.58) and South Africa (0.65) seems to be the only outliers because their mean human capital development index far much deviated from the overall mean value.

China, Hong Kong, Greece, Republic of Korea, Portugal, Thailand, South Africa and Singapore are the eight countries whose mean financial sector development exceeded the overall mean of 74.69% of GDP. The remainder of the countries had

their mean levels of financial sector development lower than the overall mean level of 74.69% of GDP.

Only four countries, namely India (73.10% of population), Peru (84.24% of population), Philippines (84.01% of population) and South Africa (81.32% of population) had their mean access to electricity levels lower than the overall mean access to electricity level of 94.93% of population. The remaining fourteen countries had their mean access to electricity higher than the overall mean level of access to electricity equivalent to 94.93% of GDP. Countries whose mean urban population was below the overall mean urban population of 69.76% of population include China (47.07% of population), India (30.48% of population), Philippines (45.86% of population), Poland (61.03% of population), Portugal (59.62% of population), Thailand (41.17% of population) and South Africa (61.39% of population). The other eleven remaining countries' mean urban population was greater than the overall mean urban population level of 69.76% of population.

China, Hong Kong, Mexico, Philippines, Thailand and Singapore had mean internet imports which were greater than the overall mean internet imports level of 14.85% of total goods imports. The remaining countries such as Argentina, Brazil, Colombia, Czech Republic, Greece, India, Peru, Poland, Portugal, Republic of Korea, Russia and South Africa had their mean levels of internet imports lower than the overall mean internet imports of 14.85% of total goods imports.

Countries such as Czech Republic (US$16 032.65), Greece (US$21 674.21), Hong Kong (US$32 638.98), Portugal (US$19 439.53), Republic of Korea (US$21 221.68) and Singapore (US$41 085.60) had their mean gross domestic product (GDP) higher than the overall mean GDP per capita of US$12 390.12. The rest of the countries' mean GDP per capita was lower than the overall mean GDP per capita of US$12 390.12. The only two countries whose mean foreign direct investment (FDI) inflows exceeded the overall mean FDI inflows of 5% of GDP are Singapore (18.51% of GDP) and Hong Kong (29.09% of GDP). The remaining countries' mean FDI inflows were lower than the overall mean FDI inflows of 5% of GDP. It is very clear that outlier countries also exist with regards to foreign direct investment, gross domestic product per capita, imports of internet goods, urbanization and access to electricity. The outliers lead to spurious results and therefore their effect must be addressed before main data analysis is undertaken (Aye and Edoja. 2017). It is for this reason that all the data sets had to be transformed into natural logarithms before final analysis usage.

## 5.3. General Model Specification

The latter was informed by prominent authors on the subject matter and other more recent empirical research on the determinants of internet adoption. These include but are not limited to Farooqi et al (2020), Kruger and Rhiel (2016), Baliamoune-Lutz (2003) and Guerrieri et al (2011). These prominent researchers concluded that the main macroeconomic determinants of internet usage include internet goods imports, import of internet goods, access to electricity, human capital development, financial development, urbanization, economic growth and foreign direct investment. The general model specification is represented by equation 1.

ICT=f (HCD, FIN, IMPORTS, ACCESS, URBAN, GROWTH, FDI)     (1)

Where ICT stands for internet adoption. ACCESS stands for access to electricity, human capital development is denoted by HCD whereas FIN represents financial development. IMPORTS is internet goods imports (% of total goods imports). Urbanization is represented by URBAN whilst GROWTH is economic growth. FDI is foreign direct investment. In this study, internet adoption (dependent variable) is proxied by (1) number of internet users and (2) internet expenditure, consistent with Kruger and Rhiel (2016).

The proxies for all independent variables used in this study are indicated in Table 1. The choice of these proxies is to a larger extent informed by data availability, prior empirical studies (Kruger and Rhiel. 2016; Farooqi et al. 2020) on a similar subject matter and how best the proxy measures the variable.

## 5.4 Econometric model specification

Equation 2 transforms the general model specification into the following econometric framework.

$$ICT_{it} = \beta_0 + \beta_1 HCD_{it} + \beta_2 FIN_{it} + \beta_3 (HCD_{it} \cdot FIN_{it}) + \beta_4 IMPORTS_{it} + \beta_5 ACCESS_{it} + \beta_6 URBAN_{it} + \beta_7 GROWTH_{it} + \beta_8 FDI_{it} + \varepsilon \quad (2)$$

**Table 4. Description and Interpretation of the Variables Used in the Econometric Model**

|  |  |
|---|---|
| Country | $i$ |
| Time | t |
| Intercept term | $\beta_0$ |
| Error term | $\varepsilon$ |
| Co-efficients of explanatory variables | $\beta_1$ to $\beta_9$ |
| Internet adoption in country i at time t | $ICT_{it}$ |
| Development of human capital development at time t in country i | $HCD_{it}$ |
| Development of the financial sector at time t in country i | $FIN_{it}$ |
| Imports of internet goods in country i at time t | $IMPORTS_{it}$ |
| Access to electricity in country i at time t | $ACCESS_{it}$ |
| Urbanization in country i at time t | $URBAN_{it}$ |
| Economic growth in country i at time t | $GROWTH_{it}$ |
| Foreign direct investment in country i at time t | $FDI_{it}$ |

*Source: Author compilation*

The impact of the interaction term (development of human capital x development of the financial sector) on internet usage was introduced in equation 2. This is in support of Guerrieri et al's (2011) argument that educated, skilled and financially able use more internet. The argument was supported by Goyal et al (2010) whose study observed that skills level and financial access were some of the prominent factors which enhanced the usage of internet in India. A significant positive sign of co-efficient $\beta_3$ means that the combination between development of the financial sector and human capital improves the adoption of internet in emerging markets. Pooled OLS, random and fixed effects were used to estimate equation 2.

Equation 3 introduces the lag of the dependent variable, in support of a study by Masiya et al (2015) which explained that it helps with capturing the dynamic effects in the adoption of internet and removing the autocorrelation.

$$ICT_{it} = \beta_0 + \beta_1 ICT_{it-1} + \beta_2 HCD_{it} \; \beta_3 FIN_{it} + \beta_4 (HCD_{it} . FIN_{it}) + \beta_5 IMPORTS_{it} + \beta_6 ACCESS_{it} + \beta_7 URBAN_{it} + \beta_8 GROWTH_{it} + \beta_9 FDI_{it} + \varepsilon \qquad (3)$$

Internet adoption is expected to be positively affected by its own lag because the benefits of using it are incremental and easily spread to a wider community as more and more people adopt it in their day to day life and commercial transactions (Farooqi et al. 2020). In order to deal away with the endogeneity and address the dynamic characteristics of the dependent variable data, this study employed the dynamic GMM to econometrically estimate equation 3.

## 6. Data Analysis, Results Description and Intepretation

Panel stationary, co-integration and main analysis of the data using panel estimation techniques are the focus of this section. Using Levin et al (2002), Im et al (2003), Augmented Dick Fuller Fisher Chi Square and Phillip Peron (PP) Chi square tests were used in this study for panel unit root tests. It is evident in Table 5 that all the variables are integrated of order 1.

**Table 5. Panel Unit Root Tests –Individual Intercept and Trend**

|  | Level | | | | First difference | | | |
|---|---|---|---|---|---|---|---|---|
|  | LLC | IPS | ADF | PP | LLC | IPS | ADF | PP |
| LICT | -3.24*** | -2.95* | 12.18** | 17.03 | -7.17*** | -5.32** | 89.22*** | 104.28*** |
| LHCD | -3.54*** | 0.23 | 21.54 | 49.38 | -4.981*** | -2.77* | -2.69* | -3.92* |
| LFIN | -10.43** | -2.84** | 46.91*** | 69.19*** | -35.25** | -8.63** | 145.09*** | 119.33*** |
| LIMPORTS | -4.00** | -1.84 | 36.77* | 83.17*** | -7.02*** | -2.01* | 54.11** | 136.99*** |
| LACCESS | -4.92** | 2.17 | 11.24 | 14.82 | -6.83** | -1.03* | 31.66* | 89.15*** |
| LURBAN | 1.49 | 2.15 | 16.89 | 35.64* | -1.43* | -1.39* | 104.83* | 139** |
| LGROWTH | -6.74** | -1.56 | 29.38 | 27.11 | -9.14*** | -3.02* | 99.37* | 141.86** |
| LFDI | -7.66** | -2.72 | 44.91** | 67.48*** | -12.61** | -2.05* | 57.82** | 119.17*** |

Note: LLC, IPS, ADF and PP stands for Levin, Lin and Chu; Im, Pesaran and Shin; ADF Fisher Chi Square and PP Fisher Chi Square tests respectively. *, ** and *** denote 1%, 5% and 10% levels of significance, respectively.
*Source: Author's compilation from E-Views*

Table 6 presents the Kao (1999) results.

**Table 6. Results of Kao**

| Series | ADF t-statistic |
|---|---|
| ICT HCD FIN IMPORTS ACCESS URBAN GROWTH FDI | -3.1217*** |

*Source: Compiled by the author*

In line with Tembo (2018)'s interpretation, the null hypothesis which says that there is no long run relationship among the variables used in this study is rejected at one percent level of significance. In other words, a long run relationship was found to exist among the variables used in this study.

Results of the study are presented in Table 7 and 8.

**Table 7. Model 1 – Individuals using the Internet (% of Population) as a Proxy of the Dependent Variable (Internet Usage)**

|  | Dynamic GMM | Fixed effects | Random effects | Pooled OLS |
|---|---|---|---|---|
| $ICT_{it-1}$ | 0.0318*** | - | - | - |
| LHCD | 0.2283 | 0.2221 | 0.3387* | 0.6202 |
| LFIN | 0.50006* | 0.1618* | 0.1828* | 0.3902 |
| HCD.FIN | 0.0117*** | 0.0921 | 0.0003 | 0.0048* |
| LIMPORTS | -0.0982*** | -0.2781* | -0.2173** | -0.1329*** |
| LACCESS | 0.8795* | 0.6488* | 0.1737 | 0.2192* |
| LURBAN | 0.6632*** | 0.2928** | -0.1782** | -0.6728** |
| LGROWTH | 0.2781* | 0.2862*** | 0.4928 | 0.1872 |
| LFDI | 0.4502** | 0.2911 | 0.1893** | 0.2003* |
| Adjusted R-squared | 0.66 | 0.56 | 0.53 | 0.64 |
| J-statistic/F-statistic | 211 | 189 | 199 | 101 |
| Prob(J-statistic/F-statistic) | 0.00 | 0.00 | 0.00 | 0.00 |

1%, 5% and 10% significance level are represented by ***, ** and * respectively.
*Source: E-Views results compilation by the author*

In Table 7 (model 1) and Table 8 (model 2), internet adoption was positively affected by its own lag (dynamic GMM), in line with a study which implied that the lag element helps with capturing the dynamic effects in the adoption of internet and removing the autocorrelation (Masiya et al. 2015).

In Table 7 (model 1), under the dynamic GMM, fixed effects and pooled OLS, human capital development had a non-significant positive impact on internet adoption whilst random effects produced results which shows a significant positive relationship running from human capital development towards internet adoption. In model 2 (Table 8), the development of human capital's impact on internet usage was observed to be positive but significant (random effects, dynamic GMM) whilst a non-significant positive relationship running from human capital development

towards adoption of internet was noted under the fixed effects and pooled OLS. These results generally support an argument by Guerrieri et al (2011) that educated and more skilled labour-force can easily and quickly learn how to use new and complicated internet.

Financial development was found to have had a significant positive impact on the adoption of internet under the dynamic GMM, random effects and fixed effects in Table 7 (model 1). On the other hand, a non-significant positive effect of financial development on the adoption of internet was noted under the pooled OLS approach in model 1 (Table 7). In model 2 (Table 8), the dynamic GMM, fixed and random effects show that a significant positive relationship running from financial development towards the adoption of internet existed. On the other hand, financial development was found to have had a non-significant positive influence on the adoption of internet (model 2) observed under the pooled OLS methodology. The results resonate with Farooqi et al (2020) and Guerrieri et al (2011) whose studies noted that developed financial sector markets are more likely to avail resources required to acquire new and more recent internet for the domestic economy.

A significant positive relationship was observed running from the interaction between human capital and financial development towards the adoption of internet under the dynamic GMM and pooled OLS approaches in model 1. Fixed and random effects indicate that the adoption of internet was positively and non-significantly affected by the interaction between development of the financial and human capital (model 1). According to model 2, the impact of the interaction term was positive but non-significant on the usage of internet under the dynamic GMM and random effects Yet the fixed effects and pooled OLS in model 2 indicates a significant positive relationship running from the interaction between human capital and financial development towards the adoption of internet. These results are consistent with the argument by Goyal et al (2010) whose study noted that developed financial sector is more likely to avail cheaper student loans to enable the tertiary students to acquire internet infrastructure required to execute the learning process. They also support Guerrieri et al (2011)'s argument that educated, skilled and financially able use more internet.

**Table 8. Model 2 - Mobile Cellular Subscriptions (per 100 People) as a Proxy of the Dependent Variable (Internet Usage)**

|  | Dynamic GMM | Fixed effects | Random effects | Pooled OLS |
|---|---|---|---|---|
| ICT$_{it-1}$ | 0.0094*** | - | - | - |
| LHCD | 0.3334* | 0.6183 | 0.1562* | 0.2178 |
| LFIN | 0.1782* | 0.3372* | 0.3872* | 0.3182 |
| HCD.FIN | 0.5628 | 0.1782* | 0.0177 | 0.5318* |
| LIMPORTS | -0.1189*** | -0.6787* | 0.02122** | 0.4236*** |
| LACCESS | 0.0900* | 0.2229* | 0.4738 | 0.1679* |
| LURBAN | -0.1783*** | -0.0273** | -0.1178** | -0.6432** |
| LGROWTH | 0.4476*** | 0.5548*** | 0.2782 | 0.2378 |
| LFDI | 0.2891** | 0.2100 | 0.4829 | 0.2293* |
| Adjusted R-squared | 0.67 | 0.57 | 0.59 | 0.63 |
| F-statistic/J-statistic | 219 | 189 | 199 | 98 |
| Prob(J-statistic/F-statistic) | 0.00 | 0.00 | 0.00 | 0.00 |

1%, 5% and 10% significance level are represented by ***, ** and * respectively.
*Source: E-Views results compilation by the author*

Pooled OLS and random effects indicates that the impact of import of internet goods on the adoption of internet was positive and significant in model 2, in support of the available literature (Farooqi et al. 2020). In model 1, import of internet goods had a significant negative effect on the usage of internet across all the four econometric estimation methods whilst model 2 indicates that import of internet goods' impact on the usage of internet was negative and significant only under fixed effects and the dynamic GMM approaches. These results contradict the available literature.

Access to electricity had a significant positive impact on the adoption of internet (dynamic GMM, pooled OLS, fixed effects) in both model 1 and 2. A non-significant positive relationship was observed running from access to electricity towards the adoption of internet under the random effects in both model 1 and 2. These results generally support Farooqi et al (2020)'s argument that higher access to electricity by the people increases the usage of internet gadgets.

Urbanization was found to have had a negative significant impact on the adoption of internet in (1) in model 2 across all the four econometric methods used and (2) model 1 under the pooled OLS and random effects. These results contradict Kruger and Rhiel (2016)'s argument that people living in the urban areas and urban firms are more likely to use internet for easy of communication and doing business. On the other hand, urbanization's impact on the usage of internet was found to be positive and significant in model 1 (fixed effects, dynamic GMM), in line with Kruger and Rhiel (2016)'s view.

In both models under dynamic GMM and fixed effects, economic growth had a significant positive impact on the usage of internet. Random effects and pooled OLS noted that the impact of economic growth on the internet adoption was positive but non-significant in both models 1 and 2. The results support Baliamoune-Lutz (2003)'s view that higher levels of gross domestic product per capita enables the people to cheaply and easily adopt new internet.

A significant positive impact of FDI on internet was observed in (1) model 1 under the dynamic GMM, pooled OLS and random effects and in (2) model 2 (pooled OLS, dynamic GMM). On the other hand, FDI had a non-significant positive effect on the adoption of internet under the fixed effects in model 1 and under random and fixed effects in model 2. The results support Farooqi et al (2020) which noted that foreign investors bring in and introduces new technology in the economy.

## 7. Conclusion

This study investigated the determinants of internet usage in emerging markets using panel data ranging from 2006 to 2019. It also explored whether the complementarity between financial and human capital development is one of the determinants of internet adoption in emerging markets. The study noted that the lag of internet, financial development, the combination of development of financial sector and human capital, access to electricity, economic growth and foreign direct investment had a significant positive impact on the usage of internet in emerging markets. The influence of import of internet goods on the adoption of internet to a larger extent was found to be significantly negative in emerging markets. On the other hand, the impact of urbanization on the usage of internet in emerging markets was found to be mixed to a greater extent. The study therefore urges emerging markets to implement policies aimed at boosting financial development, access to electricity, foreign direct investment, economic growth in order to enhance the usage of the internet. Future empirical research on the determinants of internet usage should focus on exploring the threshold levels of explanatory variables before they have a significant influence on internet.

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