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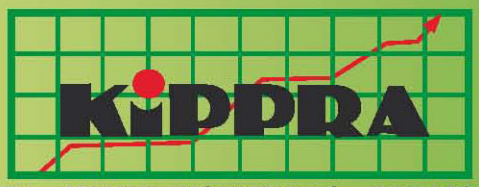

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Digital Dividends: Evidence from Internet Usage in Kenya

Ruth Njeri

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THE KENYA INSTITUTE FOR PUBLIC POLICY
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YOUNG PROFESSIONALS (YPs) TRAINING
PROGRAMME

Digital Dividends: Evidence From Internet Usage in Kenya

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Infrastructure and Economic Services Division

Kenya Institute for Public Policy
Research and Analysis

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Abstract

This paper examines the digital dividends arising from work-related Internet usage in Kenya by first evaluating the factors influencing Internet usage and, second, the effect of Internet usage on earnings from wage employment in Kenya. Robustness checks are carried out by conducting specification tests on home Internet use and specific Internet tasks. Using cross section data obtained from the 2010 National Information and Communications Technology Survey, the study used a sample of 3,783 working individuals between the ages of 15-64 years. The study used the Heckman Selection model to control for selectivity bias inherent in the Internet usage decision.

From the empirical analysis, the study found that individuals residing in urban areas, those with many years of education, skilled labour and individuals working in the finance and insurance industry were likely to use the Internet. Regarding the effect of Internet usage on wages, the study found that individuals who used the Internet both at work and at home enjoyed higher wage dividends compared to non-users. Individuals enjoying these dividends were highly educated, in skilled labour occupations and residing in urban areas. Using the Internet for Internet banking activities was more rewarding, with higher wages than any other Internet usage task.

The key policy recommendations are that the government could increase investments in Internet infrastructure to promote access by all people, particularly in the rural areas for uniform dividends. In addition to access, training of individuals on productive use of the Internet could be enhanced.

Abbreviations and Acronyms

CA	Communications Authority
GoK	Government of Kenya
GDP	Gross Domestic Product
ICT	Information Communication and Technology
IT	Information Technology
ISP	Internet Service Provider
KNBS	Kenya National Bureau of Statistics
MTP	Medium Term Plan
OLS	Ordinary Least Square
US	United States
VAT	Value Added Tax

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1. Introduction

Information Communication and Technology (ICT) is one of Kenya's foundations for economic development, according to the Second Medium Term Plan of Vision 2030 (Government of Kenya, 2013). Vision 2030 aims at developing a globally competitive and prosperous nation with a high quality of life by the year 2030, by harnessing ICT as a tool for expanding human skills through a system of producing, distributing and using information and knowledge, which will play a key role in driving productivity and economic prosperity (Government of Kenya, 2007). In the Vision 2030, the country targets to set up the requisite ICT infrastructure to provide quicker Internet in addition to making it affordable and accessible to the unserved and underserved areas of the country.

By 2015, about 74 per cent of the population had access to Internet services (Communications Authority, 2015). This high penetration is attributed to affordable Internet-enabled mobile phones, huge investments in modern under- sea fibre optic cable infrastructure to promote connectivity, investments in homegrown innovations in business applications, and an enabling policy environment.

Although there is high Internet penetration in Kenya, there is a large digital divide between rural and urban areas, which limits public awareness of the advantages and opportunities of Internet in rural areas (Government of Kenya, 2013). This limits digital dividends spillover to rural areas where majority of the population live, in effect locking them out from participating in the online economy due to risks such as inaccessibility arising from either unavailability or unaffordability. Some of these digital dividends are in earnings from wages for individuals using the Internet at work, which is the subject of this study.

The Kenya National ICT Policy 2006 (Government of Kenya, 2006) acknowledges the role of Internet in positioning the country as a hub for industrial, commercial and financial services in the region and as a medium for enhancing service delivery to the public and strengthening research, development and innovation. The policy seeks to promote systematic and comprehensive expansion of Internet infrastructure and services, with special attention to rural and urban marginalized areas of the country so as to spur equal economic growth.

Various studies have shown that users of ICT-based technology such as computers and Internet have earnings advantages compared to non-users. DiMaggio and Bonikowski (2008) estimated a wage increase of 5.2 per cent for using the Internet at work. The results were robust to specifications that included independent measures of Internet use at home. Forman et al (2009) showed that advanced Internet use led to a variance in wages across counties in the US, with usage benefiting the counties that already had high income, high education level and

population and a large percentage of IT-intensive firms. A study on the impact of ICT on businesses in Thailand (United Nations, 2008) found that businesses that used Internet had a 3 per cent increase in their sales compared to businesses that did not use.

Usage of the Internet at work has led to the creation of new jobs and has redefined the existing jobs and the earnings structure. This arises due to the complimentary role played by the Internet to the existing labour skills and firm capital (Benavente, Bravo and Montero, 2011). This study considers first, what factors influence Internet usage at work and how the usage of Internet at work affects earnings in the form of wages. In addition, the study evaluates the robustness of the above results by including specifications of Internet use at home and specific Internet tasks that users are engaged in.

The findings will help in a deeper understanding on how Internet use at work affects individual's welfare and well-being through wages. The findings will also give a better understanding of the local Internet market environment in terms of Internet access and usage gaps in an endeavor to leverage on Internet for socio-economic development of the country.

1.1 Problem Statement

Although Internet use is expanding rapidly in Kenya, with about 74 per cent of the population accessing the Internet and about 63 per cent of the population using the Internet (Communications Authority, 2015), the problem arises in equal Internet access and usage by region, gender and educational level.

For example, only 15 per cent of people living in rural areas use the Internet and 38 per cent of total users are females while less than 10 per cent of users have a high school certificate or below (Communications Authority, 2010). These disparities in usage by geographical location, gender and education may lock out some people from the enormous benefits expected to be reaped from Internet usage, in addition to increasing the divergence in wages between the users and non-users.

Previous studies on the digital dividends of Internet use, though focusing on developed countries, have shown that Internet users have earnings advantages compared to the non-users. Goss and Phillips (2002) estimated a wage gain of 13.5 per cent for using the Internet at work. Oosterbeek and Pounce (2010) found that gains from Internet use are more likely to be causal when there is a shortage of Internet devices and/or of the skills to use them than when these devices and the skills to use them are in abundant supply.

Disparities in Internet access and use in the country leads to the expectation that people who do not use Internet are disadvantaged in the pursuit for good jobs and adequate earnings, which is a major policy concern.

1.2 Research Questions

The paper sought to find an answer to the following questions:

(i) What factors determine Internet usage at work?

(ii) What are the effects of Internet usage at work on wages?

1.3 Research Objectives

The main objective of the study is to examine digital dividends in the form of wages arising from Internet usage in Kenya.

The specific objectives are:

(i) To assess the factors determining Internet usage at work

(ii) To assess the effect of work-related Internet usage on wages

1.4 Justification and Policy Relevance

The government has identified ICT as a foundation for economic development and important in strengthening the foundation of a knowledge-based economy where creation, adoption, adaptation and use of knowledge remain the key source of economic growth (Government of Kenya, 2006; 2013). The role of the Internet in expanding and complimenting the already existing knowledge and labour skills will become crucial in a knowledge economy. There is, therefore, need to clearly understand the local Internet market environment and the effect it has on users' welfare in an endeavor to leverage on Internet for socio-economic development of the country.

Enormous infrastructural investments have been made in the country in ICT in general and in Internet in particular due to the recognition of the Internet as a great equalizer. Internet promotes virtual mobility of users to products and services that were otherwise not available within their geographical reach, thereby neutralizing geographical location (McNutt, 1998). This paper explains the factors influencing Internet access and usage and proposes ideas on what needs to be done to eliminate Internet usage bottlenecks and shape the growth and use of the Internet throughout the country. In addition, Goal 9 of the Sustainable

Development Goals acknowledges the importance of ICT in promoting inclusive development (United Nations, 2015). The findings in this paper provide empirical evidence on the importance of promoting universal and affordable access and usage of the Internet in an endeavor to cover the marginalized areas of the country, where the ordinary people live.

Kenya is an economy moving towards developed status, and its future growth will increasingly depend more on skilled labour. Given that technological devices complement skilled labour, the findings in this paper provide empirical guidance on the importance of raising technological skills in the general population.

Evidence on the effects of Internet use on earnings in developing countries is thin; in fact, most surveys that have been carried out in the past have focused on the extent of Internet diffusion and ownership in Kenya, but none of those studies have sort to find out the direct impact that such diffusion may have on earnings or the differences in ownership. This study is therefore important towards addressing this research gap.

2. Literature Review

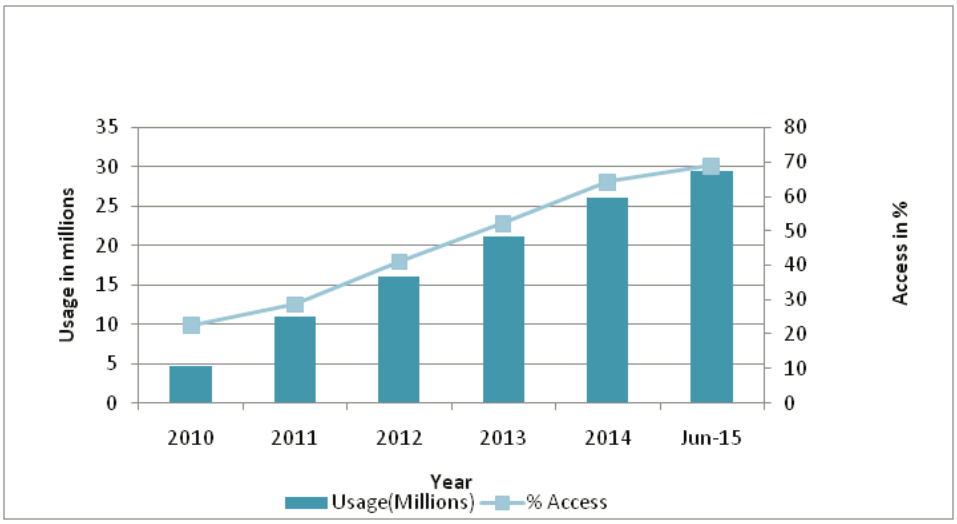
2.1 Internet Access and Usage

Internet growth is crucial towards development of the ICT sector and to national socio-economic development. Usage of Internet in Kenya for all has the potential to generate enormous social and economic benefits to individuals, businesses and the government in various ways. To individuals, the Internet promotes job creation, which comes in the way of certain Internet technology such as Internet banking and mobile applications and promotes improved education and training services through e-learning opportunities. To businesses, Internet has assisted the performance of tasks through creation of diversified supply chains, global talent sourcing and analysis of large sale and purchase data sets. The Internet has broken down information barriers, making it easier for two parties who had no way of finding each other previously or who had no information to easily find each other, acquire information on products and prices, thereby greatly reducing business transaction costs, which greatly raises productivity. The Internet has increasingly engaged customers and incorporated their feedback online, thus expanding the reach of a business to many customers. To governments, the Internet has led to economic growth; for instance, in 2012 the Internet contribution to GDP in Kenya was 2.9 per cent. Further, the Internet promotes good governance through participation of citizens as defined in the Constitution (McKinsey, 2013; Information Communication Technology Board, 2012).

In 2010, 4.77 million people in Kenya were using the Internet. This number grew to 13.54 million users in 2012, 21.3 million users in 2013 and in 2014 the number of Internet users grew by 23 per cent to reach 26.2 million (Figure 2.1). Two main reasons can be attributed to the rise in Internet usage. First, is the liberalization of the telecommunications sector in the year 2000 which saw the introduction of additional Internet service providers, including mobile network operators. This has enhanced competition, infrastructural advancements, and availability of Internet. The second reason is attributed to Internet infrastructural investments, key among this being the undersea fibre optic cable which has contributed to increased Internet accessibility and connection speed (Communications Authority, 2007).

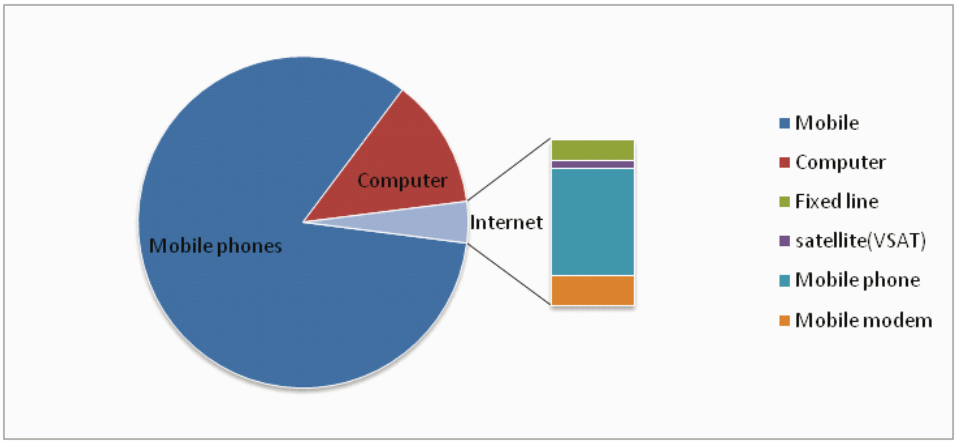
A comparison of Internet usage with other ICT technologies (Figure 2.1) shows that about 90 per cent of the population uses a mobile phone compared to other ICT technologies. From the figure, considering the proportion of Internet users, over 80 per cent access the Internet from their mobile phones owing to a higher population owning this mode of access.

Figure 2.1: Internet access and usage patterns in Kenya



Data Source: Communications Authority, and Kenya National Bureau of Statistics

Figure 2.2: Internet usage in comparison to other ICT technologies in Kenya

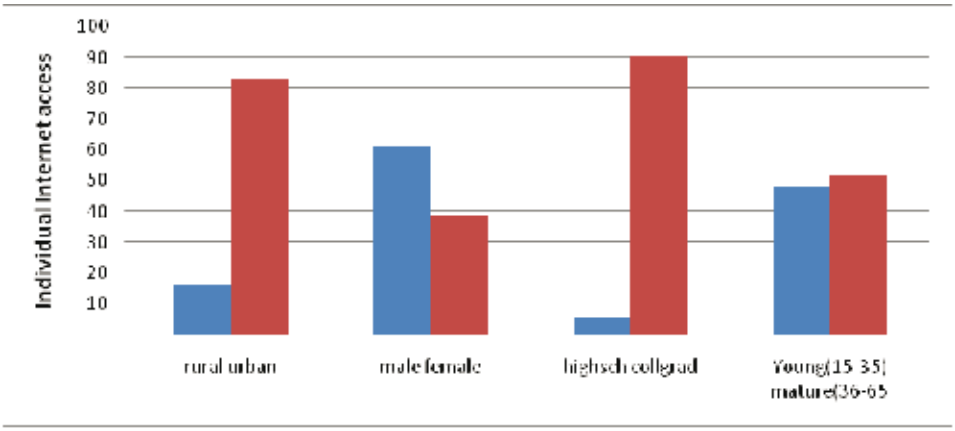


Data Source: 2010/11 National ICT Survey

2.2 Digital Divide in Usage

Digital divide patterns within the country can be very high based on geographical location, gender and education levels. Figure 2.3 shows that the digital divide between rural and urban and across demographic groups remains considerable. Individuals in rural areas and females are less likely than people in urban areas and men to use or own Internet technologies. Internet usage is common among

Figure 2.3: Within-country digital divide



Data Source: 2010/11 National ICT Survey

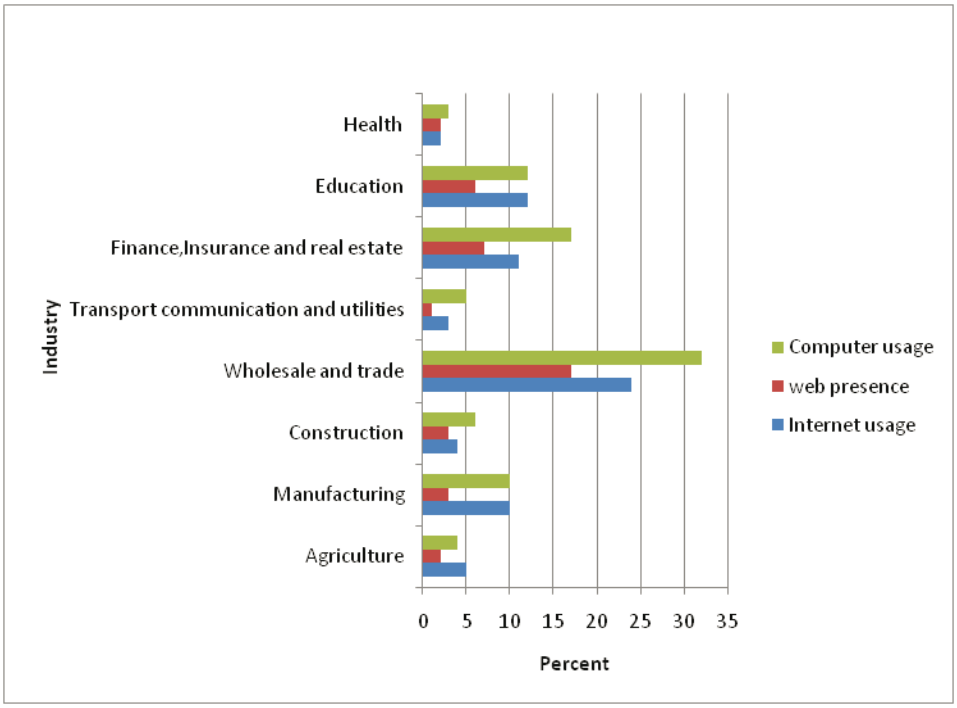
people with college level of education and above, whereas individuals with high school education and below have low Internet usage rates.

The overall goal of the Vision 2030 is for the country to develop into a knowledge-based economy and achieve a developed status (Government of Kenya, 2007). Kenya is well on its way to a knowledge-based economy as evidenced by explosion of Internet coverage and information services. A number of challenges, however, prevent the country from transitioning into a knowledge economy. These challenges are mainly accessibility and affordability of Internet due to limited coverage of national fibre infrastructure, leading to limited Internet penetration in rural areas. Other challenges include lack of technologies and devices to ensure high speed connectivity to homes, especially in rural areas. This may be due to inadequate infrastructure such as availability of energy and roads, and market inequality due to differences in income levels among different households (Government of Kenya, 2013).

2.3 Businesses Internet Usage

Internet usage among business people is also gaining popularity due to associated advantages such as quicker and better access to information, reductions in costs, and time to serve customers and improved business operations. Figure 2.4 shows the proportion of businesses by type who engage in Internet, computer and who have a website. From the figure, businesses in the wholesale and retail industry are the majority of Internet and computer users. These businesses use the Internet for purchasing and ordering of goods, and also communicating with their customers. The agriculture industry is faced with low usage of Internet technologies; this

Figure 2.4: Computers, Internet and web presence by industry in Kenya

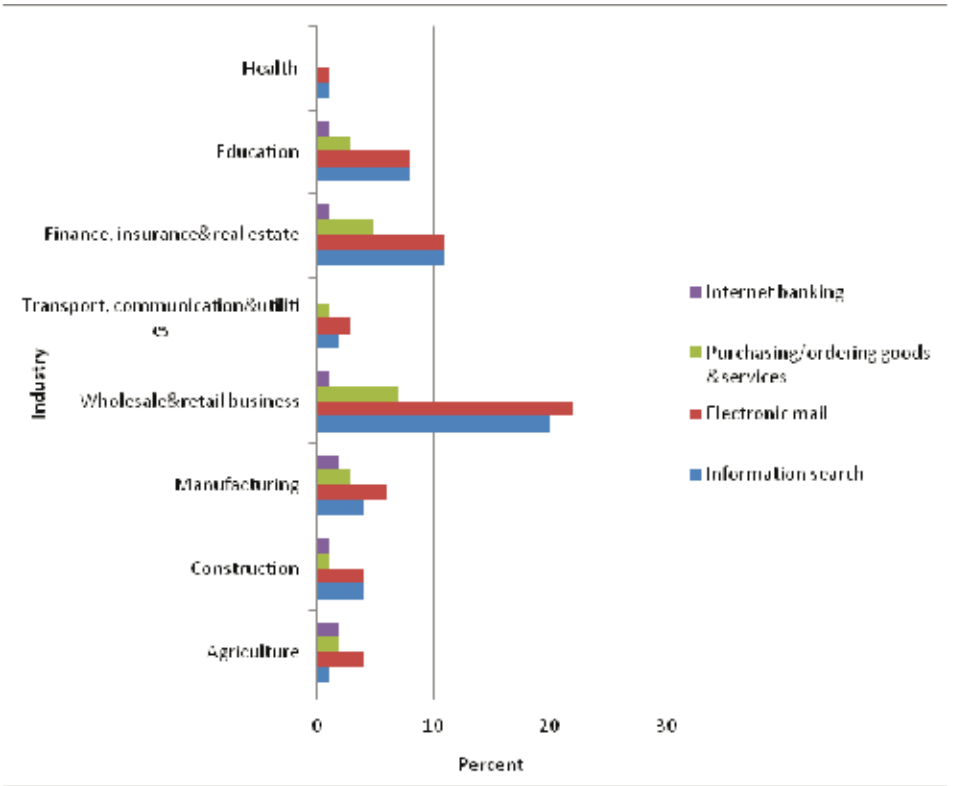


Data Source: 2010/11 National ICT Survey

may be attributed to low Internet access among farmers and small-scale informal traders in this industry. The figure also shows that very few businesses have a web presence.

Figure 2.5 shows the specific Internet tasks businesses are engaged. Seven (7) per cent of the firms who had Internet used it for purchasing or ordering of goods while a mere 1 per cent used it for Internet banking. Comparing Figure 2.4 and Figure 2.5, the percentage of firms having a website and purchasing or ordering goods online is higher in wholesale and retail trade and in finance, insurance and real estate industries. These businesses also share other characteristics such as being large in size, fast growing and skill intensive, and are often located in major towns and cities across the country.

Figure 2.5: Businesses Internet tasks



Data Source: 2010/11 National ICT Survey

2.4 Theoretical Literature Review

In this section, we focus on three theories that link Internet use and workers earnings: these are Human capital theory; Social capital theory and signaling theory as discussed below.

Human capital theory

The human capital theory postulates that workers possess a set of marketable skills as a form of capital in which they make a variety of investments. In light of this, firms will pay higher wages to well skilled educated workers because these workers will be more useful to the firm as they will be more productive and reliable members of the firm's hierarchy (Becker, 1975).

Technological change may be associated with changes in wages when a new technology favours workers with added human capital skills to implement

it. These workers may possess a set of marketable skills that put them at an advantage compared to workers without such skills. However, firms may also take affirmative steps to soften the impacts of the new technology on its workforce. Through training, this may serve to reduce the differences in earnings between highly skilled workers and workers with low skills (Fernandez, 2001).

Based on this theory, if we consider the Internet as a source of human capital, then it would be well to assume that access to the Internet and the ability to use it effectively is an important form of capital. Workers possessing Internet usage skills may be more valued by an employer, which is likely to lead to differences in earnings between users and non-users.

Social capital theory

According to this theory, human and social relations are considered a form of capital which contributes to the well-being of a community or directly to an individual's welfare (Lin, 2001). In addition, social capital is an added resource when it helps build onto other forms of capital such as existing human capital. Social relations can be formed through Internet usage when individuals invest their time and energy by joining online networks and connections with the anticipation of receiving socially collective owned capital and benefits in future.

Relations created socially may happen between individuals who previously knew each other or between people who did not know each other.

Social capital networks benefit individuals emotionally and by offering instrumental support. Emotional support occurs through support, friendship and in some cases advice. Instrumental support happens when people get information on job opportunities, new products in the market and new ways of working. Social capital and developmental welfare accessed through such connections and relations is critical as it builds onto a person's existing human capital, or what an organization already possesses (Claridge, 2004; Woolcock and Nalayan, 2000). Based on this reasoning, we can associate the use of Internet to better labour market social connections and information, which promotes better productivity and therefore higher wages.

Signaling theory

The signaling theory assumes that because of imperfection of information, the employer may not be sure about the productive capability of the worker at the time of hiring. Even after hiring, the worker may require some time to learn about the job. The employer, however, can observe certain attributes of the individual,

such as his education and work experience, which he uses as signals in hiring and determining a worker's pay (Spence, 1973).

Internet use may serve as a signal of users who are intelligent and well informed, in the same way in the age of railways the locomotive was a symbol for driving force (Castells, 2001; Turner, 2006). Workers who are proficient in using the Internet and other ICT technologies may be regarded as having higher innate abilities, which may lead to higher output at work. Employers may be inclined to offer them better employment positions with high pay because these employees are regarded as competent in their work, contributing to higher productivity in their firms compared to workers without the ability on Internet usage.

2.5 Empirical Literature

Past empirical studies on the effect of Internet usage on earnings have mainly focused on developed countries. Goss and Phillips (2002), using US Current Population Survey data, found significant wage gains of 13.5 per cent for using the Internet at work compared to those who did not. In their estimation, they used the Heckman selection model and applied the two-stage estimation technique used by Lee (1978) to control for selectivity bias. The study also used the Jorgenson Total Factor Productivity (TFP) series to examine wage differentials across different technology industries. Their results found that Internet users in low-technology industries in the manufacturing sector had high wages than high-technology industries.

DiMaggio and Bonikowski (2008) examined the effect of Internet use on the earnings of US workers. Their study was motivated by the growing divide, which is a disadvantage to those without access to the Internet especially when access and usage promotes labour-market success. This study used the Current Population Survey panel data. The estimation technique used in the study was OLS regression models and the propensity score matching technique. The propensity score matching was used to control for possible selection bias on the basis of respondents' observed characteristics. The author further carried out robustness estimates based on different Internet use specifications such as Internet use at home, effects of persistent Internet use, and Internet use tasks. From the analysis, the different specifications yielded similar results in that Internet user whether at home or at work earned higher wages than non-users. The different models yielded different magnitudes of the size of the effect of Internet use on earnings. OLS models produced a higher coefficient of about 6 per cent while propensity score matching had a coefficient of about 5.2 per cent. This may be because the OLS was not able to fully control for selectivity bias.

The digital divide in Internet access may affect information asymmetry between users and non-users, leading to differences in utility maximization between these two groups. Kim (2003) argued the above from the social capital theory perspective where Internet users have more social interaction than non-users, and therefore they have more social capital. To support this argument, the study analyzed differences in earnings between Internet users and non-users using cross-section data obtained from the US Current Population survey.

The study used the OLS model with controls on where the individual accessed the Internet, either at home or at work and the purpose for which the Internet was used either for information seeking or non-information seeking. The study also introduced a control on computer use to predict both hourly earnings and Internet use. The results showed that Internet users earned about 3.9 per cent more than non-users. Information seeking Internet users also earned more by 4.2 per cent than non-information seeking Internet users independent of computer use dummy. Introducing the computer dummy reduced this coefficient to 2.3 per cent, which was statistically significant.

In the analysis of the effect of Internet use at work on earnings, it is important to compare countries that are at the same level; for this we compare Kenya and Latin America. Navarro (2010) studied the impact of Internet use on individual earnings in six Latin American countries using household survey data. Using Propensity Score Matching method, he was able to control for selection problems associated with inability of the data to observe the earnings of the individuals before the adoption of Internet. From his study, he found sizable return to Internet use for both salaried and self-employed workers, which ranged between 18 and 30 per cent.

The spread and adoption of the Internet could be biased towards those workers with skills and technical know-how on use. These are the same workers who enjoy higher wage gains. Forman et al (2009) investigated the effect of the Internet on the convergence and divergence in local wages using US data. Convergence in wages could have arisen if Internet investments were made in geographically isolated areas that were previously not connected, while divergence may have arisen from those counties that already had advanced Internet investment and areas that had a high fraction of skilled workers. Their estimation involved Instrumental Variable approach, which is used in dealing with omitted variable bias and simultaneity. There was divergence in wages in those counties that had invested in advanced Internet. These counties had other characteristics such as high income, education, and population as well as a large percentage of IT-intensive firms. Regions with an average level of advanced Internet investment (8.9%) experienced wage growth of 0.247 percentage points above that of regions with no Internet use. The study

did not find any evidence that advanced Internet investment contributed to convergence in wages. The results show differences in wages between counties that had advanced Internet investments, and those that did not.

Hadhri et al (2012) using France Household Survey data investigated the difference between adoption and access frequency to Internet and consumer surplus. The study used Heckman methodology, estimating separately Internet adoption and access intensity patterns to resolve the selection bias problem. The selection bias arose from the fact that Internet access intensity could only be observed for people who had adopted Internet. Their estimation strategy involved a Concave demand function where Internet demand function may increase when wage increases. However, over a certain level of wage, the impact seems to be smaller and people do not increase their connection time at the same level. Their findings revealed that a higher education level, computer and Internet skills and lifestyle had a positive effect on Internet adoption. As wages increased, time devoted to Internet access intensity decreased in that the more a person was rich, the less he surfed on the web. This is in line with the theory on time allocation where individuals ask for more leisure activities as income increases. To approximate the consumer's surplus, they used the Equivalent Variation (EV) Value associated to the concave Internet demand function. The results showed a lower consumer surplus compared to the US, a fact they attribute to lower Internet adoption and low Internet intensity in France.

Goldfarb and Prince (2008) estimated the Internet adoption and usage patterns and implications for the digital divide using cross-section household data for the USA. This study used the Heckman sample selection model to model the household decision on adoption and usage. In the first stage, households made a decision on whether to use the Internet and in the second stage, households decide how much time to spend online. Their study also empirically examined which types of applications people use online. From the study, high-income and educated people were more likely to use the Internet but spend less time online, conditional on adoption. Internet usage was also higher for younger people, married people, city dwellers and whites. Although income and education positively correlated with adoption, they negatively correlate with hours spent online, mostly because low-income individuals spent more time online because they had a lower opportunity cost of leisure time.

Computer technology is one of the means through which people can access the Internet. Using a computer predisposes an individual to using the Internet. Krueger (1993) examined the effect of computers on the wage structure of employed workers in the United States. Their study was motivated by the computer revolution that was experienced in the US in the 1980s. During this period, the US

was characterized by changes in the wage structure that was driven by, among other factors, increase in the returns to education. In his work, he sought to find out the enhancing role that computer skills play in increasing the earnings of users. Using the 1984 and 1989 US Current Population Surveys, they found that workers who use computers on their job earned 10 to 15 per cent higher wages compared to the non-users. Their analysis observed that mid-age workers (40-54 years) were more likely to use computers at work. From this study, computer use contributed significantly to increase in the rate of return to education that was seen in the 1980s in the US and was one of the factors that contributed to the changing wage structure.

Studies examining the effect of Internet usage on businesses are quite limited. A study on the impact of ICT on business in Thailand (United Nations, 2008) found that computer use, Internet access and web presence was associated with significantly higher sales per employee. The study found that the use of computers, more than the Internet and the web, is a key factor in explaining higher productivity in firms. After controlling for a series of firm-specific economic characteristics such as firm age, ownership, level of education, industry sector and factors of production, businesses with Internet access had a 3 per cent increase in their sales compared to businesses that did not have Internet access.

Atrostic and Nguyen (2002) examined the effects of Computer Networks in US Manufacturing Plant Productivity using longitudinal plant-level data on computer networks. The study estimated the effect of computer networks on labour productivity across US Manufacturing plants using OLS regression equation and specifying a Cobb-Douglas production function, with robustness checks done using two-stage method. Results from this study show that average labour productivity was 6.4 per cent higher in manufacturing plants with computer networks than in plants without networks.

2.6 Overview of Literature Review

From the foregoing review, the human capital theory is the most basic and direct theory linking Internet usage to growth in earnings since it basis its justification on acquisition of Internet skills as a form of human capital and its relationship to wages. The main setback in social capital theory arises in measuring the influence of Internet usage in formation of social networks, and the relationship with earnings growth. An individual could have many social networks that may not always contribute positively towards productive enhancing information. As for signaling theory, we can interpret signaling as a perception that may or may not

denote an Internet user as an individual with higher skills and abilities, which makes him/her a higher productive worker therefore requiring high wages.

The empirical studies reviewed have focused on developed countries due to the development of ICT technology in the early 1980s when most of the developing countries did not have these technologies. The studies considered mainly used cross-section data. However, DiMaggio and Bonikowski (2005) used panel data, which explored the over time effects of Internet use on earnings. The empirical strategies used in these studies were Ordinary Least Square regression, which is likely to overstate the effect of Internet usage on wages due to its inability to control for selectivity bias. Goss and Phillips (2002) used Two stage method by Lee (1978) while DiMaggio and Bonikowski (2005) and Navarro (2010) used the propensity score matching to test for possible selection bias on the basis of respondents' observed characteristics. Hadhri et al (2012), and Goldfarb et al (2008), used Heckman Selection model to control for selectivity bias.

Using cross section data, this study considers Internet usage from the human capital theory perspective. We adopt the Heckman Selection model to control for selectivity bias arising from selectivity of an employee by the employer for positions that require Internet usage. In the first stage, we model the Internet choice decision by considering the effect of geographical location, education, gender, occupation and industry of work in affecting the Internet usage decision. In the second stage, we consider the effect of Internet usage on wages. The study also conducts robustness checks by conducting separate specification analysis on the factors influencing Internet use at home and how Internet use at home affects wages, and the effect of specific Internet tasks on wages.

3. Methodology

3.1 Conceptual Framework

Although we may not establish a direct cause and effect relationship between Internet usage and wages due to the interplay of other factors that are involved in productivity and increase in wages, appreciating the direction of causality of the Internet in productivity and wages growth and enhancing individual welfare is crucial. Usage depends on how much value individuals derive from the Internet.

Internet usage is a function of various factors. These factors include education level of the user, age of the user, gender of the user, region of residence of the user, the occupation and industry where the user works, and access to other ICT technologies such as access to mobile phone, access to computer and access to the Internet. These factors may influence Internet usage positively, or sometimes negatively. These same factors such as education, age, region of residence, occupation and industry where the user works also influence wages.

Assuming that usage of the Internet increases wages, two factors influencing the wage structure have to be distinguished. First, is the individual productivity increase arising from workers using the Internet, and which increases the individual workers wages and, second, is the productivity increase affecting efficiency units of labour and which affects wages of all workers (Borghans and Weel, 2008). However, due to limitations in data, our study considers the individual productivity affecting wages of individual workers using the Internet.

Taking into consideration the above factors, we developed a model on how Internet use at work affects wages as illustrated in Figure 3.1. From the figure, we model first the factors affecting Internet usage and later model the effects of Internet usage, personal and region factors on wages.

We model the returns to Internet use from the theory of human capital using the Mincer equation on returns to schooling (Mincer 1974) and illustrated by Acemoglu and Autor (2011).

An individual *i*,will seek to maximize his utility according to the following function;

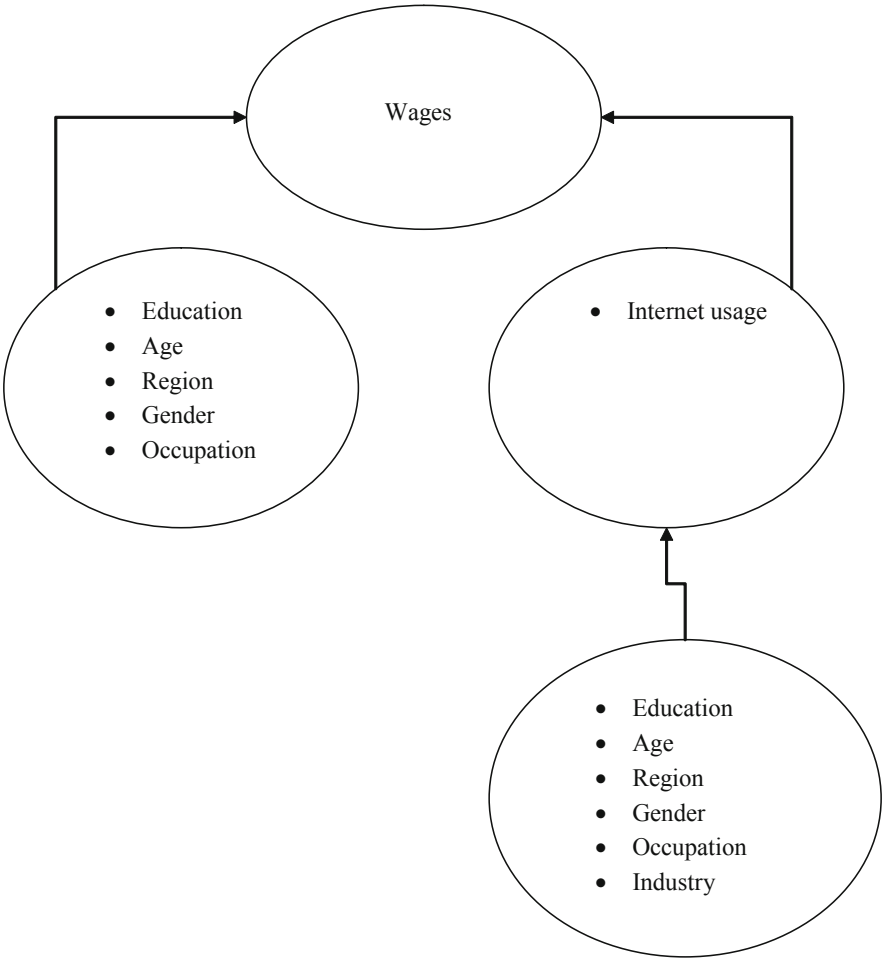
$$Max \int_0^T \exp(-(\rho + v)t)\, u\big(c(t)\big)dt \qquad (1)$$

Where ρ is the future discount rate, v flow rate of death, so that individuals have finite expected lives.

Assuming that individual i is born with some human capital h(0)$\geq\geq$0, which evolves over time according to the following:

$$h(t) = G(\dot{t}, h(t), s(t)) \qquad (2)$$

Figure 3.1: Conceptual framework



Source: Author's construct

Where;

$s(t) \in [0,1]$, is the fraction of time the individual spends improving his human capital, through investments in schooling and in our case through acquiring Internet usage skills.

Suppose also that wages grow exponentially,

$\dot{w}(t) = gw(t)$ and $w(0) > 0$

Where g is the investment in human capital.

Now using the optimal utility decision equation (1) the first –order condition yields:

$$\frac{\varphi'(s*)}{\varphi(s*)} = r + v - g_w \quad (3)$$

Equation 3 above shows that higher interest rates r and higher values of v, which is shorter planning horizons reduces human capital investments, while higher values of g_w increase the value of human capital encouraging further investments.

Integrating both sides of equation 3 with respect to s yields:

$$In\varphi(s*) = Constant + (r + v - g_w)s* \quad (4)$$

This yields wage earnings of worker of age $\tau \geq s*$ at a time t;

$$W(S,t) = \exp(g_w t)\exp\big(g_h(t-s)\big)\varphi(s)$$

Where t-s is worker experience (5)

Taking logs produces the following as the earnings of the workers

$$InW_i = constant + \gamma_s s_i + \gamma_e experience_i \quad (6)$$

Where i, refers to individual. Modifying equation 6 by introducing human capital influence due to Internet yields the following equation:

$$InW_i = constant + \gamma_s s_i + \gamma_e experience_i + \gamma_I Internet_i \quad (7)$$

Where lnW_i represents log of wages of individual i.

From equation 7 above, wage is determined by among other factors Internet usage, schooling(S) and experience.

3.2 Empirical Model

Using (equation 7) above in the analytical model, the opportunity cost of foregone wages arise due to differences in schooling, work experience and in our case Internet usage among others.

In this paper, we model the effect of the above factors using the following equation:

$$InW_i = \beta_0 + \beta_1 int_i + \beta_2 P_i + \beta_3 M_i + \beta_4 R_i + \varepsilon_i \quad (8)$$

Where i = Individual.

InW_i – Log of individual i wage. Our data does not allow us to compute actual hours worked therefore we use log monthly wage rather than log hourly wage which is the standard practice.

int_i –Internet usage dummy for individual i, where 1=Internet usage, 0 otherwise.

P_i –Vector of individual *i* personal characteristics (age, gender, education level).

M_i –Vector of individual *i* main occupation and industry of work (occupations have been classified into skilled, semi-skilled and unskilled hile industry has been classified into agriculture, construction, manufacturing, wholesale and retail trade, business services, transport and communication, finance and insurance, health and education). In classifying industries, we have excluded industries that directly deal with ICT such as those involved in provision of Internet and ICT goods and services to avoid correlation with the dependent variable (United Nations, 2008).

R_i –Region dummy (Where 1 is rural, otherwise urban)

ε_i-Error term

$\beta_0, \beta_1, \beta_2, \beta_3, \beta_4$ – Coefficients to be estimated

Estimating equation 8 using Ordinary Least Square (OLS) estimation technique results in sample selection bias. Sample selection arises when a sample is not randomly selected; in that case, the characteristics that influence the sample selection also influence the outcome. Therefore, the parameter estimates from an Ordinary Least Squares (OLS) regression model are inconsistent and biased and would overestimate the effect of Internet use on wage (β_1).

In evaluating the effect of Internet usage both at work and at home on wages, we experience selectivity where we are only able to observe the wage data for Internet

users only. This therefore consists a non-randomly selected sample resulting in loss of efficiency. Using the Internet at work is subject to selectivity bias arising from selectivity of an employee by the employer for positions that require Internet usage skills. Workers who have adopted Internet may be well educated, a reason for their being chosen to adopt the Internet in the first place. To model sample selection, we adopt the Heckman sample selection model (Heckman, 1974; 1979). This model corrects for selectivity using two estimation techniques; the two stage and the Maximum Likelihood technique.

A sample selection model always involves two equations: (1) the selection equation (First stage) - this stage considers a portion of the sample whose outcome is observed and mechanisms determining the selection process. In the first stage, individuals decide whether to use the Internet or not; (2) The regression equation (Second Stage) - this stage considers mechanisms determining the outcome variable (Heckman, 1978; 1979). In the second stage, the mechanisms determining wages is determined subject to the outcome in stage 1-decision to use the Internet being positive.

We therefore model the sample selection model using the first stage and second stage equations as follows:

Selection equation (First stage): $I_i = z_i\gamma + u_i$, *if* $I_i > 0$, 0 otherwise

$Prob(I_i = 1|zi) = \Phi(zi\gamma)$ and $Prob(I_i = 0|zi) = 1 - \Phi(zi\gamma)$ (9)

zi is a vector of exogenous variables determining the selection process or the outcome of I_i ;

I_i is a latent endogenous variable.

$\Phi(\bullet)$ is the standard normal cumulative distribution function;

Regression equation (Second Stage): $y_i = x_i\beta + \varepsilon_i$ (10)

Y_i is observed only if $I_i = 1$, if individual *i* adopt the Internet

x_i is a vector of exogenous variables determining outcome y_i,

u_j and ε_j are error terms of the two regression equations, and assumed to be bivariate normal, with mean zero and covariance matrix $\begin{bmatrix} \partial 3 & \rho \\ \rho & 1 \end{bmatrix}$

In the above model, if we assume y_i to be wage and I_i to be the probability of using the Internet, then we can interpret the above model as wages only if individual *i* is using the Internet.

The maximum likelihood estimate of equation 9 is then used to compute the inverse mill's ratio for each individual as follows:

$$\lambda_i = \emptyset(x_i)/[1 - \Phi(x_i)] \quad (11)$$

Where $\emptyset(x_i)$ is the standard normal density function, and $\Phi(x_i)$ is the standard cumulative distribution function. The inverse mills ratio is used as a control variable in estimating the regression equation –equation 10 by determining the presence or absence of sample selection.

Based on the above models we obtained the following first stage equation.

$$pr_i(internetusage\ at\ work) = Pr(P_{1i}\beta_1 + M_{2i}\beta_2 + \gamma_{3i}\beta_3 + R_{4i}\beta_4 + \varepsilon_i \geq 0)$$

$$= \Phi(p_{1i}\beta_1 + M_{2i}\beta_2 + \gamma_{3i}\beta_3 + R_{4i}\beta_4) \quad (12)$$

Equation 12 is also used in the first stage equation involving robustness check on Internet use at home thus:

$$pr_i(internetusage\ at\ home) = Pr(P_{1i}\beta_1 + M_{2i}\beta_2 + \gamma_{3i}\beta_3 + R_{4i}\beta_4 + \varepsilon_i \geq 0)$$

$$= \Phi(p_{1i}\beta_1 + M_{2i}\beta_2 + \gamma_{3i}\beta_3 + R_{4i}\beta_4) \quad (13)$$

Where:

P_{1i} - A vector of personal controls. These include: age, years of education, gender

M_{2i} - A vector of industry and occupation related controls. Industry controls include: Agriculture, construction, manufacturing, wholesale and retail trade, business services, transport and communication, finance and insurance and health industry. Occupations include: Skilled, unskilled and semi-skilled occupations.

(In classifying industries, the study used the International Standard Industrial Classification of all economic activities (United Nations, 2008).

γ_{3i} - A vector of other ICT access technologies. Other ICT access technologies include: Access to television, access to pay TV, access to fixed telephone, access to mobile phone, access to computer and access to Internet.

R_{4i} - Region dummy. Region is classified into either rural or urban.

The second stage equation is estimated if Internet usage takes place as follows:

$$E(W_i|I_i) = P_i\beta + (M_i\beta_1 + R_i\beta_2 + \beta_\lambda\lambda(x_i) \quad (14)$$

Where $W_i = P_i\beta_0 + (M_i\beta_1 + R_i\beta_2 + \varepsilon_i$ is observed if I_i=1 for individuals that chose to use the Internet and 0 otherwise.

P_i, M_i and R_i are vectors of covariates.

B is a vector of parameters;

λ, the inverse mills ratio, also referred to as the Heckman correction, is derived after estimating the first stage equation 12 for Internet use at work and equation

13 for Internet use at home.

ε_i is an individually-specific normally distributed error term.

To allow identification on more than the functional form, we include control variables as instruments that correlate with Internet usage but not wage in the first-stage equation as recommended by Greene (1997).[1]

The Inverse mills ratio λ is a product of two terms σ and ρ, where ρ is the correlation between ε and μ, and σ is the standard deviation of ε. The coefficient for inverse mills ratio (λ) is used to show whether there is sample selection or not when the coefficient is statistically significant or different from 0. The Inverse mills ratio allows Internet usage and wage to follow different patterns, assuming that the first-stage errors are normal. The Inverse mills ratio resolves the selection problem under either of two assumptions: (1) The instruments correlate with usage but not wage or; (2) the first-stage error terms are normal (Goldfarb and Prince, 2008).

In performing robustness check involving the effect of different Internet specific tasks on wages, we introduce more controls in the second stage equation-equation 14 as follows:

$$E(W_i|I_i) = P_i\beta + (M_i\beta_1 + R_i\beta_2 + S_i\beta_3 + \beta_\lambda\lambda(x_i) \quad (15)$$

Where S_i is a vector of specific Internet tasks that include electronic mail, e-government services, reading, entertainment, getting health information, purchasing goods, Internet banking, and conducting research.

3.3 Data

The study uses a cross section dataset obtained from the 2010 National Information and Communication Technology Survey conducted by the Kenya National Bureau of Statistics. The data is a household data and contains information on general individual and household characteristics such as age, region of residence (rural or urban), gender, employment status, monthly wages and years of education. The questionnaire also contained specific questions on Internet access and usage

[1] The following variables were used as control variables/instruments in the first stage: access to television, access to pay TV, access to fixed telephone, access to mobile phone, access to computer, access to Internet. Access to other ICT technologies is likely to influence Internet usage because they create confidence towards the usage of ICT. Therefore, users may be led to using the Internet. Other instruments used were Industry controls where the individual works-8 industry dummies were used, with finance and insurance giving a positive statistically significant effect on Internet usage mostly because the finance and insurance industry has a high demand for usage of Internet due to the operations of this industry in areas such as Internet banking.

for household individuals, institutions and businesses. The ability of the data to provide information on Internet and other ICT usage patterns makes it ideal for this study.

Our sample consists of 3,783 individuals restricted to employed persons aged 15 to 64 years. In this sample, individual wage was observed if Internet usage was positive. Out of this sample, 318 people were using the Internet at work and 247 people were using the Internet at home.

4. Results and Discussion

4.1 Summary Statistics

Table 4.1 gives a summary of the data that was used in the analysis. From the summary statistics, the average monthly wage received by the full sample comprising Internet and non-Internet users is Ksh 13,589. The monthly wage received by users of the Internet at work is Ksh 54,497 and 74,475 for users of the Internet at home. This shows that Internet users earn higher pay than the sample of both users and non-Internet users. Therefore, Internet users are advantaged through higher wages compared to non-users.

The sample statistics also show that 66 per cent of the total sample resides in the rural areas. However, considering the Internet users at work sample only, 18 per cent of Internet users at work reside in the rural areas. This shows that although a majority of the population lives in the rural areas, only about one quarter of them use the Internet there, while a majority of Internet users are concentrated in urban areas. The data also shows that Internet users have high levels of education with a mean of 17 years for Internet users at work and 18 years for Internet users at home, compared to the total sample of both users and non-users who have a mean of 10 years. This could mean that the ability to use the Internet is related to an individual possessing a higher level of education. The summary statistics also show that usage of the Internet is inclined towards skilled labour, where 75 per cent use the Internet at work and 78 per cent use the Internet at home, compared to 13 percent of semi-skilled and only 12 per cent of unskilled labour.

Workers in the finance and insurance and business services industry are the highest Internet users at 19 and 22 per cent for Internet users at work and 18 and 21 per cent for Internet users at home, respectively. These industries also support many activities on the Internet, such as Internet banking, which may necessitate the workers to use the Internet at work.

Access to mobile phone, access to computer and access to the Internet are a major prerequisite for Internet usage. People accessing these technologies have high Internet usage. About 95 per cent of people who had access to the Internet were using it at work. Access to mobile phones and computers is important, since these are the common media from which people access and use the Internet. We can therefore say that most people who do not use the Internet are constrained by access, and their usage would be greatly enhanced if such people had access. The data also shows that access to pay TV has a major influence in using the Internet at home, with 53 per cent of Internet users at home having had access to pay TV.

Table 4.1: Summary statistics

	Full sample				**Internet usage at work=1**				**Internet use at home=1**			
Variable	Obs	Mean	Min	Max	Obs	Mean	Min	Max	Obs	Mean	Min	Max
Wage(Ksh)	3,783	13,589	100	500,000	318	54,497	170	300,000	247	74,475	170	400,000
Age	3,783	36	15	64	318	37	21	64	247	38	21	64
Age squared	3,783	1,408	225	4,096	318	1,469	441	4,096	247	1,502	441	4,096
Years of education	3,783	10	0	25	318	17	1	25	247	18	2	25
Rural (=1 if rural, 0 otherwise)	3,783	0.66	0	1	318	0.18	0	1	247	0.11	0	1
Female (=1 if female, 0 otherwise)	3,783	0.36	0	1	318	0.40	0	1	247	0.46	0	1
Skilled labour (=1 ,0 otherwise)	3,783	0.22	0	1	318	0.75	0	1	247	0.78	0	1
Semi skilled labour (=1 , 0 otherwise)	3,783	0.26	0	1	318	0.13	0	1	247	0.13	0	1
Agriculture industry (=1, 0 otherwise)	3,783	0.28	0	1	318	0.04	0	1	247	0.03	0	1
Construction industry (=1,0 otherwise)	3,783	0.07	0	1	318	0.03	0	1	247	0.04	0	1
Manufacturing industry (=1, 0 otherwise)	3,783	0.05	0	1	318	0.04	0	1	247	0.04	0	1
Wholesale and retail industry (=1,0 otherwise)	3,783	0.14	0	1	318	0.05	0	1	247	0.08	0	1
Business services industry (=1, 0 otherwise)	3,783	0.18	0	1	318	0.22	0	1	247	0.21	0	1

Transport & communication industry (=1,0 otherwise	3,783	0.06	0	1	318	0.07	0	1	247	0.07	0	1
Finance & insurance industry (=1,0 otherwise)	3,783	0.03	0	1	318	0.19	0	1	247	0.18	0	1
Health Industry (=1, 0 other wise)	3,783	0.02	0	1	318	0.08	0	1	247	0.09	0	1
Access to television (=1,0 otherwise)	3,783	0.52	0	1	318	0.96	0	1	247	0.97	0	1
Access to pay TV (=1, 0 otherwise)	3,783	0.09	0	1	318	0.38	0	1	247	0.53	0	1
Access to fixed telephone (=1, 0 otherwise)	3,783	0.07	0	1	318	0.36	0	1	247	0.44	0	1
Access to mobile phone (=1, 0 otherwise)	3,783	0.90	0	1	318	0.997	0	1	247	0.99	0	1
Access to computer (=1, 0 otherwise)	3,783	0.18	0	1	318	0.94	0	1	247	0.98	0	1
Access to Internet (=1, 0 otherwise)	3,783	0.16	0	1	318	0.95	0	1	247	0.96	0	1

4.2 Regression Results

Table 4.2 presents the results for Internet usage at work, equation 12 and 14. The table reports marginal effects of selection (probit), equation 12 for determinants of Internet usage which is the first stage and parameter estimates for wage if Internet usage takes place - equation 14, which is the second stage using Heckman two-stage estimation technique.

The first stage of the Heckman two-stage method is the selection model, which estimates the determinants of Internet usage, and the second stage is the outcome model, which estimates the wage for those who use the Internet at work.

The coefficient of inverse mills ratio (lambda), which helps to detect the presence or absence of sample selection bias from the first stage probit was 0.277 and statistically significant at 5 per cent. This means that there is sample selection bias, which is controlled by including the Inverse mill's ratio in the second stage equation.

4.2.1 Determinants of Internet usage at work

Using Table 4.2, the marginal effects for probit model, age was found to be positive and significant at 1 per cent level. This means that Internet usage is associated with higher ages. This is common among the economically active age group. However, as one grows older, they stop or have very little Internet usage; that is why the coefficient on age-squared is negative, owing to retirement or low engagement in economic activities.

Residing in the rural areas has a negative coefficient significant at 1 per cent. This means that individuals living in the rural areas are less likely to use the Internet. This may be due to the effect of other factors such as lack of Internet access, which constraints these people from using the Internet. The results also indicate that people with more years of education are likely to use the Internet - the coefficient on the years of education is positive and statistically significant at 10 per cent. Having access to the Internet and a computer increases ones chances of using the Internet by 9.6 per cent and 3.06 per cent, respectively, significant at 1 per cent. This shows that access and usage of the Internet is limited to those with access to information technology and those in an environment to use them effectively Doctor (1994).

The above situation underscores the effect of geographical region, education and access to other ICT technologies in exacerbating the digital divide, particularly among the socially disadvantaged people (Kim, 2003). These results are consistent

Table 4.2: Determinants of Internet usage at work and effect of Internet usage on wages

	Wage model		**Marginal effects for probit model**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
Age	0.138***	0.043	0 .00169***	0.00076
Age squared	-0.001***	0.001	-0.00002***	0.00001
Years of education	0.032***	0.008	0.00025*	0.00015
Rural (d)	-0.371***	0.142	-0.00851***	0.0035
Female (d)	-0.061	0.107	-0.00102	0.00179
Skilled labour (d)	0.187	0.167	0.01073**	0.00541
Semi- skilled labour (d)	-0.013	0.204	-0.00176	0.00279
Agriculture industry (d)			0.036	0.219
Construction industry (d)			-0.261	0.241
Manufacturing industry (d)			0.036	0.253
Wholesale and retail industry (d)			-0.238	0.215
Business services industry (d)			0.161	0.144
Transport and communication industry (d)			0.190	0.207
Finance and insurance industry (d)			0 .294*	0.162
Health Industry (d)			-0.183	0.205
Access to television (d)			0.247	0.173
Access to pay TV (d)			0 .046	0.112
Access to fixed telephone (d)			0.039	0.117
Access to mobile phone (d)			0 .169	0.457
Access to computer (d)			0 .824***	0.164
Access to Internet (d)			1.142***	0.162
Constant	-4.945***	0.843	-4.945	0.843
mills lambda	**-0.277****	**0.141**		
rho	-0.303			
sigma	0.915			
Number of observations	3783			
Censored observations	3465			
Uncensored observations	318			
Wald $chi^2(7)$	46.18			
Prob> chi^2	0			

Note: Basing on P>|z|, the asterisks (***), (**) and (*) imply that the coefficient is statistically significant at 1%, 5% and 10%, respectively

with past studies. Goldfarb and Prince (2008) found that individuals with high income and are highly educated were more likely to adopt the Internet.

Individuals in skilled labour occupations, and finance and insurance industries, had positive coefficient significant at 5 per cent. This shows that Internet users are concentrated in the formal sectors of the economy. Indeed, there is a high demand for Internet usage in these sectors. Skilled labour occupations promote Internet usage, since individuals in these occupations may already have the technical know-how on Internet usage. In the finance and insurance sector, the development of many online applications has seen people use the Internet more so as to benefit from them.

4.2.2 Effects of work related Internet usage on wages

From Table 4.2 wage model, conditional on Internet usage at work being positive, age has a positive influence on wages, significant at 1 per cent. However, as one grows older, the influence of age on wages becomes negative. This result is similar to what is provided in the literature. Persons with more years of education are also likely to enjoy higher wages by 3.2 per cent subject to Internet usage at work. The coefficient for years of education is positive and significant at 1 per cent. The rural coefficient was negative and statistically significant at 1 per cent, showing that people in rural areas are likely to get lower wages subject to Internet usage at work. DiMaggio and Bonikowski (2008) also found stronger effects of Internet use on earnings of US workers even after controlling for age, gender, education background, occupation and industry of the workers.

These results on wages have shown that usage of the Internet has continued to help people who were well-off, and people who had higher wages even before they started using the Internet. Specifically, Internet usage at work is correlated with larger wage growth among individuals residing in urban areas and those with a higher level of education, while Internet usage at work has not helped people residing in the rural areas, and those with less education catch up with those with higher wages since the coefficient on these variables is negative.

Forman, Goldfarb and Greenstein (2009) found that Internet usage in the US was skill-biased, and advanced usage led to increased wage inequality across workers.

4.3 Robustness Checks

A critical concern in the analysis is that Internet usage at work may have helped better able workers who may have earned higher wages even in the absence of the Internet. These more able workers had a high level of education, therefore

necessitating the employer to choose them for Internet use at work (DiMaggio and Bonikowski, 2008). This would then mean that estimating the effect of Internet use at work on wage is overstating the effect of Internet use on wage.

In the next set of analysis, we evaluate two empirical strategies, the first examining the effects of Internet use at home. Home Internet use is less likely to be influenced by employer decisions than is Internet use at work, therefore allowing us to measure the real consequence of Internet use on wages.

As a second approach, we further carried out a specification on the effect of specific Internet tasks on wages to find out which Internet tasks had a higher contribution on wages.

4.3.1 Internet use at home

To model Internet use at home, we use equation 13 which is the first stage probit on the determinants of Internet use, using Internet usage at home as the dependent variable, while the second stage Heckman on wage, equation 14 will determine the factors influencing wage if Internet use at home is observed.

Table 4.3 presents regression results using Internet use at home. The coefficient of inverse mills ratio (lambda) which helps to detect the presence or absence of sample selection from the first stage probit was 0.325 and statistically significant at 10 per cent. This means that there is sample selection bias and its effect is controlled by including the Inverse mill's ratio in the second stage equation. In this specification, sample selection arises since we can only observe wage data for Internet users, therefore constituting a non-randomly selected sample.

From Table 4.3, the results on determinants of Internet usage at home-marginal effects for probit model shows that the rural coefficient is negative and significant at 5 per cent, showing that people residing in rural areas are disadvantaged in using the Internet even at home.

Agriculture industry, manufacturing industry, wholesale and retail industry, business services industry, transport and communications industry have a positive and significant coefficient showing that individuals in these industries are more likely to use the Internet at home, compared to finance and insurance industry which had a positive and significant coefficient on Internet usage at work (Table 4.2).

The coefficient on access to pay TV is positive and statistically significant at 1 per cent. Individuals with high end technology devices such as pay TV are also likely to have the know-how on Internet usage. Some pay TVs come with a packgage on Internet access; therefore it is likely that this means of accessing the Internet at

home is gaining popularity in Kenya. The coefficient on access to mobile phone is negative and statistically significant at 1 per cent. This means that even if an individual has a mobile phone, they are less likely to use them to access the Internet at home.

When we focus on the wage model, the coefficient on age is positive and statistically significant at 1 per cent. This means that subject to Internet usage at home being positive, higher age, which is the economically active age, leads to higher wage, although as a person grows older the influence of age on wages becomes negative. The coefficient on years of education is positive and statistically significant at 1 per cent. This means that the higher the years of education, the higher the wages subject to Internet usage at home.

Rural and female coefficients are negative and statistically significant at 1 per cent. This is in line with what was observed with Internet usage at work. Individuals residing in the rural areas and females earn lower wages subject to Internet usage at home.

The results of the wage model observed here are not very different from those observed in Table 4.2 on Internet usage at work. The results are robust and show that home Internet users with many years of education, residing in the urban areas and males have higher wages.

The effect of Internet use both at home and at work is in favour of people who are highly educated and people residing in urban areas. According to the human capital theory (Becker, 1975), highly educated individuals are more likely to earn higher wages. This then would mean that the Internet is a form of human capital, and workers possessing the ability to use it effectively are at an advantage than the non-users.

Table 4.3: Determinants of Internet usage at home and the effect on wages

	Wage Model		**Marginal effects for probit model**	
	Coefficient	**Standard Error**	**Coefficient**	**Standard Error**
Age	0.114***	0.049	0.00008***	0.000
Age squared	-0.001*	0.001	0.00000**	0.000
Years of education	0.047***	0.013	0.00018***	1.850
Rural (d)	-0.537***	0.210	-0.00410***	0.002
Female (d)	-0.309***	0.129	0.00124***	0.001
Skilled labour (d)	-0.095	0.244	0.00519	0.003
Semi-skilled labour (d)	-0.127	0.276	0.00029	0.001
Agriculture industry (d)			0.52460*	0.287

Construction industry (d)			0.32909	0.268
Manufacturing industry (d)			0.60661***	0.294
Wholesale and retail industry (d)			0.53596***	0.233
Business services industry (d)			0.28904*	0.164
Transport and communication industry (d)			0.68107***	0.243
Finance and insurance industry (d)			0.16912	0.177
Health Industry (d)			-0.07294	0.221
Access to television (d)			0.14597	0.238
Access to pay TV (d)			0.71496***	0.118
Access to fixed telephone (d)			0.15256	0.125
Access to mobile phone (d)			-0.83831***	0.373
Access to computer (d)			1.06632***	0.231
Access to Internet (d)			1.16630***	0.207
Constant	7.912***	0.976	-3.986***	0.834
Mills lambda	**-0.325***	**0.170**		
rho	-0.327			
sigma	0.996			
Number of observations	3783			
Censored observations	3536			
Wald $chi^2(7)$	44.600			
Prob> chi^2	0.000			

Note: Basing on P>|z|, the asterisks (***), (**) and (*) imply that the coefficient is statistically significant at 1%, 5% and 10%, respectively

4.3.2 Specific internet tasks

Here, we present the second stage Heckman equation on wage, equation 15, to find the effect of specific Internet tasks on wage. Specific Internet tasks include: electronic mail, e-government services, reading, entertainment, seeking health information, purchasing goods, Internet banking and Internet research.

Table 4.4 presents estimates of the coefficients on the specific Internet tasks for equation 15 that also include the covariates listed in Table 4.2.

From the table, the coefficient on Internet banking is positive and statistically significant at 10 per cent. This means that individuals using the Internet for Internet banking tasks have earnings advantage than any other Internet task. People using the Internet for Internet banking are mostly in the finance and insurance industry, and these individuals mostly use the Internet at work according to the results from

Table 4.2. Similar to what was observed in Table 4.2, age and years of education positively influence wages, while rural residence negatively affects wages.

Table 4.4: Effects of specific Internet tasks on wage

	Wage Model			
	Coeff	Std. Err	Z	P>Z
Age	0.137***	0.043	3.17	0.002
Age squared	-0.001***	0.001	-2.61	0.009
Years of education	0.033***	0.008	3.88	0
Rural=1 if rural, 0 otherwise	-0.380***	0.141	-2.68	0.007
Female=1 if female, 0 otherwise	-0.055	0.107	-0.51	0.607
Skilled labour=1, 0 otherwise	0.203	0.166	1.22	0.221
Semi-skilled labour=1 , 0 otherwise	-0.010	0.202	-0.05	0.96
Electronic mail	-0.114	0.128	-0.89	0.373
E-Government services	-0.089	0.116	-0.77	0.444
Reading	0.059	0.140	0.42	0.672
Entertainment	-0.101	0.169	-0.6	0.548
Getting health information	0.009	0.181	0.05	0.96
Purchasing goods	0.287	0.206	1.39	0.165
Internet banking	0.328*	0.204	1.61	0.108
Research	0.106	0.117	0.91	0.365
Constant	7.045***	0.894	7.88	0
mills lambda	**-0.227***	**0.142**	**-1.6**	**0.109**
rho	-0.253			
sigma	0.897			
Number of obs	3783			
Censored obs	3465			
Uncensored obs	318			
Wald $chi^2(15)$	54.58			
Prob> chi^2	0			

Note: Basing on P>|z|, the asterisks (***), (**) and (*) imply that the coefficient is statistically significant at 1%, 5% and 10%, respectively

5. Conclusion and Policy Recommendations

5.1 Conclusions

The effect of Internet usage on earnings in the form of wages is less analyzed in developing countries. This study provides an empirical investigation towards understanding the effects of Internet usage on wages and the factors associated with Internet usage.

The main objective of the study was to evaluate the effects of Internet usage on wages while controlling for relevant wage factors such as education, age, region, occupation and industry of operation. Other factors that affect Internet usage such as ownership of ICT devices such as mobile phone, pay TV, fixed telephone and computer were considered.

The study answered the first research question by showing that individuals residing in rural areas were less likely to use the Internet; the coefficient on rural residence was negative. As one grows older, they were also less likely to use the Internet. Internet use is favoured towards individuals with many years of education, skilled labour and individuals working in the finance and insurance industry. This reason arises from the fact that access to the Internet is also limited to urban areas and among well-educated individuals. This shows that the characteristic of Internet users is closely related, with the main factors likely to cause inequality such as education, region and occupation (Kim, 2003). The government has increasingly made efforts to promote availability of the Internet through liberalization of the telecommunication sector and high investments in Internet infrastructure. Despite these efforts, the analysis shows that actual usage is limited to individuals who were already advantaged, namely highly educated, skilled labour and individuals residing in urban areas.

From the second research question on the effects of Internet usage at work on wages, the study has established that individuals with higher education and skilled labour enjoy higher wages. Individuals residing in rural areas, females and unskilled labour had lower wages.

Results on home Internet use were robust to Internet use at work, in that individuals residing in rural areas were less likely to use the Internet than those in urban areas. In this specification, we find individuals working in industries such as agriculture, manufacturing, wholesale and retail, business services, transport and communication using the Internet at home, a situation which is common among individuals in small scale and self-employed industries.

The wage model for Internet users at home is consistent with work-related Internet use. Internet users at home who had many years of education, residing in urban

areas and males had higher wages than non-Internet users. This is consistent with literature where using the Internet at home is likely to boost earnings even for individuals who do not use the Internet at work (DiMaggio and Bonikowski, 2008). The study has also shown that using the Internet for Internet banking activities is more rewarding, with higher wages than any other Internet usage task.

The above results show that workers who used the Internet whether at home or at work earned higher wages than non-users. These results show that the effect of the Internet on wage reflects the individual characteristics of the workers, such as a higher education which led to high wages. The results appear to be a real consequence of Internet use on wages as both Internet use at work and at home leads to higher wages driven mostly by workers possession of the skills, and ability to use the Internet.

5.2 Policy Recommendations

Based on the above research findings, usage of the Internet is high among individuals living in urban areas, people with many years of education, and skilled labour. The study also established that individuals using the Internet were likely to earn higher wages compared to those not using the Internet. These were also individuals with many years of education and individuals residing in urban areas.

These differences in wages between users and non-users are a reflection of the digital dividends arising from technology use. The differences are also a reflection of the social divide that may persist due to unequal access to the Internet.

The government has increasingly made investments in Internet infrastructure. However, the findings show that these investments are only enjoyed by a few people; these are individuals living in urban areas. This shows that there is need to increase the infrastructure coverage of Internet to the rural areas of the country, where about 60 per cent of the population live. This coverage will help individuals living in these areas to reap the benefits arising from Internet usage, such as higher wages.

In addition to increasing Internet infrastructure in rural areas, there is need to invest in other supporting infrastructure such as electricity, road network and payment systems that will help in complementing the available Internet infrastructure.

The dividends arising from Internet usage result due to the complementary role Internet plays in the already existing labour skills. The study has shown that the effect of the Internet on wages reflects the characteristics of the workers rather than the firm characteristics, since individuals who used the Internet both at

work and at home were highly educated individuals and those in skilled labour occupations. Therefore, the government needs to invest in general skills and education of the general population, and specifically in skills on Internet usage and other ICT technology. This will go a long way in building the future skills base of the workforce and enhance diffusion of dividends arising from online technologies.

The above policy recommendations will go a long way in ensuring that individuals living in rural areas and individuals with lower levels of education are not excluded from the information society. If provided with equal opportunity, these individuals arguably stand to derive even more benefit from technology connectivity, since Internet can deliver health, education and other services that might be less widely available in rural areas (Information Technology Union, 2010).

5.3 Study Limitations

The study used cross section data, which was limiting in analyzing the over-time effects of Internet use on earnings. The dataset used was insufficient in analyzing the effect of Internet usage on businesses, due to missing data on sales of a business before the Internet adoption decision and even after adoption, even though the questionnaire contained this information. Despite the above limitations, the study provides new insights into understanding digital divide and digital dividends from Internet usage in Kenya.

5.4 Future Research

The cross section data used in this study was not sufficient in controlling for selectivity bias and endogeneity. Therefore, future research can be carried out on the effect of Internet usage on earnings, using a richer data set, in this case panel data. There is also need to carry out further research on the effects of Internet usage in promotion of e-commerce in Kenya. Our results show that usage of the Internet led to higher wages among workers who used the Internet. It would be good to know if this led to productivity increase in the firms where these workers were employed

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