INFORMATION AND COMMUNICATION TECHNOLOGIES FOR DEVELOPMENT: RESHAPING POVERTY IN SOUTH AFRICA

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ABSTRACT

The aim of this thesis is to examine the association between information and communication technologies (ICTs) and poverty reduction in South Africa. ICTs have been argued to be a means to improve household livelihoods and thereby to provide people with the capability of changing their existing poverty trajectories. The study conceptually investigates ICTs as a contributor to human development through the theoretical lens the sustainable livelihoods framework (SLF). Since ICTs broaden the asset base of the poor, the study first theorises household access to ICT as a new form of capital, termed as the 'digital basket'. This new wealth indicator augments the current well-developed list of capitals adopted within the SLF approach. This digital basket concept and the ICT systems that provide its components are described, establishing the theoretical contributions of this thesis.

The study then applies the new concept using quantitative methods to analyse the relationship of including ICT variables into poverty diagnostics as a digital basket. Between the period 2010 to 2015, descriptive statistics of household ICT ownership are provided by identifying stratified digital basket levels. The study uses the recent Income and Expenditure Survey and Living Conditions Survey to examine the distribution and trends of ICT access. These are large-sample, nationally representative household data collected by South Africa's official statistical office. The study finally tests the hypothesis of convergence resulting from ICT access through digital devices.

The findings provide evidence that the relationship of ICTs to poverty reduction is positive and statistically significant. The results further motivate support towards government and institutional initiatives to protect and enhance the ICT ownership of low income households. However it is evident from the analysis that official statistics fail to gather adequate detail with which to properly measure the 'digital baskets' of both the poor and the non-poor. Better designed surveys will be required if the relationship of ICT on poverty reduction is to be properly accounted for.

DECLARATION

I, Kathleen Diga, declare that:

The research reported in this thesis, except where otherwise indicated, is my original research.

This thesis has not been submitted for any degree or examination at any other university.

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Date: 23 November 2020

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DEDICATION

This thesis is dedicated to Dr SH O'Donoghue, Miss OD O'Donoghue and Mr. RD O'Donoghue.

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LIST OF ACRONYMS AND ABBREVIATIONS

4IR	Fourth Industrial Revolution
3G	Third generation
AI	Artificial Intelligence
ADSL	Asymmetric Digital Subscriber Line
ANT	Actor Network Theory
app	Applications
BPO	Business Process Outsourcing
CAPS	Cape Area Panel Study
CLIQ	Community-based Learning, Information and communication technologies and Quality-of-life
COICOP	Classification of Individual Consumption according to purpose
CD	Compact Disc
CPI	Consumer Price Index
CS	Community Survey
CV	Curriculum Vitae
CWP	Community Works Programme
DFID	United Kingdom's Department for International Development
DoC	Department of Communications
DPSA	Department of Public Service and Administration
DSTV	Digital Satellite Television
dti	Department of trade and industry
DTPS	Department of Telecommunication and Postal Services
DVD	Digital Versatile Disc
e-SI	Electronic Skills Institute
eSLF	Enhanced Sustainable livelihoods Framework
e-skills	Electronic skills
GDP	Gross Domestic Product
GDPR	General Data Protection Regulation
GHS	General Household Survey

GIS	Geographic Information Systems
GNP	Gross National Product
GSM	Global System for Mobile Communications
HDI	Human Development Index
HDR	Human Development Report
hh	Household
Hi-fi	High fidelity
IAI	Information Communication & Technology Access Index
ICASA	Independent Communications Authority of South Africa
ICT	Information and Communication Technologies
ICTD	Information & Communication Technology for Development
IDI	ICT Development Index
IDRC	Canada's International Development Research Centre
IES	Income and Expenditure Survey
ILO	International Labour Office
infodev	Information for Development Programme (World Bank)
ITU	International Telecommunications Union
km	kilometres
KIDS	KwaZulu-Natal Income Dynamics Survey
LAN	Local access network
LCS	Living Conditions Survey
Mbps	Megabytes per second
MDGs	Millennium Development Goals
MOOCs	Massive Open Online Courses
MP3	Motion Picture 3
M-PESA	M for mobile, pesa is Swahili for money
MPI	Multidimensional Poverty Index
MSR	Men on the Side of the Road
NEETS	No Employment, Education or Training
NeSPA	National electronic-Skills Plan of Action

NGO	Non-Governmental Organisation
NIDS	National Income Dynamics Survey
NPC	National Planning Commission
NDP	National Development Plan
OECD	Organisation for Economic Co-operation and Development
OLPC	One Laptop Per Child
OLS	Ordinary Least Squares
OPHI	Oxford Poverty & Human Development Initiative
PCA	Principal Components Analysis
PICTURE Africa	Poverty and Information and Communication Technologies in Urban and Rural East Africa
PPP	Purchasing Power Parity
R	Rands
SALDRU	Southern Africa Labour and Development Research Unit
SAP	Structural Adjustment Programme
SASSA	South African Social Security Agency
SDG	Sustainable Development Goals
SEACOM	Subsea cable system in Africa
SIM	Subscriber identification module
SIP	Strategic Integrated Project
SLF	Sustainable Livelihoods Framework
SMS	Short Message Service
Stata	Statistics Data package
Stats SA	Statistics South Africa
TPDS	Targeted Public Distribution System
UEPS	Universal Electronic Payment System
UIF	Unemployment Insurance Fund
UK	United Kingdom
UKZN	University of KwaZulu-Natal
UNDP	United Nations Development Programme
USAASA	Universal Services and Access Agency of South Africa

USAF	Universal Service and Access Fund
USB	Universal serial bus
USD	United States Dollar
UWC	University of the Western Cape
W1	Wave One
W2	Wave Two
WFP	World Food Programme
WiFi	Wireless fidelity
WSIS	World Summit on the Information Society

1 CHAPTER ONE: INTRODUCTION

"The narrative around technology and poverty eradication is still unfolding," Aleem Walji, Innovations Practice Manager, The World Bank Institute (22 June 2011, London, Activate 2011)

1.1 Introduction

Information and communication technology (ICT) devices have emerged as prolific tools for human development. Both peer reviewed and popular literature strongly suggest that these devices have been enablers for everyday life, even reaching into poor communities. The International Telecommunications Union (ITU) is the global authority on information and communication technologies. In 2018, its supply side statistics stated that there are approximately 7,74 billion mobile telephone subscribers in the world, matching one subscription per person in the global population (at 103,5 percent penetration) (International Telecommunications Union, 2018). This widespread technological reach is also found in low and middle-income countries with mobile-cellular penetration rates reaching 98,7 percent[1] of the population (International Telecommunications Union, 2018). Within international literature, recent research has identified ICTs as tools used by the poor in low and middle-income countries (Elder *et al.*, 2013; Heeks, 2014). Yet this topic is important and needs in-depth investigation because of the limited theoretical and applied analysis that reveals the group of ICT assets owned by the poor as well as whether ICTs contribute towards poverty reduction. The ability for the most marginalised to adopt ICTs within changing everyday environments may suggest mobile technology can have significant impacts on economic and social development. As a middle income country, the potential contribution of ICT is considerable in South Africa.

[1] One must note that it may not necessarily mean that every person now has a mobile phone SIM card; some individuals may have multiple SIM cards used for multiple purposes and this is also included in the calculation of subscriptions.

1.2 Background for the Study

This study is motivated by several factors. Firstly, South Africa's National Development Plan (NDP) has stated that its 2030 vision is to eliminate poverty, decreasing from the 39 percent poverty level in 2010 to zero poverty by 2030 (National Planning Commission, 2011). The NDP has further promised the reduction of income inequality within the country (National Planning Commission, 2011). These visionary goals are further supported by a multiplicity of national milestones including the improvement of job skills, higher quality of education, affordable health care, clean running water, and broadening asset ownership for the most disadvantaged. The country holds sufficient data to understand and measure many of these abovementioned issues using its development indicators. In regards to communication technologies, the NDP policy has further suggested that the country can mitigate the global digital divide and has provided recommendations for digital inclusion of the nation's entire population. The digital inclusion of South Africans requires a cross-cutting approach to meet some of development milestones discussed above as well as help expand the ICT base of especially low-income households. A country like South Africa could expect broader socio-economic benefits when ICTs become the complementary function of societal participation of its citizens.

Globally, Gomez's (2013a) overview finds a paucity of data in information and communication for development (ICTD) studies that provide evidence of research at a country representative level. Rather, most studies reviewed between 2000 and 2010 examined in-depth experience, at community or organisational levels within a particular country, focusing much less so on national level data. Thus, the absence of systematic information on ICTs and South Africa, particularly amongst low-income households is a research gap (Anwar, 2019). Yet, contemporary asset ownership such as ICTs is part of the daily realities of South African life. Thus, there is a need to investigate household ICT ownership at the national level and review its distribution amongst the population. Specifically, research can address the gap of how ICT ownership contributes in reaching the country's NDP milestones, particularly in regards to the broadened asset base for the poor. In a period of the advancement of information and communication technologies, the research around digital non-financial assets may be beneficial in the expansion of knowledge within the ICTD and development studies fields. It would also be beneficial to better understand ICTs as a household asset at the country level which can, in this case, be used as evidence towards the South African policy strategy of digital inclusion and ultimately poverty reduction.

South Africa embraces ICT adoption, moving from 31,9 percent of households owning mobile cellular phones in 2001 to 88,9 percent by 2011 to 93,8 percent in 2016 (Statistics South Africa, 2012a;2016). In 2013, low-cost basic phones were available, including affordable models such as the Nokia 100 handset at the South African price of R150 (or just over $10 USD) (Goldstuck, 2013). Such affordable handsets may have some contribution to the high mobile phone adoption rate amongst the population. Less enthusiasm can be shared for computer adoption with only 21,4 percent household ownership in 2011 and a slight increase to 24,5 percent in 2016 (Statistics South Africa, 2012b;2016). However, more recently, computer ownership level has begun to increase as new devices such as low-cost tablets and smartphones are making individual ownership possible. Even at a lower price, these new digital handheld devices can hold similar functionalities as desktop computers. Consumers also demand complementary mobile or wireless broadband data services for their devices and such requests pressure local service providers to provide diversified options for internet access.

In South Africa, the increase in diversity of ICT devices and services in the market are a reflection of current consumer needs, which were not imaginable approximately ten years ago. This array of ICTs in South Africa contributes to an expanded household portfolio of goods; yet, there is little understanding about this distinctive composition of ICTs now owned and held by households in the country. This unknown information leaves open the question of what characteristics broadly make up the digital society. To better understand this phenomenon, a starting point for examination is understanding ICT ownership at the household level.

Moreover, the ICTs described above can also be seen as must-have possessions even for the low-income user. What is also not well understood is the ICT ownership of the poor in South Africa. Amongst individuals who live below the national poverty line, on less than R432 per month[2], mobile ownership in South Africa is at a relatively high level of 74,8 percent (Gillwald *et al.*, 2012). Yet besides a few mobile phone and internet statistics, there is little known about what other ICTs are combined and included to make up a poor household's digital portfolio. This research gap is an opportunity for this thesis to accurately capture and articulate the possible value of ICTs held by South African households, including the most vulnerable, in contemporary society.

Besides the little known information about the ICT portfolio of the poor, there is less known as to whether ICT assets contribute towards life improvement or poverty reduction, especially in the context of the global South. ICTs have been shown to help people reach their chosen path in life, facilitating the work or activities they do to better their daily lives (Kleine, 2013). Another argument reveals that ICTs merely amplify existing ways of doing things (May *et al.*, 2014b; Toyama, 2011). The theories have helped to explore the way ICTs can change the life of individuals, however, there is a paucity of research that empirically show the relationship of household ICTs and poverty reduction at a national level. Through the use of representative South African datasets, this thesis hopes to fill this information gap.

1.3 The Problem

Poverty reduction remains a priority development issue in South Africa since its prioritisation in the 1994 Reconstruction and Development Plan (RDP). This development imperative however comes at a time of explosive growth in technological access and use. Yet, there is a paucity of research investigating whether South Africans own and use communication technologies to further advance their own development. Within this national context, the overall challenge is to understand the balancing act of maintaining a household's 'asset portfolio', a pertinent condition to reduce poverty. Within the sustainable livelihoods approach, an asset portfolio essentially aggregates the personal possessions held by an individual or household (DFID, 1999). The approach acknowledges how these possessions are integral for households to generate a living or maintain their

[2] R432 per month is the lower bound poverty line at 2012 prices adopted by this Research ICT Africa study, emulates the use of South Africa's National Development Plan.

everyday lives. This thesis suggests that a 21st century asset portfolio requires a re-think. In particular, building upon the current understanding, I argue that we must understand the characteristics of low income households that now own personal ICT devices, how these objects are combined, and whether such ownership of ICTs contributes to positive change in the lives of the poor.

1.4 Aim of the Study

I investigate this phenomenon of what ICTs are in possession by low income households in South Africa in 2010 and in 2015 as a way to recognise the need of research in this important topic of the contemporary asset portfolio. To address the lacuna of knowledge concerning the composition of the ICT portfolio held amongst this particular population, I make use of national household data to present the case of ICTs. The national trend or understanding of ICT assets, particularly amongst low income households, is a research gap and as the first part of this study, it would be an appropriate entry point to better understanding the ICT portfolio.

The poor of South Africa make crucial decisions about their use of resources and their asset accumulation in light of new communication technologies. In doing so, some cases see income diverted to ICTs and away from spending on essential items such as food, education or health services (Duncan, 2013; Rey-Moreno *et al.*, 2016). Other cases highlight the use of ICTs to gain further wealth and opportunity. Thus, this study examines the broader ICT for human development research field in the South African country context. With the data available, there has been some nationwide data analysis of some ICT ownership (such as individual ownership of mobile phones or computers) amongst households, however there is a broader absence of theoretical and applied multivariate analysis completed around a group of ICT assets in relation to poverty reduction. To address this gap, I empirically explore whether a group of ICT assets contributes to either the improvement or further deprivation of South Africa's low income population. Through these further observations of ICT ownership and using the sustainable livelihoods framework (SLF), this thesis examines the nexus between ICT household assets and poverty reduction in South Africa.

1.5 Objectives and Research Questions

The study critically unpacks the concept of ICTs as assets within a household, particularly its composition within low income households of South Africa and its relationship to poverty reduction. In order to do so, I suggest the theoretical development of a concept that I refer to as the 'digital basket'. This concept can be defined as a configuration of different household ICTs and ICT capabilities, and is used to comprehend the new dynamic of ICTs within a household's portfolio of assets. I argue that contemporary households are digitising their asset ownership and an exploration of this change can challenge some of the conventional notions of poverty. Specifically, the digital basket uses and builds on Warschauer's (2003) taxonomy, reviewing the inclusion of ICTs that are both tangible (such as physical capital) and intangible (such as digital content). ICTs also require specific abilities (or human capital) for effective use, and integrate networking amongst humans (or social capital). Scoones (1998), Bebbington (1999), Moser (1998) and others have utilised the economic metaphor of 'capital' to best describe assets or the livelihood resources (defined as a bundle of similar tangible and intangible assets) that people possess. Drawing on this work, the suggested capital dimension of the 'digital basket' would consist of a dynamic group of ICTs, including goods, services, skills and social interactions. Using the objectives and research questions below, this research explores the digital basket concept in-depth and its possible contribution towards poverty reduction in South Africa.

1.5.1 Objectives

The overarching objective of this thesis is to examine the association between ICTs and poverty reduction in South Africa, using economic wealth as proxied by household expenditure. In the five-year period of 2010 to 2015, the research objectives that were examined in this thesis include:

a) to critically unpack the concept of ICT household assets;

b) to suggest an updated taxonomy of ICTs under the notion of a 'digital basket';

c) to analyse this digital basket within its internal and external context through the sustainable livelihoods framework; and

d) to apply this associational notion of ICTs to poverty reduction in South Africa.

1.5.2 Research Questions

Based on the research objectives above, this thesis' overarching central question is as follows: Is there an association between ICTs and poverty reduction? This central question will be answered via the following four research questions:

1) Can ICTs be theoretically constituted assets?
2) What group or sub-groups of ICT devices, services and skills can be identified at a household level that constitute a 'capital', in this case, the 'digital basket'?
3) Using the sustainable livelihoods framework, how does the digital basket fit within internal and external factors of South African digital society?
4) What are the levels of ICTs and poverty reduction in South Africa? What is the relationship between ICTs and poverty reduction in South Africa?

These research objectives and questions are achieved in several steps. Firstly, an overall literature review of ICTs is presented both on global and South African academic sources in order to derive the theory and gaps around ICTs within the assets approach. Secondly, I interrogate the notational concept of ICTs at a household level and suggest a taxonomy or sub-groupings of selected ICTs. This taxonomy is the composition of household ICT together to become a 'digital basket'. Through the addition of the digital basket, one of my objectives is to theoretically augment the current household asset portfolio within the sustainable livelihoods framework. The third step is to apply the SLF and examine the internal and external factors which may influence the relationship between ICT and poverty reduction. Persistently high food prices, poverty, inequality, and unemployment within the country are, for example, external conditions that affect the discretionary spending on communication by the poor. Finally, the last step is to apply the new digital basket concept to poverty through an empirical descriptive and multivariate analysis using South African nationally representative data.

Introducing a new concept such as the digital basket, as proposed in this thesis, will no doubt need to undergo critique and debate. This was found during the early stages of conceptualisation of the term, social capital. However, I suggest that such debate is necessary for the development of any concept, and today, social capital is a largely acceptable term within development studies and within the sustainable livelihoods framework. Rather than be a limitation to the thesis, the identification and scrutiny of a new wealth indicator such as the digital basket contributes to current debates concerning the reduction of poverty by improving access to, and use of a household's underlying assets.

1.6 A Conceptual Framework for ICTs and Poverty Reduction

Demonstrating the role of ICT for poverty reduction requires that theories of poverty dynamics be revisited. While Toyama (2011) has argued that ICTs may be no more that amplifiers of existing dynamics, others have proposed that ICT may reconfigure or reshape these dynamics into new forms (Barja & Gigler, 2007; Barrantes, 2007). These few theoretical differences are of concern since the field of information & communication technologies and poverty continues to rely upon only a handful of theoretical frameworks (Heeks, 2006). Understanding the conceptual underpinnings of poverty and the derivation of work around assets could be useful in expanding development studies theory, and more specifically in conceptualising household level ICTs within the poverty literature.

This thesis suggests that ICTs can be conceptualised at the micro-level and that the development outcome can be the widening of the asset base of a household in order to smooth out shocks and unexpected events. For instance, this ability to increase the number of assets as an input dimension to a household can help towards activity diversity for one's livelihood and thereby mitigate insecurity (Carter & Barrett, 2006; Moser, 1998). It is through this idea of household asset expansion that I explore the ICT contribution to poverty reduction. This study argues for further understanding of ICTs as a group of household assets that can provide a new measure, or a non-financial capital indicator that contributes to poverty reduction. Little research has conceptualised ICTs as a capital indicator on its own and around its relationship to poverty alleviation (May *et al.*, 2014b).

The assets approach has influenced the recognition of non-financial assets for measuring well-being which looks beyond the measures of income and consumption (Moser, 1998). Poverty reduction occurs when the poor can respond to vulnerable situations or are resilient through the recovery from possible negative shocks in their lives. An important part to recovery is the use of available assets held by the household or individual to take appropriate action for their well-being (Moser, 1998). “The more assets people have, the less vulnerable they are, and the greater the erosion of people’s assets, the greater their insecurity” (Moser, 1998: p. 3). Human well-being can be explained by how these existing assets work together to support a person’s capability to take action. Through a diversity of assets, people can have numerous options to use such resources for work or for income generation. The end result is an accumulation of action points that are possible by a person and the ultimate intention is for the same person to move closer towards the freedom that he or she desires (Sen, 1999).

The assets approach has been operationalised into the sustainable livelihoods framework and within this, there are five key capitals which are conventionally identified: economic or financial capital, human capital, physical capital, natural capital, and social capital (Carney, 1999)[3]. In this existing approach, ICTs can be classified as a single artefact or an ability by a household member that can be placed within one of the five existing key capitals. For example, ICT products such as the ownership of mobile phones and computers could be assets classified under physical capital alongside other tangible assets such as a bicycle or a refrigerator. In other words, the bundle of assets now identified as ‘physical capital’ would include these ICT devices.

However, when advancing the thinking of contemporary assets, there is a classification limitation of the five key capital for non-physical assets such as software, social networks and digital literacy. These ICT intangibles work synergistically with physical ICTs, and blur lines of distinction due to its multiple

[3] In the development of the SLF, physical capital is also added to the framework.

interrelated functions. This ICT tangible and intangible integration can be problematic when trying to appropriately fit within one of the key capitals. The rapid penetration and uptake of mobile phones and the internet not only see convergence of devices, but also see an abundant diversity of ICT products and services. Under such rationale, ICTs can be viewed conceptually as its own capital, bringing in a new addition within the sustainable livelihood framework's concepts of capital (May, 2008). This thesis thereby proposes an alternative viewpoint to the SLF, which is that a distinct digital basket or a sixth capital could augment the five conventional capitals. This thesis argues that such an addition reflects a more accurate reality of human well-being in today's contemporary society.

The digital basket can be identified as the range of tangible and intangible assets, using various attributes of ICT as used in ICTD research, and including the following: physical products (e.g. radio, television, video recorders, computer, mobile phone, SIM cards, landline), connectivity (internet connection – both mobile or fixed), services (e.g. email and mobile applications), human digital skills, and social systems. The Warschauer's (2003) taxonomy is used in this thesis, providing a useful categorisation of ICTs. It shows how social inclusion, through ICTs, goes beyond the provision of physical products, like computers, and instead occurs through a group of assets that could produce proficient ICT users. These technology-associated resources are combined into a digital basket and essentially lead an individual to improved social inclusion. The term 'basket' has been derived from poverty terminology, specifically the 'reference food basket' provides a representative group of food items commonly consumed by a household (Statistics South Africa, 2018b). Ultimately, a final selection of food items is contextually chosen for the food basket, a minimum amount of calories is counted and its respective food price are determined. As the reference food basket is limited to food consumption, the digital basket expands the exploration of essential non-food items held by a typical household.

1.7 Research Methods

To investigate the potential relationship between ICT ownership and poverty reduction in South Africa, this thesis uses an empirical research design, drawing on quantitative methods to prepare an applied case of the digital basket and its association to poverty reduction. This investigation is explored within the sustainable livelihoods framework, focusing specifically on the context of low income households in South Africa. A descriptive and econometric analysis of survey data from Statistics South Africa's 2010/11 Income and Expenditure Survey (IES 2010) and Living Condition Survey of 2014/15 (LCS 2015) are used to provide the applied research study.

The study first describes the available household data in regards to ICT access, ownership and usage within South Africa, drawing on previous research reports and analyse of these reports over the time period. The thesis then goes further to identify the possible indicators that can provide data on ICTs at the household level. The study then provides the composition of a 'digital basket' using the available data and analyses what forms of digital baskets are held by households in South Africa. Both the IES 2010 and LCS 2015 are the data used to apply the concept of the digital basket as well as analyse ICTs in relation to opportunities to poverty reduction. Data analysis is completed using the Stata statistical package in order to understand the descriptive analysis. In its application, the ICT data combines the ICTs to form an index for the 'digital basket'.

This digital basket measure is assessed amongst households between 2010 and 2015. The study covers various demographic segments of South African households that have ICTs and those who do not It describes various social and economic characteristics of individuals, including those who are above and below the upper bound poverty line. In assessing the relationship between ICTs and poverty in South Africa, the study conducts a multivariate analysis using ordinary least squares (OLS) regressions to model the estimations. The OLS analysis is used to determine whether there is an association between the digital basket and the reduction of poverty. The OLS allow for estimates for unknown parameters in a linear regression model, specifically finding where a minimal number of differences can be seen between the Statistics South Africa collected data to a predicted line. The independent variable (or the derived continuous variable using the number of ICTs in a households) is used for ICTs. The dependent variable is a continuous variable and is the natural logarithm of household monthly expenditure. For the study, I control for several dimensions including demographic information, locality and some basic welfare indicators, such as electricity.

1.8 Thesis Structure

The thesis is structured as follows: this first chapter has provided a brief overview of the overall thesis. Chapter two provides literature on ICT, focusing specifically on its relationship to poverty. Chapter three discusses previous approaches to the study of poverty as well as some of the conceptual underpinnings around assets and the connection to ICTs. Chapter four develops and justifies this thesis' theoretical framework by highlighting the SLF adaptation, specifically the augmented components of the digital basket. This section discusses the unique conceptual contribution of the digital basket and its role in broadening the asset base of the poor. Chapter five details this study's methodology, describing the use of quantitative methods to explain the changes of ICT and poverty reduction in South Africa. Chapter six presents the research findings on individual ICTs in South Africa, mainly detailing the quantitative descriptive results derived from the available data and literature (e.g. research and Stats SA reports). Chapter seven provides the descriptive and multivariate findings around empirically applying the digital basket, mainly through descriptive statistics against socio-economic variables such as demographic, locality and other welfare dimensions. In testing the regression models, the section finally provide an empirical response to the central question, whether there is an association between ICTs and poverty reduction. The thesis concludes with Chapter eight.

1.9 Conclusion

This thesis extends current understandings of the relationship between ICT ownership and poverty reduction in the global South. Specifically, the thesis seeks to unpack the central question, what is the association of ICTs to poverty reduction. This thesis explores theoretically the broadening of the current asset base and its opportunities to influence poverty reduction. The digital basket is introduced, a newly proposed capital that augments the five conventional capitals within the sustainable livelihoods framework. The 'digital basket,' is presented as the portfolio of ICT products, services, applications digital skills and social networks. Using this rethinking of ICTs, this study applies empirical analysis on the digital basket and poverty aspects by regression analysis, using South Africa's nationally representative surveys. The SLF becomes a guide to providing a holistic and nuanced overview of ICTs and its possible contribution to reduce structural poverty and improve human well-being in contemporary South Africa.

2 CHAPTER TWO: ICT, ECONOMIC DEVELOPMENT AND POVERTY REDUCTION

"Today, 30 years on from my original proposal for an information management system, half the world is online. It's a moment to celebrate how far we've come, but also an opportunity to reflect on how far we have yet to go".

Sir Tim Berners-Lee (2019)

2.1 Introduction

In 2019, the world celebrated that the first net message was sent 50 years ago, the World Wide Web marked its 30^{th} anniversary, and that many societies in the world have undergone fundamental behavioural shifts as a result of information and communication technologies (ICTs) (Berners-Lee, 2019; Buderi, 2019). Even among the 10,7 percent of the world's population who live below the extreme poverty line (that is, on less than $1,90 PPP per capita per day in 2013) (World Bank, 2016), there are many with low income who today own and use mobile phones (Elder *et al.*, 2013).

The lower cost and greater accessibility of ICTs such as the mobile phone has seen ownership grow amongst marginalised communities. As a result, some studies in the ICTD field now cover some of the behavioural everyday changes of the poor as a result of ICT asset ownership. Yet, there remains a paucity of evidence which can help answer the main thesis question, is there an association between ICTs and poverty reduction? The purpose of this chapter is to present a review of research examining the relationships between ICTs, economic growth, and poverty reduction. Specifically knowledge gaps on the relationships and impact of ICTs on poverty are identified. However first ICT must be defined at the household level, trends in ICTs described and what is known around ICT and poverty must be explained.

2.2 Information and Communication Technologies

ICTs owned at the household level are highly diversified from personal digital devices to online products. ICTs can be defined as individually-owned items, both of newer technologies (such as mobile telephone and computer) and more traditionally analog device and media (such as radio and television), which are evolving and thus making uncertain the distinction between new and traditional (Batchelor *et al.*, 2005). As products develop, converge and mature due to adoption, these technological innovations can become affordable and available to a larger number within a population.

Convergence or "the eroding of boundaries among previously separate ICT services, networks and business practices" is the evolution of ICTs with different types of communication functions now being accessed through one or two devices (Singh & Raja, 2010, p. 1). For example, certain models of mobile phone could income or even become a radio, television and camera due to the services embedded within the one device. As platforms see value in integrating innovative ways of interactions with digital content, convergence is alternatively viewed as a "re-organisation of the economic structures and social practices for the provision and consumption of a broad range of communication and information services enabled by technological advances that lead to the digitization of data…" (Allen, 2017, p. 184).

The convergence of ICTs is not only through digital devices (such as a tablet that is both a computer and telephone), but also with other household necessities and goods. For example, a mobile phone charger has been created to attach to a portable home cooking stove and is powered by thermoelectricity (Biolite energy, nd). Another example of this type of convergence is a solar panel designed to charge mobile phones as well as provide basic lighting within informal settlements (iShack Project, nd). There is also the example of smart home devices where microchips are embedded within home appliances as sensors and machine learning can customise efficient use of, for example, a refrigerator or entertainment system (Skouby & Lynggaard, 2014). All of the above instances illustrate that ICTs are ever evolving and growing in their diversity to meet society's changing needs and wants.

2.3 ICT Trends

In 2018, the International Telecommunications Union (ITU) reported that there were approximately 8,16 billion mobile cellular telephone subscribers in the world, representing just over one subscription per person[4] (International Telecommunications Union, 2018). This widespread technological reach is also found in low and middle-income countries, with mobile-cellular penetration rates reaching 72,4 per 100 inhabitants (International Telecommunications Union, 2018). Interestingly though, internet use is not as prolific, with just under 50% or 3,9 billion of the global population characterised as individual internet users, and a paltry 19,5% internet use penetration rate (amongst individuals) in less developed countries (International Telecommunications Union, 2018). As the following section illustrated, four key technological trends reveal that a) countries with higher development scores generally align with higher ICT country scores such as ICT specific subscription rates, ownership and usage, b) high costs of ICT expenditures keep many low and middle income countries from meeting the affordability threshold, c) there is a gender digital divide between men and women ICT access, and d) from the limited household data available, there remains an ICT access gap between the poor and non-poor. ITU data on ICT access and ownership, as well as costs for internet access, can provide further insight into these global differences with regards to internet access and penetration in the global South.

2.3.1 Global Rankings on ICT Access and Ownership

Singular ICT products and development measures can be combined into an index to provide a broader understanding of the availability of ICTs, including amongst selected countries in the global South. For example, the ITU have monitored an ICT Development Index (IDI) since 2010 to review ICT developments across countries and over time through cross-sectional data. As this thesis is based around the period from 2005 to 2015, the global datasets are observed at the 2015 timeframe. Some of these ICT indicators are shown in Table 1 below, in which African countries classified as 'low to medium human development countries' using the human development index (HDI) are compared. For the comparisons of HDI, two countries, Peru and Indonesia, with similar Gross Domestic Product (GDP) to South Africa, are also included to illustrate how they fare compared to their South Africa.

[4] One must note that it may not necessarily mean that every person now has a mobile phone SIM card; some individuals may have multiple SIM cards used for multiple purposes and this is also included in the calculation of subscriptions.

Table 1: ICT Access Indicators for Selected Countries, 2015

Country (HDI rank - 2015)	(IDI rank - 2015)	Fixed-telephone subscription per 100 inhabitants	Mobile-cellular subscriptions per 100 inhabitants	International internet bandwidth per internet user (Bit/s)	Households with computers (%)	Households with internet access (%)
South Africa (119)	86	7,7	159,3	147,630	23,4	50,6
Kenya (146)	129	0,2	80,7	40,067	13,1	19,6
Zambia (139)	148	0,7	74,5	3,187	7,4	12,7
Nigeria (152)	137	0,1	82,2	2,986	9,8	11,4
Peru (87)	100	9,3	109,9	43,154	32,4	23,2
Indonesia (113)	115	8,8	132,3	6,584	18,7	38,4

Source: International Telecommunication Union, 2016; United Nations Development Programme, 2016a

As shown in Table 1, South Africa ranked 86 of the 175 countries in the IDI 2015 with regards to ICT overall performance (International Telecommunications Union, 2016). The South African score (4,70) is below the 2015 global average of 4,74, while significantly above the African regional average of 2,30. In the Africa region, South Africa is one of three top IDI-ranked countries (alongside the two smaller island states of Mauritius and Seychelles).

In closer examination of the sub-index categories of access, use, and skills, South Africa had its greatest value and rank increase in the ICT use sub-index, which moved up from 1,26 in 2010 to 3,91 in 2015 (International Telecommunications Union, 2012;2016) For mainland sub-Saharan Africa, South Africa's household internet access, mobile subscription, and computer ownership has surpassed its African neighbours' numbers, including with over half of its household population having internet access (International Telecommunications Union, 2016).

The Africa regional dataset illustrates that South Africa is prominent in ICT household demand. The table also reveals that HDI ranks of the African countries seem to align with the sequence of the country's IDI rank. The three African countries (Kenya, Zambia and Nigeria) may have low HDI and IDI; yet, over 50% of their inhabitants now have mobile phone subscriptions. The table reveals the African regional disparity of ICT use as seen by its low IDI use index score. 'Low' human development countries are experiencing dramatically lower observations of computer ownership and internet access usage (International Telecommunications Union, 2016; United Nations Development Programme, 2016a). Differences appear to reside with South Africa's international bandwidth being comparatively low, a lower rate of household computer ownership in Indonesia, and Peru's household internet access being lower than the other two countries. Gaining an in-depth understanding of these ICT and development indicators from the ITU can provide potential insights into the reasons for limited internet penetration in the global South.

With regard to access, another modality to make sense of the lower internet adoption rate in the global South has been internet affordability due to the relatively high costs of broadband connectivity (Alliance for Affordable Internet, 2018; International Telecommunication Union, 2018a). Internet affordability has been defined by the latest 2025 Broadband Commission target as a threshold of 1 gigabyte or 1GB of data being priced at less than 2% of monthly gross national income (GNI) per capita (International Telecommunication Union & United Nations Educational, 2019). Using this particular affordability target and ITU data on selected 180 countries, the 2019 Broadband Commission report found that approximately 90 countries in 2017 have met this goal while another 90 countries have fallen short of this target (International Telecommunication Union & United Nations Educational, 2019). In a 2018 research report that reviewed internet affordability of 99 countries, it is found that 1GB of mobile broadband data costs, on average, 5,8% of an individual's monthly GNI per capita (Alliance for Affordable Internet, 2018).

As for the cost, in a pre-determined Purchasing Price Parity equivalent (PPP$) by the ITU, the cost for mobile broadband (one gigabyte or 1GB) in Africa would average around $17,90 PPP. The same amount of broadband would only cost $11,40 PPP in Asia. A GSMA study found that for the poorest quintile of the total population, the cost of 1GB of data far exceeds the 2% monthly GNI threshold (GSMA, 2019b). For example, in Africa, for 1 GB of data, the lowest quintile of the population would use nearly 40% of their monthly income for this internet service (GSMA, 2019b). These high proportions of broadband cost in relation to income suggest unaffordable internet services for many people, particularly those individuals located in low to middle income countries. These global indicators show that disparity with regard to ICT affordability remains across regions and income groups globally.

While the global IDI is useful in cross-country comparisons, it has limitations. Firstly, before 2007, there was a paucity of reliable information on ICT access and usage in low and middle-income countries including around available datasets in Africa and amongst target populations like the poor (James & Versteeg, 2007). Further, the chosen indicators only provide information on a few types of ICTs—mainly mobile phone, fixed line phone, computer, and internet connection—when countries can collect and are likely collecting data on a vast inventory of ICTs now available at the household level. When looking in-depth at each sub-index, the ICT access sub-index appears appropriate when using subscription rates, computer access and internet access as indicators. This sub-index addresses the critique of previous ICT measures that were only based on the 'count' of ICT equipment.

Today, the access sub-index now includes one indicator around information processing capacity, namely the international internet bandwidth (bits/sec) per internet user (International Telecommunications Union, 2016). For ICT use, the indicator of individual internet use remains appropriate, but the other two indicators—subscriptions to fixed broadband and active mobile broadband—assumes ICT use by default if there is fixed broadband to the home or if the stated 'active' mobile broadband is sufficient. These indicators may also fit under the ICT access sub-index. Finally, the indicators for ICT skills appear inadequate since there are no established cross country comparison questions around ICT competences amongst individuals. Rather, the current index is limited to using non-ICT measures—mainly adult literacy, high school, and tertiary school enrolment figures. While the current indicators can provide some cross-country trends regarding ICT access, the latest IDI indicators are constrained by limited statistical information on ICT use and ICT skills.

Despite these indicator limitations, ITU serves its purpose in providing some meta-level data which can be compared across countries, specifically highlighting disparities between global North and global South around ICT access, ownership and affordability. Yet, the ITU reports have not consistently asked the member states to provide further disaggregation of the data; thus, there is less information and analysis on the digital disparities within a country. Specifically, as will be discussed in the following sections of this chapter, country level research (beyond the ITU reports) is beginning to be conducted to help fill this data gap in order to better understand in-depth country inequalities, such as gender differences in access. Findings from such studies can further enhance the meta-level understandings provided by currently existing ITU data and reports.

2.3.2 ICT and Gender

Gender is one entry point that can be used to understand differences in access and usage of ICTs, and limited sex-disaggregated data is now available to estimate national and global level change (Junio, 2019). In national data sets, countries can measure the proportion of individuals using ICTs, specifically around internet use and mobile phone ownership, as well as the differences of individual ownership between men and women. The ITU has reported that there are 250 million less women online than men, with this gender difference being higher in the global South (International Telecommunications Union, 2017). However, the gender gaps within countries reveal some nuances, with some countries being close to parity, and others having a wide and persistent gap (Sey & Hafkin, 2019). Further analysis of the ITU World Telecommunication/ ICT Indicators database of 2017 has illustrated that amongst 78 economies reviewed, some countries have more women using computers more than men (e.g. Saudi Arabia and Cuba at the top); whereas, some countries, like South Korea and Turkey, have far more men than women using computers (Junio, 2019). In all regions except the Americas, more men than women use the internet (Junio, 2019). As for mobile internet, the 2018 GSMA data was analysed, showing regional disparities on usage. For example, South Asia reflected the highest gender gap with 70% more men using this ICT modality than women – the largest gap than any other region in the world (Junio, 2019).

In terms of mobile phone ownership, an examination of 23 global South countries found 19 of them had a gender gap (e.g. the extent to which there is a greater proportion of men with mobile phone ownership than of women); two countries with gender parity; and two countries in which more women owned mobile phones than men (LIRNEasia, 2019). Besides two Latin American countries, 21 of the countries reported a gender gap with regard to internet use and social media use (LIRNEasia, 2019). In a close look at household data from Africa, the gender gap around both mobile phone and smartphone ownership was more pronounced in urban areas rather than rural areas; yet, women in urban areas were also more exposed to and used ICTs more than women in rural regions (Deen-Swarray & Gillwald, 2018). Overall, the gender research on ICTs show overall clear divides on internet use and mobile phone ownership, however there is less known for other ICTs as well as research beyond the gender binary of men and women.

2.3.3 ICTs and the Poor

Few ITU statistics and other global sources also do not provide consistent disaggregated data that have differentiated between low-income and wealthy households or individuals at a country level for comparison. Outside the ITU, some researchers have resolved this socio-economic data gap through ongoing data collection from the demand side on ICT access and usage at a country representative level, including through the following works: (Agüero *et al.*, 2011; Barrantes, 2007b; de Silva & Zainudeen, 2008; Galperin & Mariscal, 2007b; Gillwald & Stork, 2008; LIRNEasia, 2019; May, 2012c).

In a majority of ICTD studies, ICT access and ownership indicators can be found at the national level, but amongst them, only a handful of studies have measured ICTs access, use, and ownership amongst the poor (May & Diga, 2015). This link has been approached in a variety of conceptual categories. In each of these concepts, ICTs are theoretically aligned to a broader and more holistic undertaking, some seeing ICTs as a mechanism to expand the choices and freedoms of people which can thereby allow action towards the improvement of well-being (Kleine, 2013). Ghatak (2015) suggested that three broad categories distinguish poverty reduction and ICT policies: 1) improving the poor's access to markets (economic-related); 2) improving the poor's access to public services and infrastructure (social services); and 3) redistributing social welfare. Aker and Mbiti (2010) described five economic benefits of ICTs: increased access to information; improved production processes; developed job opportunities; developed social networks; and facilitated service delivery. Gomez (2013a) found dominant research themes of enterprise and empowerment within the ICT literature.

Within ICTD studies, the poverty measures for a minimum standard of living have been wide-ranging, including the use of income to measure the absolute poverty line ($1,25 or $1,90 PPP USD per capita per day) and relative poverty lines (a chosen expenditure threshold per capita or percentage) or nationally determined poverty data in the case of South Africa (Barrantes, 2007a; infodev, 2012b; May, 2012c). Some studies have used the proportion of a population to measure income deprivation; for example, those found in the lower 25% income bracket of the population are identified as 'poor' (Gillwald & Stork, 2008). Some studies popularly have used the term, 'bottom or base of the pyramid' to also determine a certain proportion of the population as 'poor' (de Silva & Zainudeen, 2007; infodev, 2012a;2012b) Aside from financial indicators, non-financial indicators for deprivation have been explored through the lens of human, physical, social, and ICT assets (May, 2012c).

2.3.4 ICT Access in Poor Communities

Access indicators are utilised for understanding digital inclusion, and in some cases, are the basis for gathering government support for ICT infrastructure in poorly resourced communities as well as unlocking the use of universal access funding opportunities. From a supply-side perspective, access may be defined as geographical, understanding whether mobile or internet network services are covering particular resource-poor regions and communities. Due to a lack of transparency, there remain data gaps as to the telecommunication infrastructure transparency and service coverage maps by mobile operators and internet service providers globally (Song, 2018). There are also service gaps within some rural areas, as well as sparsely spread communities where profits for commercial operators are less obvious. These areas may remain underserved by the incumbent large players.

Some government interventions such as public access venues or government-run telecentres have addressed some of these gaps, a space where many experience computer or the internet for the first time (Sey *et al.*, 2015). These public centres can be complemented with digitised service delivery such as India's public distribution system (PDS) of subsidised food to poor households, albeit imperfectly (Masiero, 2015). It has also been shown that access can include both private and shared access amongst household members (Rashid, 2011). While public access computing (including telecentres and cybercafés) has met some ICT access needs of communities through shared use, some continue to remain excluded from participation, including the poor, those with low education, and the elderly (Gomez, 2013b).

In the global South, political interference is also noted as a hindrance to ICT access, whether it be the relatively high taxes or stringent regulations placed on the importation of ICT goods and services, or the prolific internet shutdowns as took place in six African countries in 2019 (CIPESA, 2019). Due to such conditions, alternative internet solutions from the commercial end (e.g. Google Loon, etc.) as well as from a social enterprise or community-run lens (Finlay, 2018) are working to fill these remaining supply side ICT gaps of unconnected and poorly resourced communities.

Access indicators from a demand-side perspective have broadly accepted measures, some of which are standardised by groups like the International Telecommunications Union (ITU). At the ITU level, standard measures look at access and household ownership of radio, television, telephone (fixed or mobile), computers of various types, internet access of various services, and television of various types (International Telecommunication Union, 2014). In Annex A, the indicators on access and use of ICT by household and individuals are based on the March 2016 core list of ICT indicators agreed upon by an international coalition, aimed at improving the availability and quality of ICT data and indicators (Partnership on Measuring ICT for Development, 2016). While national level data at ITU is collected and ensures indicators which disaggregate the urban to rural households, by gender of household head as well as households with or without children, there is no ITU request for specific data to be collected on income level or other welfare indicators which could conceivably separate the poor from non-poor.

While the ITU has not included income indicators in its global reports, other research teams are collecting ICT access data that can be disaggregated between the poor and non-poor (de Silva & Zainudeen, 2008; Galperin & Mariscal, 2007b; infodev, 2012b). This includes detailed asset information on mobile phone, television, and radio ownership, amongst other ICTs. For instance, infodev (2012b) reports that approximately 75 percent of South Africans living below the national poverty line own a mobile phone. While, in Latin America, Galperin and Mariscal (2007b) found that there were disparate levels of mobile ownership amongst poor households in 2007, with a low 30 percent ownership in Mexico to a high 90 per cent ownership in Colombia in 2007.

In the Asian context, a study of households in Pakistan, India, and Sri Lanka in 2006, found that mobile phones are individually owned by only 25 per cent of poor households and many of the same household members relied on shared access (de Silva & Zainudeen, 2008). Other Asian countries, like Thailand and the Philippines, showed higher mobile ownership amongst poor households. In 2008, mobile ownership amongst the same revisited poor sub-population of Pakistan, India, and Sri Lanka had grown (Sivapragasam & Kang, 2011). Access had also included the usage of other services in addition to voice services, such as SMS-based information alerts and m-voting, but less so amongst internet-based activities (Zainudeen & Ratnadiwakara, 2011). In a study of 18 African countries during the 2006-2007 period, income and education factors affected the opportunities to adopt the mobile phone (Gillwald & Stork, 2008). Again, levels of mobile phone ownership ranged across countries, with Ethiopia at that time only having 3,0 per cent of its population owning phones (Gillwald & Stork, 2008).

The latest 2019 ICT study by the same research consortium who presented the above data examined households across 23 countries in the global South between 2017 and beginning of 2019 (LIRNEasia, 2019). In terms of income disaggregation, the report adopted the use of a country's average income as its baseline, rather than establishing a set criteria for poor or non-poor. For those who reported income below the national average income, the majority of countries had over 50% of that below average population owning mobile phones (LIRNEasia, 2019). Surprisingly, 17 out of 20 countries had household who reported zero income, yet stated that they own a phone (LIRNEasia, 2019).

In a review of these ICTD country level studies, the concentration of the ICT access and ownership measures have revolved around singular indicators such as mobile phone and computer device ownership as well as internet access by those at the margins. Yet national data is also collected around a notable variety of other ICTs such as television and radio, which have not been mentioned in many of these reports.

2.3.5 ICT Usage amongst the Poor

There are many cases of and research about the usage of information and communication technologies (ICTs), especially around mobile phones for human development. However, few of these studies have attempted to measure ICT usage amongst a low-income population. Usage can also been seen under the term, meaningful access, referring "to digital competencies and applications that have the potential to transform individuals' activities, opportunities and outcomes" (Junio, 2019, p. 33).

In the ITU's sample questionnaire for 2017, the individual-level usage indicators measured the use of mobile phones, computers, and the internet; internet use by location (e.g. at home or at work); internet use by type of activity; internet use by frequency; and ICT skills by type of skill (ITU, 2017). The 2017 sample questions also included individual questions for not using the internet (ITU, 2017). As with the access indicators above, disaggregation of income or expenditure was not asked within the ITU reports; therefore, the determination of financial deprivation was not part of the ITU statistics requested from countries. As for available data on ICT usage amongst those at the margins, some national level data is available. At a country level, James' (2014) study of 11 African countries found that low GNP countries had households with more intensive usage (e.g. Ethiopia, Kenya, and Uganda). Furthermore, higher GNP countries had higher usage of ICT, particularly when safety is of grave national concern (e.g. Botswana, Namibia, and South Africa) than lower GNP countries. Amongst households, internet usage amongst the poor in selected countries in Asia was very low in 2008 (Zainudeen & Ratnadiwakara, 2011).

The use of ICTs by resource poor individuals can be broken down into directly related activities, such as cash transfers, and indirectly related transactions, such as activities that promote food security, financial inclusion, and employment. For example, direct cash transfers facilitated by ICTs through mobile money applications reveal an expenditure pattern change by the poor (Haushofer & Shapiro, 2013). Mobile phones and other complementary ICTs provide farmers with useful agricultural data as well as services with the interest of improving productivity (Duncombe, 2016). In a case in Kenya, mobile money transfers were being issued to a mobile phone in a household, and those electronic transfers to the phone were found to be used to purchase food provisions (GiveWell, 2012). Examples of indirect benefits from ICT usage include the use of a citizen monitoring SMS system in India so that food could be distributed to a specific area and irregularities could be reported (Nagavarapu & Sekhri, 2013).

The ability to use ICTs to provide immediate communication on produce prices and negotiation has allowed the rural poor to engage in less food waste and improved market access (Grimshaw & Kala, 2011; Jensen, 2007). As for financial inclusion, access to various banking platforms is an improvement to previous inaccessible formal banking regimes (León *et al.,* 2015). However digital skills, the uncertainty of costs, and other risks are all factors which may still be a hindrance to use of ICT financial platforms by the poor (León *et al.,* 2015). Gender inequality is also found across digital payments, account access on mobile phone or the internet, online purchase or bill transactions and mobile money, with men using such services more than women (Junio, 2019).

The aspect of ICT usage for digitally paid activities for those at the margins has certainly opened up new opportunities. There have been targeted programmes for income generation for the poor with groups such as Jana (formerly txtEagle), and Samasource, who facilitate microwork, or small digital tasks completed on the phone or computer (Eagle, 2009). Microwork has allowed people the opportunity to earn money for small piecemeal work through mobile phones or at local offices. Even such meagre earnings through mobile phones have helped to diversify the earning portfolio of the poor. In India, in a question answered by adult internet users who were selling goods or services on digital platforms, nearly a quarter of them stated that the income received was essential for meeting their basic needs (LIRNEasia, 2019). Yet, despite having some digital literacy, low-income workers are excluded in micro-work due to poor access to computers or the complexity of tasks available, as demonstrated by Indian works using Mechanical Turk (Khanna *et al.*, 2010).

Finally, ICTs have been recognised for their greatest use of ensuring stronger social ties and improving the safety of people (Galperin & Mariscal, 2007b). Yet, those who are less-educated or who have below average incomes in their respective global South country have had far lower usage of social media compared to those with above average incomes (LIRNEasia, 2019). Surprisingly, it was found that citizens in 14 out of 18 countries stated that they used of social media, yet reported earning zero income (LIRNEasia, 2019). From the examples above, ICT usage can be predominantly found through case study analysis; therefore, a research gap remains in analysing large scale data to better understand ICT usage of individual ICTs, including digital skills and online interactions and particularly this usage amongst those at the margins (Kenny & Sandefur, 2013).

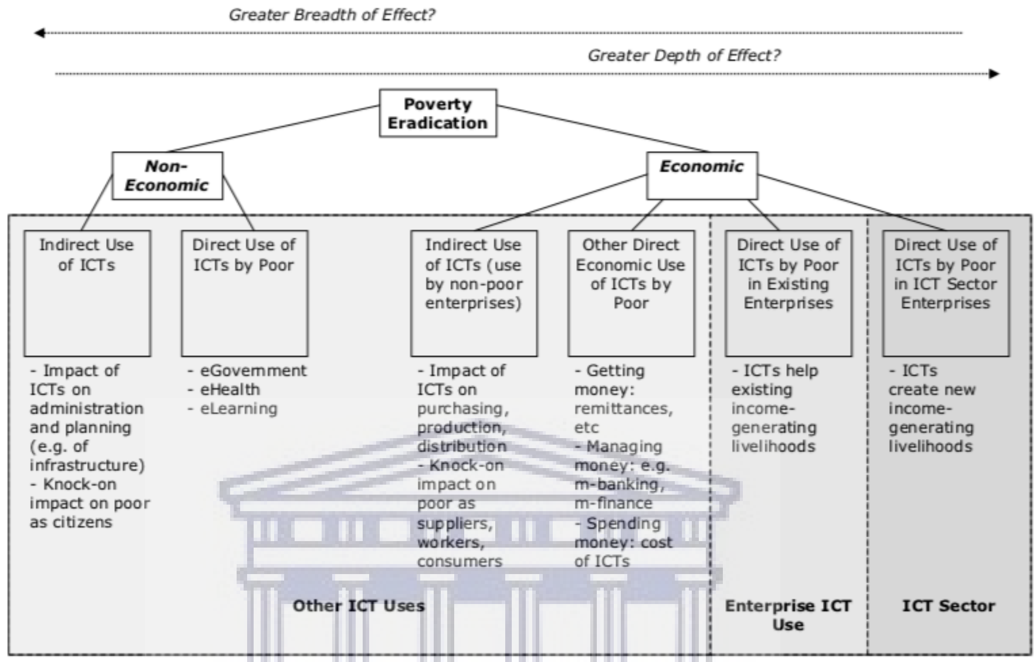
2.4 The Determinants of ICT for Poverty Reduction

Several determinants can be examined for the association between ICTs and lowering the levels of poverty. Heeks (2014) has provided a useful topology (Figure 1) for organising the economic and non-economic activities related to poverty eradication of ICTs into a conceptual map.

In this conceptual ICT and poverty map, Heeks (2014) has illustrated how the direct use of ICTs affects the lives of the poor through means of eGovernment or eLearning services. Economically, the possession of ICTs or access to ICT services can help create or enhance existing income generation activities. The indirect use of ICTs can also affect the poor via administration and planning. In reviewing all of these various topologies, social service delivery (via government) and economic development remain consistent themes of development outcomes from ICT use.

All of these examples provide useful categories for those looking to broadly conceptualise the ICTs access and use and its connection to poverty reduction and certainly contributes to this thesis in identifying that ICT household assets are beneficial for leading to some broader outcomes. Particular ICTs in possession by poor households, including mobile phone ownership, digital skills, and mobile money accounts, can be directly used for economic purposes in the pathway to poverty eradication (Heeks, 2014).

Figure 1: Conceptual Map of ICTs and Poverty Reduction



Note. Reprinted from "ICTs and poverty eradication: Comparing economic, livelihoods and capabilities models", from Heeks, R., 2014, Development Informatics Working Paper Series, 58, 6. Copyright 2014 by University of Manchester.

Determinants include the rural versus urban divide where connectivity is available as well as the factor of gender (LIRNEasia, 2019). In the global South, there are clear and, in some cases, wide gaps in mobile phone ownership and internet use between rural and urban areas as well as between female and male respondents (LIRNEasia, 2019). One clear factor is the ability of households to afford the cost of devices and services. The level of ICT expenditures by low-income populations could affect their frequency of ICT use, as well as the burden ICT access and use it could have on a household's ability to afford other costs. The balance would be to find a fair cost for ICTs which ensures that citizens, even at the margin, can participate and communicate.

A study examining the spending of the poor in relation to a pre-determined affordability threshold for the mobile phone (in this study, affordability was determined as 5% or below of personal income was budgeted for monthly mobile costs) found that in Latin American countries such as Brazil and Peru, low-income individuals spent 30–45% of their monthly income on mobile costs (Barrantes & Galperin, 2008). Ten years ago, the Latin American countries with high mobile phone service costs reflected a lower mobile penetration rate than other Latin American countries with comparably lower mobile phone costs (Barrantes & Galperin, 2008). The poor were found to pay a premium for mobile phone services, because they tended to use prepaid mobile airtime, which was costlier than post-paid mobile services (Barrantes & Galperin, 2008).

A multi-country study of mobile phone usage by individuals in Africa in 2008 found that those in the bottom 75% income range spent an average 10,9% of their income on mobile expenditures, a much higher figure than compared to the top 25%, who spent only 4,8% on the same mobile services (Gillwald & Stork, 2008). In looking at a selection of Asian countries listed in Table 2 below, data across households revealed that those classified within the poorest quintile would spend between 24,3% and 57,0% of their monthly budget on mobile services (Agüero *et al.,* 2011). Those in the top quintile of the same group of Asian households were found to spend much less—between 3,1% and 6,3% of their total monthly expenditure (Agüero *et al.,* 2011). In the latest 2019 study, clearly those above national income average and those above the average had monthly expenditure on mobile phone services (e.g. voice, SMS, and data), but more surprisingly, those who stated zero income also recalled having expenditures for the mobile phone (13 out of 17 countries) (LIRNEasia, 2019).

Table 2: Percentage of Expenditure in Mobile Services in Selected Asian Countries by Income Quintiles (%)

Quintile	Bangladesh	Pakistan	India	Sri Lanka	Philippines	Thailand
1 (Bottom 20%)	**29,7**	**45,8**	**24,3**	**27,0**	**57,0**	**24,4**
2	11,5	17,2	11,3	11,7	28,8	11,4
3	7,8	9,9	8,4	6,5	18,4	7,3
4	6,5	6,8	5,7	4,7	11,7	5,2
5 (Top 20%)	**3,8**	**5,1**	**4,4**	**3,1**	**6,3**	**3,7**

Note. Adapted from "Bottom of the Pyramid expenditure patterns on mobile phone services in selected emerging Asian countries", by Agüero, A. *et al.,* 2011, *Information Technologies & International Development*, *7(3), p.*26.

The demand for telecommunication services, even by the poorest, strongly suggests the high value placed on communication. Over ten years ago, households in Peru and Colombia identified telecommunications services as luxury goods (Agüero, 2008; Gamboa, 2007).

The poor undertake a variety of techniques to reduce their spending on telecommunications, such as missed calls. From a policy perspective, high taxes on mobile phones and their respective services can be a major deterrent for the poor in digital inclusion (León *et al.,* 2015). The consequences of high mobile costs, particularly amongst those at the margins, can be dire, including the act of sacrificing basic needs expenses, such as food, to pay for the cost of communications (Diga, 2007; Duncan, 2013; infodev, 2012a).

2.4.1 Digital Poverty

The concept of "information and communications poverty" is developed by Barja and Gigler (2007) and uses multiple non-financial indicators to relate against particular capabilities and usage. In developing a digital measure threshold, Barja and Gigler (2007) first set a reference location and the cost of ICTs as the information and communication poverty baseline or threshold. This baseline consists of a minimum level of current local capabilities, local usage, and technological constraints within the region. Barja and Gigler (2007) used a methodology to calculate a baseline economic cost of this location to compare to the selected locations. In essence, the information and communication poverty dimension was conceptualised from a geographical level and used mainly supply-side data. At the national level, there can be limitations to applying this concept of information and communication poverty due to the paucity of access and usage supply-side data against a sub-population such as the poor. While the information and communication poverty has conceptually developed its indicators and theory, it has yet to be applied in practice.

Some of the demand-side ICTD studies have been integral in reconfiguring the concept of poverty by developing a household measure of deprivation based on a digital consumption threshold (Barrantes, 2007). This consumption has been composed of multiple ICTs pre-selected by the researcher. In this case, deprivation is defined as the inability to communicate or make a phone call, which could be a denial of a fundamental human value in modern society. Certainly, the right to communicate enriches the list of human needs, including food, shelter, schooling and health. May (2012a) has stated,

> The definition of what commodities people need is relative because it needs to change as institutions, technology and social structure change. The relationship between needs and commodities change: for example, in a society where a mobile phone has come to be seen as a necessity, a person without one is needy (p. 64).

At a household level, this digital deprivation or poverty was conceived as a measure of those unable to meet the "the minimum ICT use and consumption levels, as well as income levels of the population necessary to demand ICT products" (Barrantes, 2007b). The Barrantes (2007b) study therefore, examined multiple measures of ICT ownership and household usage data, acknowledging the insufficiency of ICT supply-side statistics to measure digital poverty.

As a concept, the category of the extreme digitally poor is defined as households absent of ICT ownership, as well as those with little or no ability to deliver or accept two-way electronic exchanges. The connected category includes those households able to perform a few tasks around two-way electronic exchanges and use mobile-enabled devices for mainly voice phone calls. The digitally wealthy category identifies fully participating households that are sufficiently capable of performing two-way electronic exchanges on the internet as well as through the telephone (Barrantes, 2007). It is the utilisation of combined demand-side indicators on household ICT access, ownership, and usage indicators which then compose the ICT household index.

In applying this digital poverty topology to a sample of 17 000 Peruvian households in 2003, 68,0% of the households were identified as extremely digitally poor. In the same sample, Barrantes (2007) disaggregated the poor as those who did not have enough reported income to cover the cost of Peru's basic food basket. This group made up approximately 17,6% of the Peruvian sample. Those households who were identified as poor were almost all identified as extremely digital poor. This 2003 study remains one of the few research studies that composed a digital index to determine the digitally poor. This 2003 study was later updated with 2010 follow-up research, which slightly adjusted the digital poverty topology descriptions. In 2010, the unit of analysis changed from household to individual, the telecentre indicator was removed, and specific internet usage indicators on passive or active usage were added. As a result, the various digital poverty categories were changed using the following indicators shown in Table 3 below. Ultimately, the extremely digitally poor did not indicate telephone and internet usage while the digital wealthy were classified as both sufficiently active in using the telephone and internet (Barrantes, 2010).

Table 3: Revised Classification Criteria According to Digital Poverty Level

Digital Poverty Level	Indicators in Survey
Digitally Wealthy	Telephone user, active internet user
Connected	Telephone user, passive internet user
Digitally Poor	Telephone user, no internet
Extremely Digitally Poor	No telephone, no internet

Note. Adapted from "Digital Poverty: an Analytical Framework", by Barrantes, R., 2010, Chronic Poverty Research Centre conference, p.8.

Using this revised 2010 topology, an applied digital poverty study of 1 500 individual Peruvians found that over half of the respondents were digitally poor (58,7% of the sample). The digitally poor were found to have characteristics such as lower annual incomes, lower levels of education, and living outside of the urban capital. This small sample size limited the opportunity to disaggregate the data for a sub-sample of income-poor individuals (as was done in Barrantes' 2003 study).

One East Africa study follows up with this applied concept of digital poverty and it also uses a household ICT index (May, 2012c). While Barrantes sets specific mobile phone and internet usage indicators for each digital poverty category, May's (2012c) study relied on digital poverty indicators that utilised a count of ICT observations. As illustrated in Table 4 below, in the East Africa study, the economically poor (as in, those who measured below an absolute poverty line of $2,00 USD per capita per day) had a greater population of households stating access of zero ICTs, or of being digitally poor, than those of the non-poor. At the same time, 14,7% of the non-poor were still categorised as digitally poor, and 11,3% of the poor were considered digitally wealthy. Similarities to the non-poor results were found in those living in urban areas, and the same could be said for those who identified as poor and living in rural areas.

The Barrantes (2007), Barrantes (2010) and May (2012c) findings show that the characteristics of education levels of household members, income levels, and the number of youth in a household affect digital poverty levels.

Table 4: Digital Poverty Status of Households by Financial Poverty Status and Geolocation (%)

ICT	Not poor	Poor	Urban	Rural
No ICT	7,0	23,4	9,1	21,6
Digital poor	14,7	27,4	14,6	27,1
Connected	50,8	38,0	48,8	40,1
Digitally wealthy	27,5	11,3	27,5	11,3
n=		1473		1508

Note. Adapted from "Digital and Other Poverties: Exploring the Connection in Four East African Countries" May, J. D., 2012c, *Information Technologies & International Development*, *8(2), p.*43.

Regarding the conceptual evolution of digital poverty, there can be limits on developing a digital poverty threshold which is used repeatedly over time. Barrantes take a stance of relativity—targets would need to change over time in relation to the dynamic change of ICT usage. Regardless, the concept of digital poverty provides an alternative way of thinking about poverty, using digital ownership and usage as a possible proxy measure for well-being of households and individuals. These studies have certainly provided more in-depth observations around ICTs which would have been limited had the macro-level ICT supply within poor areas been used as the only mechanism to monitor digital poverty.

In a review of ICTD literature, the measures of ICT access, ownership, and usage were found to be changing over time, and indicators are becoming further standardised in order to be comparable at a country level. At a supply-side level, low and middle-income country statistics show ICT ownership and access growth. A dearth of data remains, but some demand-side studies are measuring country representative data on ICTs amongst the poor. While the rate of adoption by the poor is growing, the rates remain uneven in various countries and sub-populations. Furthermore, ICT usage data (such as depth and quality of usage) amongst the marginalised, particularly at a national level, is also not well measured or understood.

2.4.2 Do Poverty Levels Impact on ICTs?

The period after the 2000s saw a proliferation of mobile subscriptions and other ICTs, including amongst those at the margins, and this ICT uptake has led to extensive and congruent literature coverage around ICT and poverty (Adeya, 2002; Diga, 2013; Spence & Smith, 2009). Within the studies, research has started to cover the associations and possible causal inference being made around poverty and ICTs. The direction in which this relationship happens is explored, and the first case is to examine if there are social or economic factors amongst households or individuals which then impact the level of ICTs. More broadly, the digital poverty could be viewed as "a concept that seeks to grasp the multiple dimensions of inadequate levels of access to ICT services by people and organizations, as well as the barriers to their productive use" (Galperin & Mariscal, 2007a, p. 8).

Barrantes (2010) and May (2012c) have called for further research examining whether an individual's income level has an association with ICTs. The theory proposed is that the greater the income within a household, the greater the ability to afford the cost of ownership for an increasing number of ICTs. The 2010 Peruvian analysis confirmed that as poverty levels dropped within a household, there was an improved likelihood for the individual to be identified as connected through a mobile phone or the internet (Barrantes, 2010). The study is limited to one year of data collection, so measured changes over time are not possible, and the study only includes two types of ICTs.

In another study on poor communities in four East African countries, an analysis of whether income levels affected ICT access showed that the association was positive and significant (May 2012c). In showing some of the contributing determinants, ICT access was more likely in a household if one member of the household had completed at least a secondary education and if the household was located in an urban centre (May, 2012b). Finally, an important predictor to ICT access is the per capita household expenditure measure in relation to the absolute poverty line (set at $2,50 USD per capita per day) (May, 2012c). The rural geographical factor has been examined, seeing less ICTs obtained and retained within such homes, dependence on wireless technologies in underserved communities, as well as individuals having less skills to adopt the technologies (Salemink *et al.*, 2017). In a meta-analysis of socio-economic status (commonly using the parents' education and income levels) and ICT literacy (based on performance-based assessments) amongst school going children, there was a positive and significant correlation (Scherer & Siddiq, 2019).

The quantity of ICTs could be the measure for impact as households or individuals change in socio-economic status or specifically move out of poverty. However, one must also note that improvement in wealth could lead to a change in the quality of ICTs, which can see the number of ICTs remain the same. For example, a basic phone could be upgraded to a smart phone. Another observation is that one advanced ICT upgrade could be made up of converged ICTs in one device. For example, the connection to the internet and radio are two assets that today, can be available on one smart phone or tablet. With these convergence cases, there can be limitations in using the quantity of ICTs in a household as the impact measure. Within the limited studies available that examine income poverty in relation to changes of ICTs, the research shows that as a household moves away from poverty, it is likely that the household will have greater levels of ICTs.

2.4.3 Do ICTs Impact Poverty?

If poverty impacts upon ICT access, the reverse causation also may apply. The contribution of ICT ownership to poverty reduction theoretically stems from the concept of positionality—that those previously excluded or located at the margins can shift out of this position with the use of ICTs and, therefore, better connect to economic centres (Graham, 2019). Referring to third-level digital divide, those material outcomes as a result of ICT or specifically internet use remain limited in nature, particularly in its measures (Scheerder *et al.*, 2017). The poor can participate in activities using ICTs which lead to improved income or work opportunities. It is through these incremental improvements that poverty can be eventually eradicated. Toyama (2011) has argued that technologies are limited in their impact by the existing intention and conditions. Institutions that are failing, for example, will continue to run poorly even with the introduction of ICTs (Toyama, 2011). Also, those identified as rich will own multiple ICTs with superior digital skills that will surpass those held by the poor.

Studies measuring the impact of ICTs on poverty are limited. One review of several studies on the impact of mobile phones on development found that 18 studies showed mainly short-term results and only four of the studies covered more long-term impacts (Duncombe, 2011). Additionally, despite all these studies being located within marginalised communities or amongst low-income respondents, none of the reviewed studies measured changes to the income poverty level (Duncombe, 2011). In a panel on mobile banking, households found with access to mobile money services improved in household consumption and savings over time, thereby lowering poverty rates (Suri & Jack, 2016). A review specifically on the impact of internet on poverty alleviation was found to be uncertain for less advanced economies, despite clear technological improvements (Galperin & Fernanda Viecens, 2017). The delay of impact could be due to inadequate skills and human investments as well as low adoption levels in low and middle-income countries (Galperin & Fernanda Viecens, 2017).

Several studies look at various poverty dimensions despite the lack of a measure of income poverty-level impact. In one Bangladeshi programme, the village phone introduced mobile phone kiosks in various areas and found improvement in income generation (Aminuzzaman *et al.,* 2003). However, impact measures found that transportation effects were greater than the economic empowerment of users. In a study of Ugandan rural households, migration from rural to urban centres was more likely to happen within households with mobile phones than those without (Muto, 2012). One study found women with access to mobile money services increased their diversity of work options, such as transitioning to non-farm related activities like retail (Suri & Jack, 2016).

In a 2004 study of rural communities in three countries, high-income earners benefited from the economic value of the mobile phones, and lower-income earning respondents benefitted less so (Souter *et al.,* 2005). Of greatest value by the respondents was the impact of mobile phones during vulnerable situations, such as emergencies (Souter *et al.,* 2005). In Kerala, a study on the mobile phone usage amongst fisherfolk and traders saw reduced information asymmetries, and therefore less wastage, particularly of the traders (Jensen, 2007). A study was conducted on self-perceived well-being amongst individuals in South Africa who participated in ICT activities (including free internet and computer hours at an ICT centre, alongside computer training and goal setting activities) (Attwood *et al.,* 2014). The respondents reported their subjective well-being at the beginning, in the middle, and at the end of the study intervention. The respondents who made full use of the ICT opportunity and had high participation in ICT centres with good functionality saw a greater positive change in their quality-of-life than those who did not fully participate (Attwood *et al.,* 2014).

In Tanzania, multiple poverty measures were monitored when an ICT intervention was implemented amongst micro businesses. The ICT intervention consisted of these businesses receiving a free mobile phone, free periodic mobile airtime (the cost of $20 USD a month) and free internet access at the local internet café for five months (Mascarenhas, 2014). Using a quasi-experimental design, another town, which was similar to the previous town, was also measured for poverty levels amongst small business owners (the initial poverty level of both towns was measured at around 55,0%) but without any provisions of free ICTs. In returning to the two towns after the intervention period, the poverty level of the town without intervention dropped by 16,1% while the poverty level of the town with the ICT intervention dropped by 38,9% (Mascarenhas, 2014). In a more in-depth look at the multiple poverty dimensions, the control group saw improvement in two poverty dimensions while the treatment group saw improvement in five dimensions. While the study only measured improvements over a short half-year period, clear effects were seen between the two compared towns.

During a similar period as the Tanzania business study, a four-country study of poverty and ICTs in East Africa was also conducted. A panel study looked at household level poverty and ICT dimensions over time in Kenya, Uganda, Tanzania, and Rwanda. The households were randomly chosen using a nationally representative sample of the poorest enumerating areas of the four countries. The study then used an ICT index to measure ICTs amongst the households and found that the ICTs had statistically caused a change in per capita expenditure over the 2007 to 2010 period (May *et al.*, 2014a). With every unit increase in ICTs, there was a 3,7% improvement in a household's poverty status during the same three-year period (May *et al.,* 2014a). The proportional expenditure changes per capita amongst households with ICTs had a stronger effect on the poorest than the non-poor surveyed. Overall, the convergence between the poor and non-poor was small, but it was a positive gain moving in a pro-poor direction. The results are, however, viewed with caution because gains from ICTs among the most-poor might only be reflected in the medium term (6 to 10-year period). This study was the first and only multi-country panel study which intentionally reviewed dimensions of poverty and ICTs for impact over time. These empirical studies are limited; therefore, further studies that refine the poverty and ICT relationship analyses at a national level can contribute to solidifying the conclusions of pro-poor or positive quality-of-life changes.

The few micro-level, demand-side studies above provide a starting point for testing ICT indices against a poverty-level relationship. The exploration of a wider range of ICT indicators was previously argued for ICTs and their synergistic elements. ICT assets that could be considered for measure include the elements of the diversity of tangible ICTs, digital content, ICT skills, and social ICT interaction. For example, ICT skill indicators are usually based on proxies, such as school enrolment and adult literacy, but these indicators do not mention ICTs. ICT competencies and other measures of digital literacy could help improve this asset measure. Overall, the lack of empirical studies which look at ICT as a bundle against poverty reduction provides reason for this thesis by specifically examining the digital basket and its association to poverty in South Africa.

2.4.4 Digital Inequality

The measure of wide disparities of ICTs amongst stratified groups within a population suggests the internet is a reflection of existing inequalities (Zillien &

Hargittai, 2009). “Those already in more privileged positions are reaping the benefits of their time spent online more than users from lower socio-economic backgrounds” (Zillien & Hargittai, 2009, p. 287). Van Deursen and Van Dijk (2014) have argued that current realities in social, economic, and cultural relationships are reflected within internet usage indicators. While increased ICT access is observed globally, previous hypotheses that ICTs help people converge towards equality with regards to income or other social differences are challenged by these studies. The digital disparity remains unresolved, and the ongoing demand for mobile internet and broadband infrastructure reach are shifting the ‘post’. The high cost of these core services are a concern which questions the inclusivity of ICTs to the most marginalised.

2.5 Conclusion

As has been illustrated in this chapter, the literature review examines the concept of household ICTs, technological trends over period up to 2015 and I summarise an overview of the global ICT trends, specifically that a) countries with high Human Development Index scores generally align with greater IDI, b) many countries have high ICT expenditures per capita, leaving many low and middle income countries from meeting the affordability threshold, c) gender remains an issues within the ICT digital divide, and d) the ICT disparity is distinct between the poor and non-poor, yet the analysis is limited. Another observation is that ICTs are wide-ranging and continually influx, meaning that any study examining issues of ICTs needs to constantly draw on an ever-changing conceptualisation of these devices. An overall inventory or contemporary review of the ICTs that a household can collectively own would be a practical starting point. While the chapter has revealed the technological trends, three major research gaps also come to mind amongst these trends, including 1) the paucity of studies that observe a portfolio of household ICTs at a national scale, 2) the limited understanding of ICT ownership and usage through nationally representative or large scale data, particularly when observing disaggregated characteristics such as by gender or by household wealth and 3) the lack of empirical work that examines the impact of ICTs on poverty.

As has also been illustrated, there are digital disparities amongst countries and within countries globally. While global organisations like the ITU have helped by providing understandings of access and use in the global South, they often fail to provide nuanced understandings of disparities in these categories within countries. Thus, other entry points such as gender and class help to further our understandings in this regard. Drawing on these ideas, this chapter has attempted to provide various insights into how these disparities, specifically the population segments of the poor and non-poor, have been studied and how these disparities can be further examined going forward.

Finally, in terms of determinants of ICTs on poverty reduction, a few studies show that ICTs are having a positive effect on the poorest in relation to the non-poor, particularly in the medium term. However, given the paucity of work which tests multiple ICTs and the effect on poverty, advancing on these studies could help fill the research gaps at the national level. To further understand this study's discussion of the relationship between ICTs and poverty, the following chapter reviews previous studies and frameworks for conceptualising poverty.

3 CHAPTER THREE: CONNECTING ASSETS TO POVERTY REDUCTION

3.1 Introduction

As previously outlined, over the past twenty years, ICTD researchers have been examining the possible relationships between people's access and use of ICTs and the alleviation of poverty. Having discussed theory and research on ICT and global development issues, in this chapter, I discuss some of the key concepts of poverty as well as present some global statistics showing the distribution and trends of indicators used to measure poverty. Specifically, I describe what is understood at the micro level around two concepts: the 'ends' and 'means' of poverty. The literature discussed highlights how thinking about poverty has moved from a static notion of the concept, which measures household income as an 'end' at only one point in time, to a dynamic notion, which can measure non-financial outcome indicators over a determined period of time. Specifically, this expanded conceptualisation of poverty looks at human well-being from a theoretical lens of assets, in that the one pathway to poverty reduction has examined household asset accumulation. I put particular emphasis in this chapter on a household's asset portfolio—which are individual possessions used for everyday activities, by elaborating on tangible and intangible notions of assets, assets as capital, and describing the conventional five capitals. Throughout this discussion, I argue that the digitalisation of contemporary society puts to question the appropriateness of the current five conventional capitals and the exploration of ICTs is a research gap when we think of broadening a household's asset base to move out of poverty. In discussing assets within a key operational model in poverty research, the sustainable livelihoods framework, I illustrate how this study challenges some of the conventional notions of poverty, and suggest that ICT assets can be added to this theoretical framework.

3.2 Global Trends of Poverty Measure

"Overcoming poverty is not a gesture of charity. It is an act of justice. While poverty persists, there is no true freedom". ~Nelson Mandela

At the global level, poverty is conventionally defined in absolute terms, referred to as "subsistence below minimum, socially acceptable living conditions, usually established based on nutritional requirements and other essential goods" (Lok-Dessallien, 1999, p. 2). The case of the minimum living standard is also disaggregated into further categories of "indigence or primary poverty and secondary poverty (sometimes referred to as extreme and overall poverty respectively)" (Lok-Dessallien, 1999, p 2). To be in extreme poverty is to be absent of the basic nutritional needs for human survival, and overall poverty provides further degrees of deprivation within a household.

Countries around the world commit to monitoring their poverty reduction progress by comparing their deprivation levels against the agreed global poverty measures. These measures chart the country's progress over time and against other countries. The Sustainable Development Goals (SDGs) were agreed upon on 25 September 2015, and of the 17 SDGs, goal number one is to end extreme poverty in the world (United Nations Development Programme, 2016b). Currently extreme poverty is defined by the population living below the income poverty line, Purchasing Price Parity (PPP) $1,90 per capita per day. The SDGs are part of the 2030 Agenda for Sustainable Development, and they follow on from the Millennium Development Goals (MDGs), which concluded in 2015 (United Nations Development Programme, 2016b). Clearly, the end of poverty remains a top priority within international development. The original intention of the Millennium Declaration was to provide a global platform where all countries could agree on meeting some human development outcomes such as the lowering of poverty. This global commitment against poverty is not recent. Rather, this development work goes back to the United Nations declaration in the 1960s to provide some assistance to the poorer sections of the global population.

Over 50 years later, in reflection of the initial declaration, ongoing evidence of global poverty show shifts of improvement to human development. The global demarcation of poverty is set at the extreme income poverty level, and this poverty threshold is calculated against the average per capita per day income estimates of each country. To date, the global reports show a downward trend of global income poverty. For example, although 767 million people remain poor, under the $1,90 a day extreme poverty line in 2013 (World Bank, 2016), the global poverty rate was

10,7% in 2013 compared to 34,8% in 1990 (World Bank, 2016). This decreasing trend is mainly due to efforts of the world's largest economies, such as India and China, where decreased income poverty is observed within their large populations (World Bank, 2016). However, there however remain ongoing and persistent poverty levels in some regions of the world, especially in sub-Saharan Africa (World Bank, 2016). The majority of poor people are found in middle-income countries (a change from 1990 to 2007), where the largest number of the poor in absolute numbers is observed (Sumner, 2012).

Other dimensions of poverty have also changed. The Human Development Report has provided annual detailed information on development indicators beyond the measure of extreme income poverty for almost three decades. This Report ranks the countries through an aggregate of certain indicators, creating a statistical index called the Human Development Index (HDI). These cross-country comparisons were originally developed in order to monitor progress on the MDGs. Since 2000, the reports have provided basic developmental indicators through a mix of financial and non-financial variables. Today, the reports use standard cross-sectional data to compare country HDI scores and indicators across countries and over time.

Table 5: Human Development Indicators, 2015

Country (HDI rank - 2015)	Population (millions) 2015	Gross Domestic Product per capita (USD$) 2015 (2011 PPP $)	Population living below income poverty line (%) National poverty line	Gini Coefficient	Life Expectancy at birth (2015)	Child Malnutrition Stunting (% under age 5)	Unemployment (% of labour force) (2015)	Population with at least some secondary education (% ages 25 and older)	Internet users (% of population) (2015)
South Africa (119)	54,5	12 390	53,8	63,4	57,7	23,9	25,1	74,9	51,9
Peru (87)	31,4	11 672	21,8	44,1	74,8	14,6	3,5	61,5	40,9
Indonesia (113)	257,6	10 385	11,3	39.5	69,1	36,4	5,8	47,3	22,0

Source: Adapted from United Nations Development Programme (2016a)

In Table Five above, some of the 2015 HDI indicators are listed to give a comparative perspective across three countries (United Nations Development Programme, 2016a). The comparative countries—Peru, Indonesia and South Africa—were chosen because the three countries are similar in terms of their GDP per capita. The three countries are also categorised as either medium or high human development countries, making their overall HDI scores and rankings relatively comparable. In review of the data for these three countries, Table 5 shows how South Africa clearly falls short due to higher poverty, inequality levels, and unemployment when compared to Peru and Indonesia. Yet, South Africa also reflects a higher secondary education completion level and internet user population compared to the same two countries. Mobile phone subscriptions amongst these three countries are quite similar, well over 100 subscribers per 100 people, meaning each person may be carrying more than one subscription to a mobile SIM card.

The global multidimensional poverty index (MPI) has taken the work of the HDI further by developing a deprivation threshold measure using multiple non-financial indicators. This work allows researchers to compare MPI scores across 104 countries (Alkire & Robles, 2017). In the latest measure, the dimensions of health, education, and living standards provide the conceptual basis of multidimensional poverty. This means that if a person is deprived in "at least one third of the weighted MPI indicators", they would be classified as 'multidimensionally poor' (Alkire & Robles, 2017, p. 3). Using this multidimensional poverty line, Alkire and Robles (2017) have found that 1,45 billion people are poor, approximately 26,5% of the global population. Over time, the ability to measure global poverty through a selection of various financial and non-financial indicators improves the depiction of a country's human development context and allows for comparison across other similar countries.

3.3 Theory of Poverty

Following on from these macro-level poverty measure trends, poverty measured at the micro-level is defined when "one or more persons do not attain a level of material well-being deemed to constitute a reasonable minimum by the standards of that society" (Ravallion, 2017, p. 3). Yet, similar to the above discussion, there has also been an evolution in terms of how poverty has been conceptualised at the micro-level, specifically at non-financial indicators. As emergent 'material' priorities change within household assets, so do their respective household practice. For example, newer dimensions, such as ICT assets most valued amongst households and individuals, asks poverty researchers to a re-think how poverty is measured. To better understand how this can be done, the following section provides a conceptual review of poverty at the micro-level. Specifically, the concepts of the poverty ends and the means as well as poverty traps are reviewed. Examining these concepts will illustrate the need for expanded theory in this area which looks to augment the current thinking on non-financial assets at a household level.

3.3.1 The 'End' or Poverty Outcome Measure

"…measurement not only identifies targets and target groups, but also reflects our understanding of poverty and why poverty persists" (May, 2012a, p. 63).

Poverty can be viewed as an 'end' or outcome measure, using proxy indicators that provide an estimate on the material improvement of a household or individual. The concept of poverty has evolved from solely looking at insufficient household incomes or financial deprivation as a proxy to poverty. Rather, through the on-going influences of theorists such as Sen (1999), Alkire (2008), and Moser (1998), amongst others, the notion of poverty has expanded to look at a wider set of non-financial measures. An overall poverty outcome is based on calculating a minimum level of deprivation a human being can endure before one is deprived of their basic needs.

Depending on the researcher's choice of conceptualisation, this 'minimum standard' can be revealed in various ways. Firstly, indicators can include 'absolute' measures (such as the global $1,90 per capita per day) or 'relative' measures or a proportion of a population (such as the bottom ten percent of a particular population) (Hulme, 2013). Secondly, the choice of these poverty indicators can be pre-determined by a fixed measure. In contrast, subjective poverty is a self-perception of one's state of impoverishment (Hulme, 2013). Bhutan's 'Happiness Index,' for example, has taken the subjective poverty approach (Hulme, 2013). Thirdly, poverty can also take a narrow or one-dimensional view such as the sole use of the indicator on individual income (or consumption), or poverty can take a broad measure using a combination of multiple financial and non-financial dimensions. Sen's (1999) human development approach for example, reveals deprivation based on a variety of capabilities necessary to meet a set of human needs (usually beyond income) that are of value to the individual.

Well-being outcomes can also be multidimensional to involve economic, social, and environmental outcomes (Siegel, 2005). They can be material, based on wealth, or non-material, based on personal and social welfare (Siegel, 2005). Chambers and Conway (1992) listed three indicators of well-being: production, employment, and cash income. Scoones (1998) divided livelihood outcomes into five elements: 1) employment, 2) poverty reduction, 3) well-being and capabilities, 4) livelihood adaptation, vulnerability and resilience, and 5) natural resource base sustainability. These multidimensional lenses allow for conceptual expansion into emergent topics of information poverty, digital poverty, and energy poverty, which are outcomes to contemporary society's needs and demands. Although the literature remains limited in these emergent concepts, use of the multidimensional approach to poverty outcomes can allow for such conceptual expansions to further current understanding of the improvement of human development.

3.3.2 The 'Means' or Conditions of Poverty

Poverty can also be viewed as the 'means' or conditions (both internally and externally) necessary to maintain a certain standard of living within a household. Such conditions of poverty can include that of individual agency or structural factors. First, individual agency places emphasis on the internal strategies taken by a person to move out of poverty or to improve their overall well-being. This individual agency is a power from within individuals which is used to take action to improve his or her well-being (Sen, 1999). Transformative realisation could be described as the following: "Empowerment happens when individuals and organized groups are able to imagine their world differently and to realize that vision by changing the relations of power that have kept them in poverty, restricted their voice and deprived them of their autonomy" (Eyben, 2011, p. 2). The internal condition, such as individual agency, affects deprivation.

As for a second condition of poverty, structural factors, these can be viewed in two ways: externally, through the institutions that govern a state, or internally from the physical structures or assets owned by an individual. Under institutional structures, governments are under pressure to find the balanced mix of improved economic growth policies, while assuring gains to their population in human capital through health and education programmes (Rodrik, 2013). Whether it be ongoing changes to national social welfare programmes (Drèze & Sen, 2013) or decisive strategies of market deregulation for growth (Bhagwati & Panagariya, 2013), such institutional decisions are conditions which have great influence on whether a household remains poor. While democratic governance processes would allow for citizen participation in establishing institutional policies, such institutional decisions, once set, are structurally provisioned to households, meaning these decisions are typically external to and not controlled by individual households.

Structural institutional issues are external conditions which can be differentiated from the concept of structural internal conditions to an individual such as assets. Assets can be the physical goods owned by an individual and can help to influence a person's level of poverty. The poor may possess less than sufficient physical material and non-material assets. It is this accumulated stock of assets which can be effectively used or strategised in order to improve well-being (Siegel, 2005). Carter and Barrett (2006) viewed assets as a mechanism to assess poverty trends over time. Asset poverty in this case is when a household's asset accumulation is insufficient to move out of poverty. Thus, asset poverty is thus a cause of structural poverty from which escape is difficult.

In contemporary society, the portfolio of household assets which are valued and necessary to maintain a reasonable standard of living can evolve over time and may need ongoing investigation. Individual agency and structural factors (both institutional or within households) are concepts within the 'means' or conditions towards better understanding deprivation.

3.3.3 Poverty Traps

Further building upon the 'means' of poverty reduction, assets can be a conceptual approach that explains the means to move people out of poverty over time (Carter & Barrett, 2006). The time-oriented feature of poverty provides the viewpoint of poverty either at one point in a single year or through monitoring changes over a duration of time. In combining this idea with a household's assets, the concept of 'poverty trap' reveals how poor maintenance of a minimum standard of resources and abilities can lower people's abilities to handle unforeseen circumstances (Carter & May, 2001). Defined as "any self-reinforcing mechanism which causes poverty" (Azariadis & Stachurski, 2005, p. 302), poverty traps thereby leave people vulnerable and perpetually trapped in deprivation.

Carter and Barrett (2006) have demonstrated another view of poverty through a dynamic approach. Their studies have helped poverty researchers move from static models of measuring financial or income poverty to a dynamic understanding about how poverty can be monitored over time. Furthermore, their work has expanded the concept of assets as a component of 'structural poverty': assets can be seen as an additional mechanism to view poverty transitions. The main point of the Carter and Barrett 2006 work was to explain asset dynamics or "those households caught in a long-term structural poverty trap from those expected to follow an upward trajectory, that is, those who enjoy structural economic mobility" (2006, p. 185). The basis of their theory was that households wishing to observe high returns from their own production processes may need to have a minimum starting point of assets, or an asset poverty line, which sets the base of structural poverty. When household income levels drop, those who can meet this minimum point of assets can then continue to accumulate assets, change their livelihood strategies, and eventually move out of stochastic poverty (Carter & Barrett, 2006). However, those who cannot meet this minimum point of both household income and assets are classified as being in structural poverty, and will be stuck in a poverty trap or remain persistently poor even with the accumulation of some less productive assets in their portfolio.

Carter and Barrett (2006) do not go into detail as to what sufficient assets are necessary to move out of structural poverty. Yet, their work can be built upon by focusing specifically on the assets that are sufficient as an minimum base and necessary to carry out household strategies and move out of structural poverty (Carter & May, 2001; May *et al.*, 2011). Aside from this asset threshold, further complexities around asset accumulation have been investigated, specifically how physical assets interact with human capabilities, such as psychological assets (Barrett *et al.*, 2018). For example, some individuals experience perpetual compromise of their human capabilities, including that of mental health or other personal trait issues. Integrated approaches, such as a combined programme addressing both physical asset and human capability needs may be best suited for intervention (Barrett *et al.,* 2018). In this section, clear research gaps remain in understanding the conditions which allow deprivation to persist or concede in contemporary society.

3.4 Assets as a Contributor to Poverty Reduction

The material wealth or quality of assets in a household provides important insight into non-financial goods accumulation and how insufficient assets can threaten long-term prospects of poverty alleviation (Carter & Barrett, 2006). Assets are defined to "include conventional, privately held productive and financial wealth, as well as social, geographic and market access positions that confer economic advantage" (Carter & Barrett, 2006, p. 179). Some assets can be material and non-productive (e.g. household valuables), and when sold could give "unearned" income. Other assets are productive (e.g. human capital, land, and livestock) and provide "earned" income when the asset is applied to specific activities like farming (Barrett *et al.*, 2001, p. 317). In further issues around poverty, assets provide some understanding in the strategies taken up by the poor to respond to shocks and material shortages (Moser, 1998). Bebbington (1999) has specifically seen assets as "vehicles for instrumental action (making a living), hermeneutic action (making living meaningful) and emancipatory action (challenging the structures under which one makes a living)" (p. 22). The assets are the specific inputs within a household, accumulated into a portfolio for use in their everyday lives.

The term 'capital' has been adopted as an overall, conventional topology to describe the terms of assets, resources, and commodities within a household or individual. Its categorisation helps to simplify the many types of resources one can have under the auspices and influence of a 'sustainable livelihoods framework.' Scoones (1998) and Bebbington (1999) state that capital is an economic metaphor for assets. Calling it an 'asset vulnerability framework', Moser (1998) has presented a classification of grouped assets, calling each grouping a 'capital' (namely labour, human capital, productive assets, household relations and social capital). The 'capital assets' framework has emphasised on the tangible holdings of individuals and households, an aspect which would centre people within policy deliberations (Rakodi, 1999). Another term, 'livelihood' is also related to assets, defined as "the capabilities, assets (stores, resources, claims and access) and activities required for a means of living" (Chambers and Conway, 1992, p. 6). This particular definition of assets was developed to ensure those at the margins were first in mind within rural development practice and wider issues of sustainable development (Scoones, 2009).

When people possess these types of capital or assets, they can develop strategies for best use in delivering, in some cases, productive outcomes. In this framework, assets "can be stored, accumulated, exchanged or depleted and put to work to generate a flow of income or other benefits" (Rakodi, 1999: p. 316). Those who are severely poor, particularly affected by famine or food crisis will have very few assets and thereby act upon fewer survivalist coping strategies. The coping strategies can include the use of insurance mechanisms availed to the household, the on-going disposal of key productive assets, and lastly resort to destitution and forced migration to find assistance (Corbett, 1988). In other cases, there is a market failure in providing sufficient provisions to the poor or allowing those with low asset base to accumulate a minimum living standard. Social protection or safety net interventions may thereby be necessary for households to gain enough resources to smooth out assets to the minimum level (Barrett & Carter, 2013). The choice of strategies is based on the primary objective to retain the ability to avoid destitution and generate future livelihood or income, not just for avoiding hunger, which all comes into play in decisions of asset retention.

As briefly discussed above, the asset-based approach is the ability to mitigate poverty through the accumulation of a sufficient minimum level of assets and to use these assets towards effective livelihood strategies. In this section, further details are provided on two characteristics in which assets can be approached: 1) its tangible and non-tangible nature, and 2) the levels of assets.

3.4.1 Tangible and Non-Tangibles Assets

Defining assets as either tangible and non-tangible helps differentiate the goods and services within a household's portfolio. Carter and Barrett (2006) concentrated on assets distinguished as tangible goods or durable physical goods that can be easily assigned a value. For example, a household can have stores that include food stocks and things of value, including gold, jewellery, and cash savings. Households can also have resources such as land, water, trees, farm equipment and tools, all of which are tangible and can easily be assigned a price should it need to be liquidated for cash (Chambers & Conway, 1992).

Less is mentioned about non-tangible items, such as individual human effort; as assets, the intangibles can provide value, which may be less clear in determining its financial worth. Carter and Barrett (2006) brush through these ideas of the intangibles as 'intrinsic characteristics' (p. 186). Examples of individual skills and abilities to save reveal intrinsic characteristics which may influence one's level of desired accumulation (Carter & Barrett, 2006). Chambers and Conway (1992) stated claims and access as intangible assets defining claims as demands that can be requested from others for support, particularly during times of shock. Access to assets allows for the use of a resource, store, or service to gain material, information, technology, or income. In such services, the use of transport, education, techniques for agriculture, and other information based resources are stated as accessible and are intangible in nature, not necessarily claimed as owned by an individual.

Some literature makes clearly distinct the differences between tangible and intangible assets, while some note the blending of the two concepts. Siegel (2005) has listed tangible assets to include, land, natural assets, livestock, housing, financial assets, and human capital; whereas, intangible assets include social capital, political rights, capacity, and openness of institutions. He has also distinguished another grouping of assets which mix both tangible and intangible assets due to their synergised ways of working together: 1) productive assets (such as natural, human capital, physical and financial capital), 2) social capital (as in, social networks and governance), and 3) locational (such as access to infrastructure and agro-ecological zone) (Siegel, 2005). There are categories of assets which do cross over and mix both the tangibles and intangibles.

What is less known and may require further investigation are those assets that may carry both tangible and intangible characteristics and how best to categorise such emergent assets, such as the connection to the internet or mobile devices. Contributing to the debate around "materiality" of digital artefacts, Leonardi (2010) has suggested that rather than concentrate on physical goods or matter as the central link to an ICT, it may be useful to consider the ICT and its usefulness necessitated from intangible interactions and processes. This idea is further supported by the argument of digital convergence, as multiple separate physical devices are re-imagined to be in one all-encompassing gadget, consolidating communications such as two-way audio, video and other digital content (Singh & Raja, 2010). Communication devices are ever changing goods as they evolve with social practice and economic structures (Allen, 2017). All the above aspects further blur the lines of material value and intangible complements for what is seemingly one tangible product.

3.4.2 Source of Assets

Assets can be sourced from different levels, through an individual, government, or community or global entity. First, individuals can possess intangible assets, such as their social connections and the intrinsic ability to use connections to source and produce goods and services. Individuals can also accumulate tangible assets, such as a bicycle or mobile phone, throughout their lifetime. Asset ownership could also vary in terms of individual ownership or couple ownership, determined by rules of joint property in a country, and amongst individuals, assets ownership can be gendered (Doss *et al.*, 2018). In an applied case, women have been found to possess lower asset ownership than men in terms of business, large and small livestock, in the case of India, residential and agricultural land ownership (in the case of Karnataka, India) (Doss *et al.,* 2018). Sex-disaggregated measures of asset control and ownership show the unevenness under current gender norms and there implies a need for innovative approaches, such as joint-ownership as an example entry point towards equal asset ownership (Johnson *et al.*, 2016).

Governments and institutions also contribute to a household's asset base, whether it be through the provision of education to children, health care services, or housing prospects. Sometimes, direct poverty interventions assist citizens who cannot operate as a normal working age person. Financial assets, such as social welfare grants, can be issued by government, local institutions, or even remittances from family. Besides individual and government, other community or philanthropy organisations are assisting with cash or food resources for the poorest. Communities can also be found to have co-ownership to assets, such as cooperative structure, where decisions of assets, specifically non-divided asset ownership, are made collectively (Iliopoulos & Valentinov, 2018).

Finally, the global source of assets is emergent, specifically in reference to digital identity. Transnational corporations have developed global platforms in order to provide a service which allows for trusted social interactions, which alone is an asset itself. The service can bring social or economic connections of people, reinforcing existing relationships (e.g. Facebook, Instagram), or developing new relationships, whether it be connecting travellers to homes (e.g. AirBnB) or to taxi services (e.g. Uber, Taxify, etc). This global asset source has been relatively beneficial to the connected, however it is not without its limitations. Individual digital profiles and the content produced from the networked interactions can be aggregated to become meta-data or big data, which is also a valuable asset. Such meta-data can be used to gain insights on trends or behaviour. Debates on the ownership or transparency of this meta-data, data protection, and privacy are ongoing, as well as how this data is used has been called into question (Allen, 2017; Bomu, 2019; Dance *et al.*, 2018). An individual or household can develop a diverse portfolio of tangible and intangible assets within their lifetime, much of which can be sourced from private, public, or community or global means. Now, with the definition of assets in hand, one framework, the Sustainable Livelihoods Framework, continues to challenge the notion of poverty and provides an operationalisation to review of non-financial assets that are accumulated by households and their dynamics in poverty reduction. Specifically, assets are described through a taxonomy, the five conventional capitals which has been popularised under this framework.

3.5 The Sustainable Livelihoods Framework

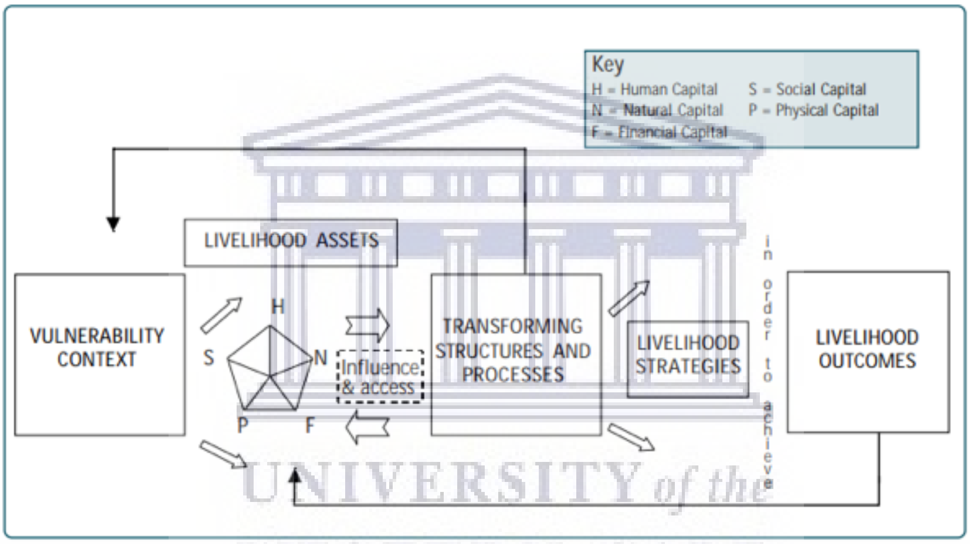
The Sustainable Livelihoods Framework (SLF) can be used as a process map to operationalise the portfolio of assets and how they can be used towards human development. The original SLF is an analytical framework which can help examine human development through a holistic country or region-wide analysis of ICT and poverty (DFID, 1999). Firstly, a livelihood can be defined as follows:

> *"A livelihood comprises* the capabilities, assets (stores, resources, claims and access*) and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks, maintain or enhance its capabilities and assets while not undermining the natural resource base" (Chambers and Conway, 1992, p. 6).*

In examining human development through a holistic lens, the SLF is composed of some well-developed components: resources, motivation (or livelihood strategies) and structural institutions as seen in the Figure below. The resource component (labelled as livelihood assets) would investigate the main basis of this thesis, which is the assets that a household possesses. Secondly, the motivation of households would be scrutinised through a process pathway (labelled as livelihood strategies and livelihood outcomes), illustrating how people can use their resources, gain the ability and tactics to take action using these resources, and at the end, reach a changed status of well-being. Lastly, integrated within the resources and motivation are the structural institutions. Basically, the external context of vulnerability, the policies and institutions (labelled as transforming structures and processes) are three SLF elements which are analysed and show how they either hinder or support a household's livelihood. It is through these three basic components that human development can be conceptually framed in a nuanced and holistic perspective.

Within a household, an inventory of assets is important, particularly should the assets be needed for liquidity as well as to help with future income opportunities. From development theory, the livelihood asset framework is helpful in providing a taxonomy of fundamental assets. In one example of a livelihoods asset framework, Scoones (1998) has listed capital that hold tangible aspects, such as financial capital, human capital, and physical capital. He also mentioned some capital that possess non-tangible characteristics, including natural capital and social capital. Overall, these five types of capital are conventionally applied to the sustainable livelihood framework, popularised by United Kingdom's Department for International Development in the late 1990s (DFID, 1999). The sustainable livelihoods framework, illustrated in Figure 2 below, provides an entry point to operationalise the various components that are embedded within human development. Since this period, the composition of household capital continues to change, and emergent are the possibilities of new capitals of exploration composed within a household's asset portfolio.

Figure 2: Sustainable Livelihoods Framework



Note. (pg. 2), Reprinted from "Sustainable livelihoods guidance sheets", by Department for International Development, 1999, DFID. p. 2. Copyright 1999 by Department for International Development.

Further iterations of the original DFID version of the sustainable livelihoods framework reflect on the changing nature of assets. Carter and May (1999) apply asset-based poverty, a concept later developed by May (2008), as grounded on a revised portfolio of assets. This revision includes an asset portfolio distinguished through capital: natural capital, human capital, social, political and legal capital, physical capital, and financial capital. Essentially, the May 2008 model broadens the components listed under social capital. Attwood and May (2015) go further in enhancing the agency portfolio, stating that psychological resources encompass personal characteristics and can touch upon the other resources. Kleine (2013) in her conceptual expansion of the SLF portfolio, further raises the concept of informational resources. The idea is that a person can hold the possibility of knowledge acquisition, and ability of processing information into knowledge as an intrinsic asset. The multiple capitals can be combined and support livelihood strategies that can improve individual and household well-being (May, 2008). The question however remains as to what current set of assets or capitals are sufficiently reflective of today's contemporary society.

I argue for the need to further augment the asset framework, changing the five conventional capitals to include an additional capital categorisation called the digital basket or a portfolio of ICTs. The next section goes through the five conventional capitals and the following chapter proposes a justification for the sixth capital, the digital basket.

3.5.1 Financial Capital

Financial capital, described as the capital base for a household (Scoones, 1998), can come through various assets: cash, credit/debt, savings, social protection schemes, insurance, remittances, wages and self-employment to name a few. First, cash can be kept or further stored within savings or credit mechanisms. The ability to store money or access credit helps a household maintain a decent life. However, it is noted that microfinance which is considered another financial intervention to improve the financial well-being of the poor was found with an inconclusive result (Duvendack *et al.*, 2011). Government can provide social protection programmes to assist citizens who may have limited ability to earn the same income as an able-bodied working person. The extra support may be distributed to young school children, the disabled or the elderly through various social welfare grants issued by government or other local philanthropic institutions.

In South Africa, social grants have been proven to improve the well-being outcomes of poor children (Coetzee, 2013), as well as to help alleviate poverty (Woolard & Leibbrandt, 2010). Social grants in the form of cash transfers are shown to be effective financial assets to move a household out of poverty. From the individual to community level, remittances are transferred regularly in low and middle-income countries from urban to rural locales, from overseas diaspora to their local village relatives. These financial resources also add to the household's portfolio of assets. Finally, wages and self-employment are other financial resources earned through the productive work of an individual.

While financial resources are lauded for their direct assistance in buying needed goods and services, not all financial resources have guaranteed the dynamic movement of individuals or households out of poverty. A critique of financial capital, especially for the most poor is that cash can be easily stolen and access to storage of funds like banks can be administratively difficult, leaving many people "unbanked" (Chaia *et al.*, 2012). Nevertheless, financial capital is extremely important in well-being, either initiating life strategies or facilitating the access and use of other assets within a household or individual's portfolio of assets.

3.5.2 Human Capital

Human capital has been noted for the ways that investments in schooling, on-the-job training, quality medical care, and information held by an individual may help them in the long run through improved earnings and consumption (Becker, 1962). They include the skills, knowledge, the ability to work and good health (DFID, 1999). This intangible capital is taken upon by people with the intention to seek higher productivity. Ultimately, an improvement on one's future wage should be viewed as the anticipated end result. The differentials in wages amongst workers are traditionally based on completed education levels and years of work experience.

Other knowledge or information is another aspect to Becker's (1962) human capital. He states "information about the political or social system… could also significantly raise real incomes" (Becker, 1962, p. 27). The human capital expansion to include cognitive abilities of an individual to choose appropriate processes or decisions could also influence employability and improved wages (Hartog, 2001). The ability to effectively search or put strategic spending towards finding job opportunities are meant to lead to higher earnings. The increases to earnings is a major payoff to human capital. The cognitive ability to determine the steps and processes of implementing new technologies alongside training of technological use would be advantageous traits in today's workforce and improve the employability of a person.

While formal education, training and work experience are the conventional aspects to human capital that can influence the economic well-being of a person, there may well remain other immeasurable factors, which understate the value of this capital. Cognitive ability or other unobservable human capital traits are particularly relevant in this contemporary period of ICT assets.

Critiques to human capital arises with Bowles and Gintis (1975) where they argue that human capital theory has not well considered the social institutions that influence the differentiation amongst low skill and high skilled workers. The human capital theory proposed by Becker (1962) leaves out the social reproduction of inequality and perpetuates the differences in wages, training, and schooling which leads to productivity. For example, the schooling system, which is trying to easily delineate out 'better workers', may be the contributor to further segmentation of wages for the workforce. In turn, this practice helps to continue the social reproduction of inequality and is a critique to use of human capital towards improved well-being. Despite some structural shortcomings, human capital remains an important asset for an individual and its related indicators postulate contributions towards an improved well-being.

3.5.3 Physical Capital

Physical capital takes on a material characteristic, including the basic infrastructure such as transport vehicles, shelter, electricity, water supply, sanitation and energy (DFID, 1999). It can also include producer goods such as tools and equipment in order to be productive and to earn a livelihood. Siegel (2005) lists household level assets to include productive assets (tools, equipment, work animals), household assets such as housing and physical household goods such as vehicles, radio or television, and stocks (e.g. livestock, food, jewellery). For basic infrastructure, such public goods can be accessed without paying while other times, it is accessed through a usage fee. Some physical goods can also be co-owned by a group or accessed through rental arrangements. Poor access to basic infrastructure and service provision can have implications to human health as well as be reflective of the substantial time used to conduct reproductive work such as fetching water and wood (DFID, 1999). The critique of physical capital ownership such as equipment, is that it can be relatively expensive for the initial cost and the further cost of maintenance can be financially burdensome (DFID, 1999). Yet the material good are the visible signs of wealth held by a household and valuable for provision of basic needs.

3.5.4 Natural Capital

Natural capital can be composed of natural resource stocks, including land, soil and water for agriculture, forest and marine resources, all of which are accessible to households in order to derive a livelihood (Scoones, 1998; DFID, 1999). On top of this base, the development of other environmental services (as in, air quality, protection from floods) could also be included which are over and above the possession of natural resources themselves (Mukherjee *et al.*, 2002). The degradation of natural capital can influence capital accumulation, such as the choice to invest in seed and equipment if soils are very poor for cultivation (Barrett *et al.*, 2018).

Natural capital is important as our health and well-being heavily depends of good quality natural capital (DFID, 1999). Negative implications of natural capital include the deterioration of environmental resources due to pollution as well as fragmentation of land ownership within poor households. Overuse of soil from farming can deteriorate soil quality and quality of water can be compromised from contamination from industrial waste. Mukherjee *et al.* (2002) state that natural capital was easier to capture in rural areas than in urban areas since the rural depend on the natural resource-base. Urban areas were found to be very polluted or natural resources were inaccessible to the poor in the urban cities.

3.5.5 Social Capital

Social capital, theoretically made popular across political discourses by Bourdieu (1986, p. 21) is defined as "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalised relationships of mutual acquaintance and recognition…" A household's social capital can include social ties to relatives, community networks, and other relationships of trust, as well as intra-household dynamics themselves (Siegel, 2005). The three main features of social capital are networks, norms and trust, which are then utilised by people to reach shared objectives together (Bourdieu, 1986). The idea of mutual trust and reciprocity is valued for its ability to lower costs of working together (DFID, 1999). Social capital can also be looked at as the ultimate ‘end’, using economic and cultural capital to gain the outcome of a social status within networks. There is also further evidence in South Africa which suggests that social capital is an important determinant of household welfare (Maluccio *et al.*, 2000). A case in India has found that social networks could positively influence income diversification (Johny *et al.*, 2017). At the other end, social capital in the United States was argued to be on the decline from the mid-70s to early 90s, and explained by the arrival of the television, as it displaced face-to-face social and leisure activities (Putnam, 1995). This argument comes specifically from Putnam’s own definition for social capital to be specifically based on norms and social trust that lead to cooperation in shared activities. However his definition of social capital is narrowly defined to be built and strengthened primarily through face-to-face interaction (Putnam *et al.*, 1994) and needs to be extended if it is to accommodate digitally derived social capital.

A critique of social capital points out the wide range of its definitions, that its usage is versatile across a variety of disciplines, and therefore issues with the heterogeneity of measurement is apparent (Schuller *et al.*, 2000). The most vocal argument against the popularity of social capital arrives from Fine (2010), who for the last twenty years has stated the complicity to use social capital without accounting for context and political economy. The poor are thereby left to improve their social connections and networks for enhanced well-being, yet little attention is placed on the external economic structures which perpetuates underdevelopment (Fine, 2010). Exclusion by certain targeted groups as well as strictly hierarchical relationships may be disadvantages of social capital (DFID, 1999). The conceptualisation of the term, social capital, undergoes various debates on its relevance, all of which is necessary for the development of any concept. As one of the newer capital, the process of including social capital as one of the five key capitals in the SLF reflects the need to adapt and to scrutinise capitals over time in order to sufficiently reflect societal changes. As a result, social capital is now a largely acceptable term across a variety of disciplines, including economic development, and a World Social Capital Monitor[5] is in progress.

The five conventional capital provides the basis of operationalising the review of non-financial assets and its dynamics around poverty reduction. This review of the five capitals has revealed some shortcomings, specifically on how to appropriately place contemporary assets such as ICTs. Aligned with capabilities, the standard of living of an individual can also vary over time based on what is of value to the person at the moment (Sen, 1999). Given that today's ICTs are of value to the poor, further dynamics can include the ways in which ICTs interact with aspects of social, political, economic, personal, and cultural capital that can generate a particular social outcome, whether it be life improvement or furthering inequality (Ragnedda, 2018). Building on this idea, one suggestion can be to update the SLF approach to include ICTs as a sixth capital.

3.6 Conclusion

In summary, this chapter grounds the theoretical concepts of poverty through the lens of the assets approach as well as reveals the two major research gaps, mainly 1) the appropriateness of the current five conventional capitals and 2) the lack of exploration of ICTs as part of the asset approach to poverty reduction. I illustrate how this study challenges some of the conventional notions of poverty, and suggest that ICT assets can be added to the theoretical framework. Firstly, the poverty trends illustrate that there remains poverty disparities across the global South despite some gains (World Bank, 2016; Sumner, 2012), and ongoing measurement has evolved the thinking of poverty. From conventionally looking at poverty based on the one static notion of an income threshold for a household, the concept of poverty has advanced to include multiple non-financial measurements as well as seen entry points to understanding the conditions which allow deprivation to persist or concede in contemporary society. This chapter has specifically illustrated the need to look at assets and their non-financial contributions in smoothing out consumption and thereby avoiding households from falling deeper into poverty (Carter and Barrett, 2006). In other words, the broadening of a household's asset base allows for diversification of activities to generate income and may become a pathway to

[5] World Social Capital Monitor website: https://sustainabledevelopment.un.org/partnership/?p=11706

poverty reduction (Moser, 1998; Bebbington, 1999). The chapter examines the current SLF to understand a household's asset accumulation, particularly through the review of five conventional capitals, and challenges the sufficiency of these capitals in today's contemporary society. As with social capital being added as the fifth capital and was followed by open scrutiny, the SLF can be treated as a dynamic framework which needs to adapt over time. Specifically, one suggested gap in the literature is around assets that expand to include technologies (e.g. mobile phones and the internet) within a household portfolio. Assets such as ICTs in the contemporary society, provide a refreshing theoretical perspective to human development and allows for the further investigation of its influence to reduce poverty, a literature gap worth further exploration.

4 CHAPTER FOUR: THE CASE FOR THE DIGITAL BASKET

4.1 Introduction

As outlined in the previous two chapters, an asset-based approach can be applied to address current research gaps with regard to understanding possible relationships between ICTs and poverty. In this chapter, I will first review some of the available ICT analytical frameworks to illustrate how an asset-based approach to studying this phenomenon can be assumed by using the Sustainable Livelihoods Framework (SLF). This framework addresses the identified research gaps that fail to understanding ICTs and poverty from human development paradigm. I will then describe the components of the SLF, detailing the specifics of four sub-groups of ICTs: digital content, physical ICTs, human capital for ICTs, and social capital for ICTs to provide the rationale for adding the concept of the digital basket to the SLF. As I will describe, this concept draws on an adapted version of the SLF (see May *et al.,* 2014b) as well as applies the Warschauser's (2003) taxonomy to build a contemporary inventory (for 2019) of ICTs at the household level.

4.2 Theories of ICTD

The research field of information and communication technologies for development (ICTD and sometimes referred to as ICT4D) explores the phenomenon of ICTs and their relationships to socio-economic development. In regards to human development, ICTs can be "multi-purpose technologies which could empower individuals to attain development outcomes of their own choice" (Kleine, 2010, p. 675). For example, mobile phones have been argued to be a transformative device, benefiting development on one hand, and, on the other hand, contributing to existing inequality due to the current structures of society (Carmody, 2012). The mobile phone has been identified as an 'enabler' or a technological tool that facilitates the activities of everyday life (Porter, 2012). Yet at the same time, there are also debated in the field and informed by research, about whether poverty levels can be changed by ICTs (a thread of discussions can be followed under the Boston Review initiated by Toyama (2012)). This ongoing debate is further supported by claims that the mobile phone is becoming a "new paradigm," and that ICTD has evolved into a new phase of the "per-poor" (Heeks, 2009, p. 15) or grassroots innovation, or the inclusion of poorer nations or communities in contributing to the innovative and digital space (Heeks, 2009). ICTD research has thereby gained traction around human development, especially within low and middle-income countries (Gomez, 2013a). A review of ICTD literature suggests that one dominant ICTD research topic is that of ICTs and their effect(s) on low-income and resource-constrained individuals and households (Gomez, 2013a). This ongoing research retains optimism that the lives of the poor can be transformed in terms of socio-economic functions as a result of their access to ICTs, while the less sanguine reflect on the minimum nature of well-being change by owning a mobile phone or accessing the internet.

In considering these diverse perspectives, research on the relationship between ICTs and poverty can be categorised into the three following development paradigms: 1) toward economic growth; 2) toward inequality; and 3) toward poverty reduction integrated within a human-technical system. Within ICTD research, much of the theoretical reflection of ICTs has been through the first two paradigms, one that takes an economic and transformational approach to society. Some of the researchers in this field have argued that low and middle-income countries can 'leapfrog' forward through economic growth, largely enabled by technological advancements in its institutions (Castells, 1999). In other words, if nations make significant investments in technological infrastructure, new industries in services can strive allowing these countries to skip conventional developmental stages (such as industrialisation). Through new and unconventional ways of doing business, modernisation through ICT services and products would then flourish and contribute heavily towards regional GDP growth and thereby converge on previous global disparities.

In contrast, the second critical development paradigm is that ICTs contribute to further inequality in human development. While some nations will undertake the technological investment route, Castells (1999) has suggested that other less-resourced countries may fail to invest, struggle to stay abreast with modern-day communication needs, and would thus fall behind in terms of its technological advancement relative to the rest of the world. These countries' inabilities to fast forward institutional changes through communication technologies would leave them with a large inequality gap within the country compared to other nations. Even within society, Brynjolfsson *et al.* (2014) have argued that global changes in labour due to technology would include repetitive and menial work being taken over by technology and the strengthening of wealth and work would be derived from a new creative elite. It is suggested that without strong public policy, such drastic personnel changes would see wealth flow to this new creative digital group while lower job opportunities and wages to less skilled labour-–all of which can reinforce inequalities. The differences in socio-economic attributes between the poor and the non-poor would widen with the increased availability of ICTs (Etzo & Collender, 2010). Heeks (1999) has discussed similar binary aspects of technological optimism and pessimism, and a recent review (Friederici *et al.*, 2017) has revealed that the internet and other ICTs' impact on economic development are inconclusive. Thus from these two paradigmatic perspectives, ICTs can be seen in one of two ways- either they support the acceleration of economic growth or reinforce social inequalities.

The third emergent paradigm is that ICTs can be neither economically transformative towards growth nor inequality. Rather, through their effective use, ICTs can promote human development and capabilities and thereby contribute towards improved non-material human well-being (Smith *et al.*, 2011). For example, through sectorial initiatives, governments can integrate ICTs in health, education, and public service delivery which can help improve the effectiveness of national development programmes and broaden the reach of these services to the countries' targeted populations (Kleine, 2013). Another human-centred approach is that of human rights and how those at the margins must be protected from violations and abuses of rights, particularly as digital processes become embedded in many aspects of our lives (Bachelet, 2019). This approach implies that ICTs can be used as tools that facilitate equity and social justice, a viewpoint that is most appropriate for a poverty reduction analysis. ICTs can also help people themselves reach their own chosen paths in life, facilitating the work or activities they choose to engage in towards the betterment of their daily lives (Kleine, 2013). This scenario emanates from an argument that communication technology amplifies the success or failure of existing human intent towards development (Toyama, 2011). Further to this point, ICTs do not replace the deficiencies which may already exist in a system (Toyama, 2011). For example, adding new computers to a classroom will not mitigate a situation where quality teaching does not exist due to a lack of teachers in the school.

ICTs can be no more than amplifiers of existing human dynamics; from an individual perspective, ICTs can enhance a person's decision around their livelihood strategy (Toyoma, 2011). Given that this thesis intends to better understand the ICT assets and its relationship to poverty reduction, this third paradigm that employs the human development perspective is most fitting for this study's analysis.

There are several operational frameworks that help carry out the third paradigm, and specifically understanding human development through the complexities of ICTs and poverty reduction. Some frameworks strongly emphasise the external institutional aspects or the policy and regulatory aspects within the system. As for institutional frameworks that examine ICTs and poverty, Harris (2003) was perhaps one of the first researchers to illustrate an ICT and poverty alleviation framework from an ICT pro-poor policy perspective. Referring to a social policy commitment for targeted poverty alleviation directives, his conceptual framework breaks down components of ICT strategies, infrastructures, institutions, services and access points which assist disadvantaged groups. The framework provides well-developed contextual and policy-driven categories, yet overlooks describing the human side, or the micro-level household ICT use and features around human choice and motivation in accessing or using ICTs.

A socio-technical system could be a useful way to operationalise and reflect on the nuanced interactions between ICTs and people, and how they unfold into profound transitions towards human development (Scoones, 2009). A systems framework would provide both micro-level (within a household) and macro-level (external context) linkages in understanding change amongst the most impoverished (Carney *et al.,* 1999). Besides understanding the relationship between ICTs and poverty at a household level, the systems approach would also analyse the influences of broader social, economic, and political changes. This systems approach offers the opportunity to include complex and nuanced micro-macro level analysis.

To address the limitations in frameworks that predominate an institutional entry focus, this section discusses three people-centred conceptual frameworks that could help to analyse the relationship between ICTs and poverty are: 1) the Actor Network Theory (ANT); 2) the Empowerment Framework; and 3) the Sustainable Livelihoods

Framework (SLF). In discussing these three frameworks in-depth, I will illustrate why the SLF is the most suitable framework to examine the holistic nature of ICTs and its connection to poverty reduction.

The Actor Network Theory (ANT) highlights the behaviour of individuals who are adopting technology (Avgerou, 2010). In ANT, the process concentrates on technological use by individuals, their behavioural changes and the adjustments to the technology to enable this behavioural change (Avgerou, 2010). The theory is useful in being able to follow the progression of a project from the beginning to conclusion, which analyses the successes and failures within the project (Walsham, 2017). A stakeholder analysis within a project utilising ANT can also determine if actors have agreed or are aligned to the terms of the project (Andrade & Urquhart, 2010). This theory's particular specificity to the behaviour of the individual limits the social understanding of ICTs, as it does not allow for analysis of ICTs' place within a larger structural or complex system (Walsham, 2017).

The Empowerment Framework is another people-centred conceptual framework in ICT and development (Alsop & Heinsohn, 2005; Sam, 2017). Rosenberg and McCullough (1981) defined empowerment through a term of "mattering", or people using perceptions of others in society in understanding their significance to the world. This concept has also been defined "as a person's capacity to make effective choices; that is, as the capacity to transform choices into desired actions and outcomes" (Alsop & Heinsohn, 2005, p. 5). Empowerment within this framework seeks to observe the agency of people (particularly the poor) to then reflect on their own current arrangement, build scenarios to resolve their issues, and then take steps to alleviate their impoverishment (Sam, 2017). Within an Alsop and Heinsohn (2005) and Sam's (2017) empowerment framework, the components of agency, institutional structure, capabilities, and degree of empowerment work together to reach the end goals of development outcomes. Degrees of empowerment can be specifically viewed for the following elements: existence of choice, sense of choice, use of choice, and achievement of choice (Alsop and Heinsohn, 2005; Kleine, 2010). Kleine (2010) has further extended the empowerment framework by arguing that one can explore an individual's ability to make choices towards their own well-being. These choices are based on acquired resources within their external context. The empowerment framework can investigate the deeply rooted internal issues of the most disadvantaged while placing it in the centre; yet the framework only allows for such investigation within the context of an individual's external environment.

Complementing the empowerment framework, Sen (1999) has further guided the discussion of human development as life improvement based on the measurement of enhancing a person's freedom. Human development is dependent on what a person values, and on a person's ability to determine and prioritise their required set of capabilities (Sen, 1999). Capabilities are defined by a person and have a certain combination of functionings, which are defined as activities that one values doing or being and are possible to achieve (Sen, 1999). A person has a set of capabilities which is the motivation and ability to improve their lives and thereby enhance the freedom that they seeks. A capability can be influenced by the available prospects of making a living and other social or psychological consequences of poverty and exclusion (Moser, 1998). Human intention contains the notion of freedoms as described by Sen (1999) and helps to further explain empowerment that can be enabled within households in a nuanced way.

The empowerment framework is especially useful for research using participatory or ethnographic methods with the intent of investigating issues of the most marginalised, which typically have very difficult variables to measure. For example, psychological agency, or development outcomes like political freedom are variables that remain under developed in measurement and would be extremely difficult to measure in a large aggregate survey. Overall, the ANT and Empowerment Framework are important for their people-centred focus and how they attend to the ICT artefact and its respective systems. However these particular frameworks are not congruent with this study that seeks to analyse national level data and its context. Instead, a human centred framework is most applicable to understand the phenomenon of ICT assets of households at a national scale and within the specific country context of South Africa. As will be discussed in the following section, the human-centred framework of SLF can address these above discussed limitations, as it incorporates the ICT and poverty reduction nexus and has been tested in previous iterations at a national scale.

4.3 The Sustainable Livelihoods Framework and ICTD[6]

Of the available ICTD frameworks, the SLF is most appropriate to analyse country-level household data about ICT possessions and use as well as highlighting the specificities of national and sub-national ICT policies and institutions. This approach also offers the suitable components to help understand the complexity of a household's well-being, and, in the context of this study, the South African context of growing inequality and contemporary digital change.

The sustainable livelihoods approach has been previously applied to ICTD studies. Dorward *et al.* (2003) have acknowledged the absence of technology from the original SLF as well as the difficulty in placing it as an appropriate component. In some cases, adaptations of the SLF were utilised to address ICTs, particularly in reflecting on the five conventional capitals and the livelihoods strategies (Albu & Scott, 2001; Chapman *et al.*, 2004; Duncombe, 2006) Technologies could be acknowledged for their use within livelihood strategies as well as identified as livelihood assets (Dorward *et al.,* 2003). Kleine (2013) has gone further by extending the SLF assets and livelihood strategies to include the concept of empowerment. She has expanded the list of capitals (to include education resources, psychological resources, and health, for example) and structures (including specific technologies and innovation aspects) as well as augmented the framework with concepts of agency and degrees of empowerment. She has termed these combined changes--the choice framework. The choice framework embodies Sen's (1999) original intention to view value from the decisions made by the individual. The choice framework has been useful in explaining the various components and complexities of achieving a high quality of life amongst telecentre users in KwaZulu-Natal (Attwood & May, 2015).

As for livelihood outcomes, the digital poverty concept being used as an external predictor in the multi-dimensional schism of poverty measurement (Mascarenhas, 2014; May *et al.*, 2014a). Various adaptations of the SLF have been useful in allowing for holistic analyses that focuses on ICTs. There is also a technological and

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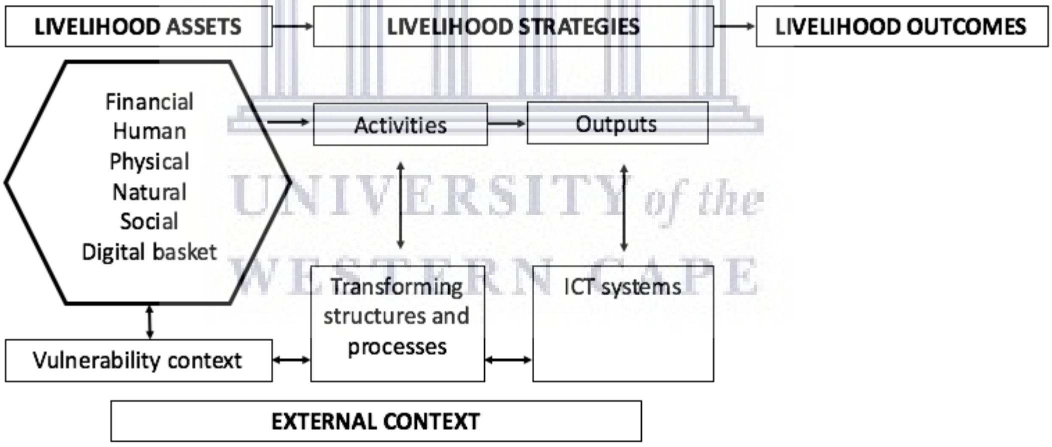
[6] The concepts of the SLF are presented in summary in this section and it was not meant to deliver a comprehensive overview. Aspects of technologies are highlighted with the SLF concepts.

telecommunication infrastructure discussion within public policies and institutions, and its effect can be found in the provision of public services and markets to the overall population. The SLF has also been adapted to expand analysis of the external context and specifically to include the ICT systems (May *et al.,* 2014b). Given the nature of this thesis to analyse context at a national level and the application of the ICT system has limited to East Africa study, this May *et al.,* (2014b) enhanced SLF is chosen as the operational framework and to be uniquely applied to this thesis from the South African context.

Figure 3 provides an illustration of the enhanced Sustainable Livelihoods Framework used for the study. As mentioned, the May *et al.,* (2014b) framework is used for this thesis however, there has been one further addition to the framework. The digital basket is an additional livelihood asset or a sixth capital amongst the five conventional capitals.

Figure 3: Enhanced Sustainable Livelihoods Framework



Source: Author, adapted from May *et al.,* (2014b) and DFID (1999)

This sixth capital provides this refreshing theoretical perspective to resolve the previous arguments in Chapter 3 of how to categorise the unique household ICTs particularly in the context of today's contemporary society. It also further provides an appropriate framework to the issue raised in Chapter 2 on the current lack of research that analyses the multiplicity of ICTs and its relationship to poverty. The next section builds on Chapter 3 around assets and takes the argument further to rationalise the concept of a digital basket for a household.

4.4 Resources or Livelihood Assets

The five key capitals of the SLF as described in the previous chapter are well established and have been scrutinised in development studies literature. Financial, human, social, physical, and natural capital concepts have brought about distinctions of what resources may make people 'wealthy'. In their individual portfolios of the everyday, the money one possesses, the highest educational levels attained, and the number of networks with colleagues, friends, and family all form the accumulation of household resources. Yet, as previously discussed, markedly missing from the literature on these capitals and other discussions about household assets has been on the possession of contemporary ICT assets. Given the important role ICTs play in contemporary society, they warrants a place within the asset portfolio of a household. Conceptually, they can be analysed in two different ways. Firstly, ICTs can be classified as a component within one of the existing five SLF capitals. Today's accessibility of communication technology provides a contemporary rationale to include such assets, measured as isolated counts within physical capital ownership (such as the mobile phone) as seen in existing micro-level analysis (e.g. Gillwald and Stork, 2008). The digital infrastructure and investments in digital hardware can also be categorised under physical capital. The emergent concepts of digital literacy and ICT competence can help improve measures within human capital, especially with the expected higher demand of digital skills for future employment. In other words, the digital skills to use technology are subsumed under human capital. Urquhart *et al.* (2007) have also revealed how ICTs conceptually have aspects within the social capital dimension through improved knowledge and information within social relationships. ICTs can interact with existing capital leading to both positive and negative outcomes (Ragnadda, 2018). The limitation in using the existing five key capitals is what has been argued as digital convergence, meaning that some physical ICTs may only work effectively when they operates in conjunction with other intangible ICTs and therefore blur the distinct lines of the existing five categories (Allen, 2017).

Given this limitation, a second way to consider ICTs within the sustainable livelihoods framework is to augment the current arrangement and add a sixth capital, or a bundle of ICTs. Bundling household ICTs addresses the issue of digital convergence by allowing for the unique synergies of the tangible and intangible elements to operate together. To date, research on a portfolio of ICT household assets at a national level and within an SLF is limited. May e*t al.* (2014a) developed an ICT index to measure ICT assets at a national scale. Various physical assets such as the computer and mobile phone were combined with intangible assets such as connectivity (e.g. an internet connection–either mobile or fixed), and services (e.g. email and mobile applications). This combined score became a household's ICT access level and this level was measured at a country representative level in four East African countries.

While the May *et al.* (2014a) study provided a clear example of a digital index, the number of ICT indicators used in the study was limited, as well as its applicability to only to four countries in East Africa. Thus, the digital basket proposed in this thesis provides another unique perspective that builds on this East Africa work by providing a larger number of ICT indicators and focusing on the context of another African country, South Africa.

4.5 Digital Capital

In this section, I begin by providing a theoretical overview of the concepts of digital capital, and how it has been conceptualised in the literature. I then unpack the concept of ICT household assets to justify the need for the concept of the digital basket to be added to the SLF. Early ICT literature made mention of the concept of 'digital capital', yet it was in the context of the business ecosystem, meaning it was limited in terms of being adapted to the household level perspective (Austerberry, 2004; Brynjolfsson *et al.*, 2014; Tapscott *et al.*, 2000). More recently, the concept of a 'digital asset' has gained some traction in the field of ICT research, being defined as "digital things with value, digitally produced and realised in a digital consumption" (Blanke, 2014, p. 8). Industrialisation and its means of production through technology bring forth the digital capital concept from a firm perspective. Brynjolfsson *et al.* (2014) have referred to the idea of digital capital as technology units that help add value within a factory production process. The intention is for the digital component to harvest innovative process change within factory operations and thereby improve productivity.

Digital capital has also been referenced in regards to its relationship to human ability, driving business know-how in relation to a knowledge business economy (Tapscott *et al.*, 2000). While Tapscott *et al.'s* (2000) conceptualisation of digital capital is aligned to human development, the contents of their book mainly reference the emergence of new business web models. The concept of "digital ecosystems" furthers the emerging business proposition of digital objects as going beyond that which is stored or managed for a company. Rather digitised content is around processes of digital value creation and production as it evolves through human- and machine-enabled crowdsourcing (Blanke, 2014). The crowdsourcing aim is that businesses will succeed by integrating human and computing (by outsourcing collective intelligence online) into production processes (Blanke, 2014). Crowdsourcing can use large aggregated datasets on human behaviour to build algorithms and help make predictions for future processes, as seen in the example of artificial intelligence for health (including processes for diagnosis and treatment) (Davenport & Kalakota, 2019).

Austerberry (2004) has applied the concept of business property to digital media content, whereby such content has been assigned intellectual property rights. As new content is created, media archives can be leveraged by re-using previously created material for such new productions (Austerberry, 2004). This literature promotes the benefits for a business to consider the organisation of their ICT assets in order to use their digital objects more effectively and reduce content development redundancies (Austerberry, 2004). In application, the term, 'digital asset management' has concentrated on the mechanisms of archiving the rich diversity of media assets, and creating a framework for the monetisation of these assets within a firm (Austerberry, 2004). In the electronic banking sector, digital capital can be viewed for its internet customer capital (or customer trust, loyalty, analysis of complaints, and so on) and internet service capital (or security of transaction, stability, speed of transactions, and so on), all of which are gains to the consumer for its convenience and lower cost of transactions (Liu, 2008). The term 'digital asset', in this regard, has been limited to intangible digital content from a business perspective. These above business case perspectives are clear on ICT's value added to business elements, but limited in underpinning digital capital within a household micro-level context.

This next section focuses on ICTs from a household perspective and responds to one of the research questions, whether ICTs can be theoretically constituted assets. Reflections on ICTs at the household level reveal some further conceptual underpinnings around personal property. Some domestic ICTs have financial value, and one insurance website, Everplans, contains details of how households should consider ICTs under three categories of property: personal digital property, personal digital property with monetary value, and digital business (Everplans, nd).

Some digital property can be of personal or sentimental value with little monetary value, while others are noted for their financial value, either owned personally or within the person's business. From a legal perspective, four ICT attributes have been proposed: 1) access to information, 2) tangible ICTs, 3) intangible ICTs, and 4) metadata (Haworth, 2014). In respect to intangible assets, the United States has circulated the 2015 Revised Fiduciary Access to Digital Assets Act, defining 'digital assets' specifically as:

> "types of electronic records currently in existence and yet to be invented. It includes any type of electronically-stored information, such as: 1) information stored on a user's computer and other digital devices; 2) content uploaded onto websites; and 3) rights in digital property. It also includes records that are either the catalogue or the content of an electronic communication." (Uniform Law Commission, 2015, p. 6)

This quote illustrates that an ICT can holds an intangible goods definition limited to the electronic record and the intellectual property rights attached to it.

Other concepts of digital capital are far broader, such as from a media and communications perspective, whereby digital capital is defined as a pre-determined 'set of dispositions' gained by individuals who use ICTs in contemporary times (Park, 2017). The disposition gains include a person being fully equipped with digital readiness or having the habit of using ICTs for their lifetime, leading to effective engagement (Park, 2017). Others have referred to personal ICTs to include both the physical artefact and intangible product owned by a person. Similarly, the concept of digital belongings is defined as "a mix of artefacts one has created and gathered oneself, institutional records, and published media" (Marshall *et al.*, 2006, p. 1). What distinguishes ICTs from other assets are the blurred lines of one digital product possessing a network of both material elements (e.g. the hardware such as computer components, mobile phones and storage devices) simultaneously with social or intangible elements (e.g. software, the internet, cloud storage) (Oosterlaken, 2011). ICTs are also multi-dimensional in their function, and have the ability to store, transform and transmit information, which confers the capability of two-way knowledge access and creation (Oosterlaken, 2011).

Digital capital has been defined as the combination of accumulated digital competences (or a set of internalised abilities and aptitudes around information, communication, safety, content-creation and problem-solving), and "externalised resources" (digital technology) (Ragnedda, 2018). Such a conceptualisation, thus makes ICTs a different 'commodity' than, say, chilled food or physical mobility. From a community perspective, digital capital is revealed by the available resources (e.g. internet infrastructure, online information, communication tools and digital literacy and skills) and the benefits being utilised by members themselves (Roberts & Townsend, 2016). Integrated digital products and services can result in a system of interactions, so people can benefit from the multiplicity of services and create socio-economic opportunity for themselves (Fransman, 2010; May *et al.,* 2014b). It would therefore be fitting to categorise physical ICTs and their complementary intangible components together as a distinctly embedded unit.

In an applied examination of ICT portfolios, one study on the inherited technologies of the bereaved looked at the ownership of 11 ICTs left behind by the deceased (Massimi & Baecker, 2010). In the case of tangible goods, like a computer or television, the items were easily inherited, but intangible assets such as email or online bank accounts were either missed or destroyed (Massimi & Baecker, 2010). This legal interest in ICTs in regards to executing the estate of the deceased is a useful and pragmatic starting point; however, it falls short in including the ICTs of those who may still be living, such as digital skills and literacy and social networks.

Another case that reviewed household ICT portfolios looked at changes over time; in 1970, households in the United Kingdom had four consumer electronics; whereas, in

2004, households had 17 consumer electronics (Martiskainen & Coburn, 2011). Again, this finding illustrates household changes in the composition of electronic devices within a household over a particular time period and misses out on the intangible aspects of content. In another UK study of individuals, an index of digital capital (which look at components of digital access and digital competences) has illustrated a positive relationship to income (Ragnedda *et al.*, 2019). In this case, the digital capital was built on four sub-components of digital equipment, connectivity, time spent online and support and training for the digital access part. In addition, five sub-components of information and literacy, communication and collaboration, digital content creation, safety and problem solving for the digital competence part were also included (Ragnedda *et al.*, 2019).

Some studies have listed ICT ownership (as in a list of physical ICT equipment) within telecentre establishments and amongst households (May, 2012c; Mbatha, 2016), giving a baseline of the composition of digital devices that can be possessed. In the South Africa context, the aggregated household consumption expenditure of ICTs show salient consumption levels in telecommunications, broadcasting and information supply services (Statistics South Africa, 2017a). Individual ICTs are reported annually at a household level, but not combined as an ICT asset portfolio. Given the paucity of work in this area, I argue that the current nature of ICT assets is exceptionally unique and needs further analysis as its own capital category, the digital basket. Aside from the applied cases (e.g. May *et al.,* 2014; Ragnedda *et al.,* 2019), there also remains a lack of literature which empirically tests the concept of digital capital (Ragnedda *et al.*, 2019). Understanding household ICTs from a portfolio standpoint would advance the debate on overall asset compositions as well as provide a useful way to reflect on contemporary additions around poverty reduction.

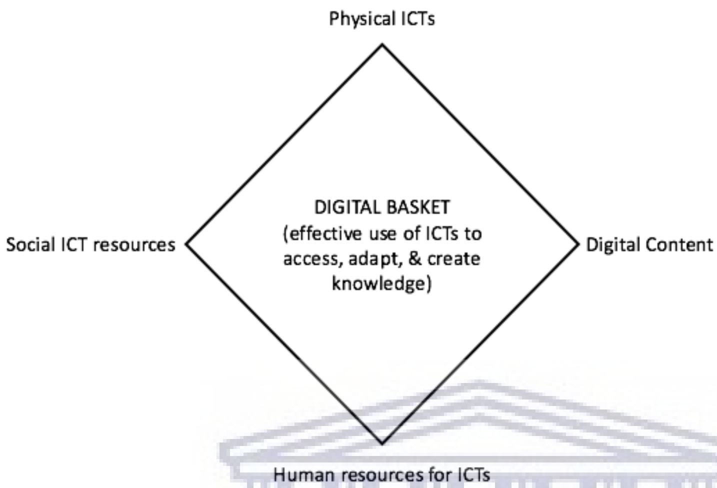
4.6 Digital Basket

The digital basket is conceptualised as a portfolio of ICTs specific to the household that have tangible and intangible aspects that work synergistically and bring unique value to the lives of household members. This term attempts to differentiate from the existing digital capital definitions which has one side around business elements and has another side that provides broad descriptions at a household level. As mentioned in Chapter 1, the term 'basket' has been derived from poverty terminology, specifically the 'reference food basket' which is a representative group of food items commonly consumed by a household and through caloric calculations, a food poverty line is determined (Statistics South Africa, 2018b). Given that the reference food basket is limited to food consumption, the digital basket expands exploration of commonly owned ICTs held by a typical household and examines these ICTs from a human development perspective.

This section answers the research question what group or sub-groups of ICT devices, services and skills can be identified at a household level. In this case, the digital basket is a broad asset group which can be defined by four specific ICT sub-groups of digital content, physical devices, digital skills and networked interactions and specifically how these ICTs are most effective when working together. For example, a physical digital artefact is required in order to refine the practice of, say a non-tangible asset of digital literacy. The continued use of ICTs can make a person digitally literate and thereby build up their digital skills or interaction with others online. The same ICT asset can be rendered ineffective unless household members can maximise its usage and practice. Computers can only function effectively by an individual when they possess a mix of competent digital skills, stable internet broadband, and up-to date applications. The physical ICT cannot function effectively when isolated from the 'intangible' human competences, appropriate digital content and networked social interaction.

To meet this study's research objective of finding an appropriate mechanism to look at household ICTs, Warschauer's (2003) taxonomy can be used to understand the components of the digital basket. His disaggregation has reflected how social inclusion, through ICTs, goes beyond the provision of physical products, like computers, and instead occurs through a group of resources that could produce proficient ICT users. These technology-associated resources are combined and essentially lead an individual to improved social inclusion. As illustrated in the Figure 4, Warschauer's work (2003) has suggested that four categories around ICTs for social inclusion taxonomy and it has been updated to make up the ICTs within a digital basket: digital content, physical ICTs, human resources for ICTs, and social ICT resources (p. 47).

Figure 4: Digital Basket and Sub-Components



Source: Author, adapted from Warschauer (2003)

In Table 6 below, Warschauer's original four classifications are listed in the first column followed by the 2003 list of the ICTs in the second column. The third column provides an expanded list of contemporary (2015) household ICT assets, which are classified under each of the four categories. This 2015 list is informed by the previous section on household ICTs and the need to create an ICT inventory list for estate planning as well as to match within the thesis timeframe from 2005 – 2015. I have composed this updated list by drawing on a few different resources. The first is the United States Fiduciary Access Act (2015), which has provided a reference template of possible ICT assets to consider when estate planning. Some of these ICT artefacts are included in the 2015 inventory list. The second resource is from the United Nations' inventory of expenditures called the Classification of Individual Consumption according to purpose (COICOP). This document has listed a number of ICT expenditure items that are expected to be included in 2019 version of this UN text (United Nations, 2018). Finally, I have also drawn on a supply-side discussions of the digital economy around goods, software, infrastructure, services, retail, and content on the ICT sector (Bukht & Heeks, 2017). While this list is currently exhaustive, further evolution can be anticipated as new consumable household items come to market; some ICT goods and services are replaced or re-envisioned, and others may become redundant. The description of application of ICTs provides a glimpse of household ICT inventories in a 2015 contemporary society in a useful taxonomy based on Warschauer's (2003) four categories.

Table 6: Four Digital Basket Categories and the Applicable ICTs

Digital basket sub-category	Warschauer (2003) definition	Household ICTs within a revised (2015) definition
Digital content	Digital content and language	* Downloaded app or tools such as digital software (Microsoft Office, LibreOffice), video games, mobile applications, Artificial Intelligence (AI)/Machine learning apps (e.g. TurnitIn, Grammarly), communication tools (e.g. Skype, Facetime, WhatsApp or Facebook Messenger) * Downloadable content like third party photos or videos (e.g. clips like Youtube), electronic books, music / podcasts (one-off purchase or rental) * Domain name costs and hosting services for website portals * Personal website, databases, and blogs that you produce and manage * Intellectual property (your own copyright digital materials, trademarks, any code you have written and own)
Physical ICTs	Computer and connectivity (internet infrastructure, and public access venues)	* Physical digital artefacts: telephones (including mobile phones and smartphones), computers (laptop or desktop), tablets, digital music players, e-readers, digital cameras, and other digital devices * Previous non-digital artefacts which are becoming digital (via connected sensors or the Internet of Things): radio, smart television, satellite dish, television digital satellite television (DSTV), and other domestic appliances * Dedicated digital storage (in physical device or online): flash disks, external hard drives, compact discs (CDs), cloud online services and accounts (e.g. Dropbox and iCloud), (continued)

Digital basket sub-category	Warschauer (2003) definition	Household ICTs within a revised (2015) definition
Physical ICTs (cont'd)		* Peripherals including printers, computer screens, digital parts (wires), accessories (e.g. mouse, keyboard headset, speakers, and so on), modems, 'wearables', drones, 'smart technologies', third generation (3G) dongles, replacement parts for ICTs, robotics * Access to 3G, or other mobile GSM, fibre optic, ADSL cable installation, and other internet connectivity services * Access to landline telephones or DSTV connectivity services (wired)
Human Resources for ICTs	Literacy and education Electronic Literacy (including computer, Internet-based information, multimedia, and computer-mediated literacy), Computer education and computer-enhanced education	* Human skills retained from computer or digital device/application certifications, computer training courses (no certificate), completion of online subjects offered through offline, blended or massive open online courses (MOOCs) * Production capability in digital services by household member (e.g. teaching online English course, virtual assistant) * Skilled labour for physical product repairs, maintenance, or installations for third party services * Labour that delivers paid digital content and services (e.g. Mechanical Turk, Fiverr)
Social ICT Resources	ICTs through community development and institutional reform virtual communities, shared community resources, social mobilisation Government transparency, citizen feedback, civil society	* Any online accounts (including email and communication accounts & their contents) * Accounts to manage money or hold money: digital remittances & bank accounts, PayPal, loyalty rewards accounts (credit card, airline, car rental, hotel, and so on), bitcoin accounts, shopping accounts (with stored information on your bank details), crowdfunding accounts * Membership to digital oriented groups (e.g. computer clubs, LAN parties, and so on) * Digital identity: issued by national government, online accounts for photo or video sharing accounts (e.g. Flickr, Picasa, (continued)

Digital basket sub-category	Warschauer (2003) definition	Household ICTs within a revised (2015) definition
Social ICT Resources (cont'd)		Instagram, YouTube, video gaming) including the personal data and interactions you provided, and its metadata * Online accounts for other social media accounts (e.g. Facebook, Twitter, LinkedIn, Pinterest) or media account subscriptions (e.g. video-on-demand, Netflix, Spotify, and so on) * Online accounts for digital platforms that facilitate market entry, services and/or fees (e.g. administration via AirBnB, Uber, and so on), shopping accounts (e.g.eBay, BidorBuy, Gumtree, Facebook Marketplace)

Source: Author, adapted from Warschauer (2003)

Having provided an illustration of how I am envisioning Warschauer's (2003) taxonomy to be used and specifically listing the contemporary ICTs that can be obtained by a household by 2015, in the next section I will describe in depth each of these categories in the sub-sections that follow.

4.6.1 Digital Content

Digital content is an intangible aspect of a digital basket and equates to online digital materials that cater to a range of communities and are available in a diversity of languages. Warschauer (2003) originally described digital resources to include content, language, and applications available through the internet, all of which respond to the needs of new users. Digital production is that the "end product or service might itself be digital or digitally transmittable" (Graham, 2019, p. 2). The digital resources would meet the need of locally relevant information (for example, topics of health, education, and cultural websites), as well as sufficiently cover language appropriate content.

In its definitional expansion, this digital content category can also comprise various intangible software, content applications, and services. In some applications, software platforms are purchased, leased, or provided for free (e.g. Microsoft Office, Google Chrome, and so on) in order to access and use digital content. The application or 'app' allows for access to or consumption of information; however, it can also encourage collaboration and production of new material that is provided by the user (Alvermann *et al.*, 2018). Within a mobile device or computer, applications such as AirBnB and Google Maps allow users to access information, as well as allow people to reciprocally provide reviews to restaurants and accommodations. Some apps such as Grammarly or TurnItIn include the use of machine learning or artificial intelligence for its content or services. Services such as Wikipedia also provides crowd-sourced digital content that is downloadable and accessible to households. Similarly, GoFundMe (and various crowd-funding alternatives[7]) is an example of how individuals can create their own content via a webpage in order to crowd-source funding.

The United States government has referred to digital content as any electronic records that are stored or uploaded online (Uniform Law Commission, 2015). The digital content includes downloaded material not created by the household, such as third party digital books, music, applications, software, photography, and so on that is retained by the household. Content can also be part of a service that is rented or used through subscription basis and is not necessarily owned by the household, as seen through video on demand or the Netflix content streaming services. Public libraries and privatised journals have also allowed for the 'rental' of services, which allows a user to view a book or content for a limited period of time, with or without a fee. Such digital services blur the line of household ownership, as, in some cases, the access to applications or services are the asset itself, rather than the retained ownership of digital material.

Digital content can also include original digital materials that are created by the household themselves, such as photos or documents produced for personal or professional reasons. Austerberry (2004) revealed how archives of digital media can be re-used to create new material for future productions, giving digital content endless possibilities within households. The production of digital material by a household also further expands the diversity of knowledge in the online community. Website domains and intellectual property created by a person are also included as

[7] GoFundMe crowdfunding alternatives: https://doublethedonation.com/tips/gofundme-alternatives/

digital content. Individuals and households accumulate digital content either through the purchase of new products or services or by producing their own digital content.

4.6.2 Physical ICT Capital

The physical ICT category can consist of the physical products, such as computers and mobile phones, as well as domesticated and previously 'non-digital' items such as the analog television, the fixed line telephone, and assorted media players (like hi-fi stereos or DVD players). Warschauer's (2003) original list was brief, and mainly described physical resources such as the access to internet connectivity and computers. Today's physical ICTs, however, can be expanded to include all new tangible ICT products such as tablets, telephones, and their peripherals (e.g. printers and speakers). Conventional media ICTs that were previously non-digital, such as smartphones, smart televisions, and digital radios, can also be included. These previously analog[8] (or essentially offline) products are evolving, and the convergence or the "reorganisation of the economic structures and social practices for the provision and consumption of a broad range of communication and information services" (Allen, 2017, p. 184) affect the evolving design of digital cameras, televisions, and radios.

There is also recognition of firmware or an embedded software that is now found in previously analog goods such as appliances (e.g. refrigerators and ovens), vehicles (e.g. car sensors or the latest Tesla car), and many ICTs (e.g. computers and entertainment devices) to allow for programmed control of the equipment (United Nations, 2018). The advances of these latest technologies are revealed through the integration of the devices either as digital peripherals which are compatible or as internet-mediated platforms (e.g. the Siri voice assistant on an Apple Phone and other personal applications using artificial intelligence). These items can also be digitised and absorbed within another ICT (e.g. cameras and radio can be found embedded within a smartphone).

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[8] Analog devices "record data linearly from one point to another" and thereby "read the media, such as tapes or records, by scanning the physical data off the media" (Source: https://pc.net/helpcenter/answers/difference_between_analog_and_digital)

New ICTs have entered into the market, some of which were not imaginable in 2003, when Warschauer developed the taxonomy. Drones, for example, have the ability for individuals to own them and take local topographic images that were previously limited to satellite imagery. Another new ICT product is portable digital storage, which can be a physical, through a universal serial bus (USB) stick, or virtual, as seen in cloud storage. Retaining storage services usually requires either ownership of a physical device like a portable hard drive or accessibility through an online server and retained through a once-off cost or time-bound payments (e.g. monthly or annually). Such virtual online services blur the lines of ownership, as the data storage can perhaps be more appropriately to be classified as access and use of intangible digital services rather than ownership of them. Another example of such ICT is emerging technologies, such as wearable technology, that allow individuals to track various health elements (e.g. a device that records their heart rate and number of steps walked in a day) on a smart watch or mobile phone. Again the physical device requires access to an intangible service or application (paid or unpaid) for personal data to be tracked, resulting in blurred lines as to whether the app or the metadata collected is necessarily owned by the individual.

The physical forms of ICTs seems to be boundless as newly engineered products come to market to meet the needs of households. As Warschauer (2003) categorised in his original taxonomy, access to internet connectivity is a physical telecommunications infrastructure, whether it is wired or wireless broadband. Connectivity could also be the ability to access internet services within a nearby public access venue or cyber-café. This access is not necessarily owned by a household and, in most cases, a dominant service provider leases the access to its services. The ability to access internet connectivity (or other communication connectivity) can be seen as an asset in itself, ensuring that households are able to utilise their physical devices and information available online.

4.6.3 Human Capital for ICTs: Digital Literacy and Skills

Human resources related to ICTs can encompass a wide set of generic digital literacies, all of which are important for social inclusion and participation in using physical ICTs and their respective digital content. This category comprises of the intangible investments in human capabilities with regards to digital skills. Through the investment input of these literacies, a person could gain in savings, efficiencies, and improved quality of life through better abilities to make decisions.

Digital literacy has unique cognitive and complex aspects that are required to effectively use various ICT products. For example, Warschauer (2003) broke down digital (or electronic) literacies into four sub-categories: computer literacy, information literacy, multi-media literacy, and computer-mediated literacy (p.111). Computer literacy is defined as basic skills needed to access information from computers is accessible (e.g. proficient understanding, processing, and utilising) (De la Fuente & Ciccone, 2003) or "minimum knowledge, know how, capabilities and abilities about computers" (Bork, 1985, p. 33). Digital literacy is different from what is today distinguished as 'computer literacy,' which concentrates on the technical aspects of the computer and its applications. The concept, digital literacy expands from solely computers being used as the ICT platform, given today's convergence of mobile phones, computers, and other handheld digital devices. Rather, what is required is a new understanding of cognitive skills and abilities that move beyond basic typing and reading skills. Eshet-Alkalai (2004) provided some conceptualisation around 'digital literacy' through a topology of five aspects: photo-visual literacy; reproduction literacy, branching literacy, information literacy, and socio-emotional literacy. Such digital literacy is of higher order and is proposed to be vital to contemporary human capital and a productive labour market in its pursuit of economic change (Claro *et al.*, 2012).

Digital competences expand from digital literacy to include the types of digital skills required to perform work activities effectively and in a timely manner. In addition, advanced 'electronic or e-skills' or 'ICT skills' are mainly defined through internet use at various levels (Schmidt & Stork, 2008). Lack of ICT skills would defer the use of ICT services meaningful to the citizen (Schmidt & Stork, 2008). For example, the use of short messaging systems (SMS) requires some basic literacy and typing skills, meaning this service may not be easily usable for the illiterate, poor, and elderly, as was found in some cases in Asia (Kang & Maity, 2012).

Digital competences can be learned either at school, university, at the workplace, or by informal self-teaching. Warschauer (2003) included computer education and computer-enhanced education, which can include ICT inputs such as enrolled computer training courses or the number of hours spent learning. These computer training indicators are becoming well developed as digital competency indicators, and research provided some applied demonstration of how this characteristic can lead to improved employability and incomes (Morissette & Drolet, 1998; Olson *et al.*, 2011).

Digital competency can also be gained through informal learning or learn-by-doing, which has been promoted as an approach to digital literacy. There are cases of informal learning which do not receive formal certification, yet helps an individual improve their current work and perhaps their income generation. For example, Rangaswamy and Cutrell (2013) have done work in the urban slums of India and concluded that the youths' ongoing use of mobile internet for games and entertainment allowed them to further their digital literacies and skills. This digital competency gained from ongoing use may be more difficult to measure as a bonafided ICT asset due to its unstructured nature.

Digital competences are evolving beyond the available conventional measures of human capital, such as the highest level of completion of school, which is currently the typical proxy indicator for ICT skills. Today's trend of online courses, or Massive Open Online Courses (MOOCs), furthers Warschauer's original definition around distance learning, giving wide access to courses through online or email correspondence. The completion of such courses involve human resource inputs to various subjects presented via the internet and through computer use. The completion of the online courses can be measured as a human-based ICT. The maintenance and installation of these physical resources by third parties can be included in human ICT resources, as some of the limited time or lifetime warranties help to ensure the products are repaired, updated, and function effectively.

An expansion of this concept could include an individual's ability to produce new digital products and services, which can create market or wealth offerings. In some cases, a person can provide a digital service, such as the creation of a digital logo or the design of a website page, in exchange for money. The development of intermediary portals such as Fiverr, Upwork, or Mechanical Turk provides a central location to market one's digital services, thus expanding the possibilities to extend digital skills beyond what was formerly restricted to the geo-location of a person.

As digital devices become more prominent in people's lives, some minimum form of digital literacy and competency level measure could be considered to understand the necessary human resource assets needed to use mobile phones, computers, or the internet more effectively. By examining existing and evolving ICT assets for human capacity, it becomes apparent that difficulties exist in terms of quantifying and assigning a value on these human inputs or as an intangible asset within a household. Further research to these latest ICT inputs on human capacity is needed.

4.6.4 Social Capital for ICTs : Networks and e-culture

Social networked interactions are structural, as they are based on community, institutional, and society's support of ICT access. Alternative definitions focus on how much an ICT is capable in meeting certain cultural expectations or knowledge of cultures within society (Tondeur *et al.*, 2011). With that said, social capital is related to cultural capital, which refers to the range of human absorption of or socialisation within a certain dominant society, whether it be its knowledge, cultural objects, or institutions (Bourdieu, 1997). Given that new ICT competences are necessary in contemporary society, cultural capital can take on a new meaning, with certain ICTs being an asset indicator for cultural capital. Bourdieu (1997) has further stated the following with regard to the meaningful use of technology:

> To possess the machines, he [sic] only needs economic capital; to appropriate them and use them in accordance with their specific purpose he [sic] must have access to embodied cultural capital; either in person or in proxy. (p. 50)

ICT is the 'culture' of technical know-how, and for some "represent[s] a form of transmission of upper- and middle-class values" (Koivusilta *et al.*, 2007, p. 102). For example, a person's relationship with technology draws cultural value through the online interactions that occur between individuals and those within their family, their school, and social circles (Selwyn, 2004). Other digital interactions involve IT experts who help support users (Selwyn, 2004). From an education approach, digital cultural capital has been defined for its concepts of technological know-how, time investment of self-improvement through digital skills, participation in ICT education and family, and the peer and media influences of 'techno-culture' (Seale, 2013; Seale *et al.*, 2015). Digital cultural capital can cross over to digital skills through the inclusion of participation in ICT education and training (Selwyn, 2004). As for digital social capital, the indicators can include networks of face-to-face and online contacts, including online and commercial help lines (Seale, 2013; Seale *et al.,* 2015; Selwyn, 2004). These qualities of digital networked interactions are a new culture and being part of the interactions can be considered a household ICT asset that is necessary to fit into contemporary society.

The final ICT form in this category is social relations and social structures that were included in Warschauer's (2003) original taxonomy. This sub-category can be expanded from the original definition through inclusion of digital groups within social media platforms, which connect and create virtual networks that were once only reserved for face-to-face meetings between friends, family, and business associates. The use of ICTs assists in reinforcing existing relationships as well as creating new social network connections. Alongside computer classes, people can be part of computer societies and groups, such as LAN 'parties', where young people meet and bring their computers to a physical location in order to play games together. All of these examples of digital groups reveal that networked social connections can be of high value to a household whether it is for work, social, or recreational purposes.

Another category of social ICT assets can include the creation of an individual's digital identity and their metadata which facilitates networked interactions. For example, the social ICT asset can be creating a digital identity to use a digital service within a software or app. The digital identity is what is shared by the user, such as their name, photo, birthdate, and other characteristics. Further data that the user uploads or shares within the platform and the feedback from others on the user's contributions also become a social ICT asset, whether or not an expenditure is made from the social transaction. The digitalisation of services ultimately requires humans to increase their digital footprint. Digital identification allows for their citizenship to be verified, and there is the potential for low- or no-income beneficiaries to social resources provided by government as is seen from the nation-wide Aadhar or biometric identification system in India (Masiero, 2015). The inputs shared on an online digital platform and the solicited feedback and interaction are of high value to users and can be considered an ICT asset.

Other digital service platforms rely on the user inputs, the main social ICT asset, in order to function and thrive. With banking, new online accounts are created to manage money, and there is an increase offering of mobile banking for financial services for the poor in low and middle-income countries (Duncombe & Boateng, 2009). Digital platforms request personal information or generate a social profile and how such data of gender, religion, relationship status, and so on is inputted becomes an asset to the digital platform institutions. Online social networks are on the rise and reliant on user inputs. For example, Facebook, Instagram, and Twitter, look for innovative ways to promote user to upload and provide inputs online and keep users connected to their social network. The 'sharing economy' provides one-on-one linkages through online intermediary services (such as AirBnB or Uber). Such services only succeed when a digital identity is formed and inputs are shared through peer feedback--a person gains an online reputation, establishes their authenticity, and further improves trust amongst 'strangers' within this network (Zloteanu *et al.*, 2018). Such information improves the reliability of the network to connect services and provide income to previously unused capacities (in the case of AirBnB, renting a spare room, and in the case of Uber, hiring out a car that would typically sit in the garage, unused). These are contemporary examples of the rise of the digital identity and the inputs provided by online users as ICT assets of a person.

There are implications in taking part in social networked interactions, particularly around establishing one main ICT asset, the digital identity. Such digital information is a key resource for social connections shared and, in its current form, it is being collected by and on national government and converged global online platforms. While convergence can see seamless communication activities within one platform, there is now clear evidence that the owners of the global platforms are using data to mould user behaviour in exploitative ways (Allen, 2017). Some people may not have the skills or affordability to maintain their digital identity to ensure their privacy is protected or that risks are informed as well as averted should one wish to not be exploited. In fact, in a review of privacy policies held by finance technology companies in India, almost all policies are written in English, and the majority do not specify the processes taken to file a grievance. Only a minority of the firms' written policies provide users with the right to withdraw (Rathi & Mohandas, 2019). The protection of vulnerable persons is an important consideration in the rise of digital identity as ICT assets.

National governments that issue digital identification that replicates their national identification system could be exposed to surveillance, lack of privacy, data protection, if there is poor transparency and data governance. These issues can further drive digital exploitation and exclusion (Bomu, 2019). Online personal data online has recently been exposed to abuse by social network platforms through the distribution of personal data without the consent of users. Facebook, for example, is entering partnerships with third parties and, in some cases, selling personal data without the user's consent (Dance *et al.*, 2018). In these cases, Facebook had no transparency in how and what they were sharing around digital identity data, which is a valuable asset that users provide in exchange for their use of Facebook's platform. Companies extract value from the user-generated personal data provided to them; yet, there is opacity and a power imbalance around how they monetise the data. Transparency of platforms that receive personal information on digital identities is another rising concern.

There is also conflicting viewpoints around the ownership and the property of an individual's digital identity. One argument is that the personal digital information and data which individuals have are of his or her sole control and he or she can take it as their own property to sell off their privacy rights (Kerry & Morris, 2019). For example, the Financial Times has created a calculator for individuals to monetise the value of their personal data[9]. Such valuation of data will see individuals gain little compensation for their data (Kerry & Morris, 2019). Another argument personal digital information needs to be accessible so it avoids undermining data needed for public interest (Kerry & Morris, 2019).

[9] https://ig.ft.com/how-much-is-your-personal-data-worth/

Currently, legal steps are being taken to mitigate digital identity data misuse, such as through the implementation of the European Union's General Data Protection Regulation (GDPR) policy. This policy requires companies or institutions that collect user data to ensure the protection and privacy of their users.[10] Overall, as with human ICT assets, social ICT assets bring forth some new and important aspects of networking to a digital basket; however, some implications have emerged surrounding identity and privacy protection.

4.6.5 Digital Economy and its Intersection with ICT Resources

This section draws in the components of the digital basket that intersect with the digital economy, which can be defined as "that part of economic output derived solely or primarily from digital technologies with a business model based on digital goods or services" (Bukht & Heeks, 2017, p. 13). Through the digital economy, there are contemporary ways to generate income online that would not have been possible in the Warschauer 2003 period. For example, a household or person can hold particular ICT assets that can be used within existing or new activities of the market value chain in order to enable income generation, even as entrepreneurs in rural communities (Roberts & Townsend, 2016). This is seen in the cultural creation of a digital brand or specific digital content that can attract and market to online consumers and to engage in a trade or sale of a good or service. Individuals can use online markets to sell and market goods or services to trusted friends as well as unknown global clients. There are also new means of gaining finance such as through crowd-sourced funding. In fact, all types of ICT assets could be used as a means of economic activity. Given this characteristic, ICTs can be viewed for their economic benefits that cut across the four ICT resources that are currently listed: physical ICTs, digital content, human ICT resources, and social ICT resources.

The above descriptions have provided a topological explanation of each of the digital basket's categories and a comprehensive list of present day household ICT assets that fall into these categories. As is illustrated, the current 2019 ICT asset list is much more extensive than Warschauer's (2003) resource list. This revised list of ICT

[10] EU GDPR website: https://www.eugdpr.org/

assets is an important contribution of this study, as it demonstrates how the household digital basket can change over time to accurately reflect the household's portfolio of contemporary ICT assets in 2019. In looking at the changes between 2003 and 2019, the rapidly changing nature of ICTs leaves a question around the incompatibility of measurement and planning over time. The expansion of possible ICTs also brings into question what are the benefits of a wider range of assets, and whether this wider possibility of ICT ownership contributes to a diversity of new activities and improvements to the quality of life for the wider population. In updating Warschauer's 2003 taxonomy, the discussion further substantiates the need to better theorise what constitutes as ICTs, as today's ICTs are vastly diverse, numerous, and can potentially increase each household's asset portfolio.

4.7 Pathways: from Strategies to Outcomes

Within the sustainable livelihoods framework, there is a process pathway which comes in three parts: a) the accumulation of livelihood assets, b) the livelihood strategies and c) the livelihood outcomes (DFID, 1999). Asset accumulation has been previously described in the last section with the inventory of ICTs as well as in Section 3.5. The livelihood strategies takes the accumulated assets and using them together to become effective and meaningful activities (DFID, 1999). The livelihood strategies are primarily made up of the activities and the immediate outputs generated from these activities. In the process of accumulating assets, trade-off decisions are continuously made. Livelihood strategies can be described as the revealed behaviour of an individual or household in terms of all the trade-off possibilities; these strategies form the basis of managing the available assets (Siegel, 2005). In Scoones' (1998) version of the sustainable livelihoods framework, he examined the rural context and established three broad livelihood strategies: agricultural intensification/extensification, livelihood diversification and migration. Related to these rural livelihood strategies, coping and asset management are further household strategies that will help lower vulnerability (Moser, 1998). In a difficult situation, an individual can develop methods to cope with temporary declines in assets or to adapt to more long-lasting change (Moser, 1998).

As with other household assets, ICTs can be used to build a contemporary livelihood strategy. In the design of the technology itself, the tool can actively shape and direct a person's ability. More specifically, the mastery of ICT use can facilitate action around earning an income, seeking out job prospects, or addressing family emergencies in a timely manner. Duncombe (2012) has provided a mapping of ICTs in relation to livelihood strategies. For example, mobile phones can be utilised within livelihood strategies for asset substitution, enhancement, combination, exchange and forms of dis-embodiment (Duncombe, 2012). In all these strategy examples, the mobile phone allows for small efficiencies which at the onset may be overlooked, but in fact are major savers of time and money. Livelihood strategies are ultimately based on the meaningful use of a household or individual's asset portfolio and how the use of these resources help to achieve certain livelihood outcomes.

Following the accumulation of assets and the livelihood strategy is the third aspect in the process pathway, which is the livelihood outcome. The livelihood outcome is defined as the output or the achievements from pursuing one's livelihood strategies (DFID, 1999). Some of the examples provided as livelihood outcomes include increased income, improved well-being, reduced vulnerability and improved food security (DFID, 1999). In this definition and examples of livelihood outcome, others have used other terms, such as the concept of impact. In Duncombe's (2011) 'impact value chain' approach, impact findings were delineated as being into three categories: those with either short-term results of outputs, medium-term results of behavioural change and broad socio-economic changes as development impacts. One literature review (Duncombe, 2011) examined the studies on mobile phones, development, and impact. Of the 18 studies he reviewed, four highlighted long-term development impacts through mobile phones, while the majority measured more short term or output indicators (Duncombe, 2011). In a review of the impact of digital platforms within agricultural value chains, while an emergence of new platforms serve as intermediaries in assisting farmers, the studies are limited of impact results, and particularly in reporting user demographics (Ezeomah & Duncombe, 2019). These examples illustrate that impact studies on poverty and ICTs, while not abundant, have begun to emerge in the last ten years.

There are several concepts and perspectives which hold similar attributes to the SLF livelihood outcome. A similar approach uses impact measures to describe the concepts of first-order and second-order effects (Sey *et al.*, 2015). The first-order effect looks at the ability to demonstrate the usage of ICTs, a relatively short term output, while the second-order effect is the ability to see overall changes in human development, such as poverty levels due to ICTs (Sey *et al.*, 2015). As a first order effect, there have been clear changes in the access, usage and/or ownership of ICTs, particularly amongst the poor, as recognised in the previous chapter. As for second order effects, the livelihood outcome can be placed in this category, as it can assist, for example, in articulating the role of ICTs in reaching poverty reduction. Some second order effects include communicating with family and friends, furthering one's education or interest as was found in the self-assessments of change by individuals from using public access ICTs (Sey *et al.*, 2015). In literature on the digital divide, livelihood outcomes are similar to what is referred to as the third level digital divide (Ragnedda, 2018; van Deursen & Helsper, 2015). The third level digital divide are the measured social and economic outcomes when ICTs are used. Finally, the human rights approach has been a dominant force in setting and monitoring the minimum basic standards for human life as development outcomes, which also have similar aspects to the SLF livelihood outcome. Examples of basic non-financial human aspects that are measured include health (such as child mortality rates) and education (such as highest level of education completion).

There have been research studies which examine ICTs, how livelihood strategies are built around ICT use and then some measure of livelihood outcome is revealed. Some of limited work of ICTs and their relationship to the livelihood outcome of poverty reduction was examined in-depth in Section 2.4.3. Individual ICTs are being empirically associated with livelihood outcomes such as income accumulation (Arifin, 2011) and improved understanding of household welfare from a usage perspective (James, 2014). One study proposes a correlation between mobile phone and malaria reduction (Mozumder & Marathe, 2007). In the interest of this thesis, studies which examine livelihood outcomes based on the access and/or use of ICTs, specifically amongst the poor, are limited.

Within the three parts of this process pathway, human development runs on complexities which may not be easily explained in a straightforward or linear way. For example, Rogers (2008) has noted that, "Life is not simple, but many of the logic models used in programme theory evaluation are" (p. 29). This means that the impact of ICTs on economic or social outcomes are not necessarily linear, and can run through what Rogers has termed as complicated and complex programmes. Within these programmes, there can be multiple stakeholders and multiple pathways of outputs, outcomes, and impact(s). The SLF process pathway is designed as a linear process of livelihoods assets (inputs), livelihood strategy, and livelihood outcomes as a simple way to explain the chain of events in human development. However, in a study on ICTs, this process is realistically embedded with numerous external and internal factors, beyond the physical device itself, that influence the pathway and thus leading to further complicated and complex programmes (Duncombe, 2006).

4.8 External Conditions of the SLF

Vulnerability, policies, and institutions (all of which can be labelled as 'transforming structures and processes') are three external components that influence the process pathway when analysed within the SLF (DFID, 1999). Vulnerability relates to the external environment where people operate and they are unlikely to have much control over, such as weather-related shocks, trends, and seasonality (DFID, 1999). Vulnerability can dramatically affect the portfolio of assets held by a household can be dramatically affected by vulnerability. For example, the shock of a fire outbreak or natural disaster could result in the loss of assets and leave households in drastically vulnerable positions. Economic downturns are vulnerabilities that could see farming output assets worth less than originally planned. As described by Sen (1999) in his work on food insecurity, death may result not necessarily from a shortage of food, but rather from people's lack of entitlement to available food. Such entitlements can be externally motivated and can play out within issues of vulnerability from say climatic conditions as well as institutional systems (DFID, 1999). Unexpected seasonal changes could also result in rural farmers being uncertain of forthcoming crop production and what meagre income can be derived from a poor agricultural season. High unemployment and poverty levels are also vulnerabilities for a state, as living standards are lowered in order for households to cope. Vulnerability can be mitigated by institutional structures such as disaster management plans by local government or other personal insurance policies which ensure resources are allocated at time of emergencies.

As for ICT assets, vulnerability within the external environment could affect such household assets in a variety of ways. For instance, a vulnerable household can have safety issues when known and valuable ICT goods are in its possession, making them a target for theft. ICTs can also be destroyed if not protected from the natural elements like rain or lightning. On a more positive note, ICTs assets can also be used to mitigate against vulnerability. For example, in the absence of physical infrastructure, such as access to roads or financial services in rural areas in Africa, mobile phones are seen, to a certain extent, to be filling the gap to ensure social inclusion and economic development (Mothobi & Grzybowski, 2017). Another example of how ICTs are used to address vulnerabilities is their use to providing information that monitor seasonal changes or price fluctuations through mobile phone applications or low cost technologies like community radio that help farmers better predict forthcoming climatic problems (Ospina & Heeks, 2010).

Policies and institutions, as mentioned above, are the other two external factors in the SLF that fall under transforming structures and processes. These two components help to shape (or prevent) individuals' access to and possession of assets. As for structures, these can include the various levels of government and private sector that seek to implement policies and enforce laws in the interest of the people. For example, governments are entrusted to make difficult budget spending decisions to enable poverty reduction strategies, such as deciding whether funding should be used for appropriate sanitation and transportation initiatives or for to internet infrastructure access. Efficient decision making in this context would be, rather than weigh out one decision over the other, examining these issues in complementary and interrelated ways that conceptualise the improvement to enable sustainable poverty reduction should be holistically. Put differently, this means understanding the complexities and locally contextualised nuances of the issue and deriving an solution that acknowledges these things. Nevertheless, national development priority decisions are challenged by these types of country spending decisions. To address such complexities with regard to structures that affect ICTs, national governments have assigned ministries of telecommunications and agencies to implement ICT policy and regulation.

Processes guide how the structures operate and interact through laws, policies, and culture. These organisations (structures) and policies (processes) could help to directly or indirectly support a household's asset portfolio through the resources invested in public services, such as health or education, as well as physical infrastructure such as roads and highways. The external policies and institutions can influence the accumulation of ICT assets within a household both at the global and national or sub-national level. In regards to ICT policy, resolving the digital divide is a global public issue influenced by current international agreements. These external conditions are built upon the World Summit on the Information Society (WSIS) and International Telecommunication Union (ITU) global initiatives whereby the policy imperative revolves around all countries developing publicly funded interventions to ensure ICT universality. This imperative would help reach all people, regardless of their background, to have access to ICTs. Some national level policy include setting taxes on the purchase of ICTs and its respective services can affect the affordability of ICTs. National governments set regulation for various telecommunications operators on the provision of telecommunication services. For example, the assignment of radio spectrum or the decision on which mobile operators can provide GSM and telephony services fall under national processes. The government decision to incentivise contractors to build telecommunication infrastructure in rural and remote areas that dominant operators see as unprofitable is part of a strategy to address digital inclusion.

In addition to these three areas of external conditions (vulnerability, policies and institutions), the ICT system is included as part of the enhanced SLF (May *et al.,* 2014b) and is the operational framework used for this thesis. The ICT system closely attends to the external environment of ICTs, specifically through the technical, economic and social lenses, which are most pertinent to today's contemporary society. The ICT system was previously included in an East Africa study on poverty and ICTs; it is an adaptation that the study made to the SLF (May *et al.*, 2014b). This

ICT system includes the well-described components of the Diga and May (2016) ICT ecosystem framework.

As I have illustrated in this chapter, by adding the one component to the framework (e.g. the digital basket as a sixth capital) as my theoretical contribution to knowledge, the SLF furthers current understandings of how ICTs affect the pathway from the diverse processes to the diverse outcomes. Specifically, as will be illustrated in Chapter 7 of this thesis, making these adaptions to the SLF can advance our understandings of the relationships between this added sixth capital, digital basket, and poverty reduction, as it allows for contemporary process mapping to analyse the ICTs and human development within their complex system at the country level.

4.9 Conclusion

In this chapter, I have argued that a human development approach and one analysed through the sustainable livelihoods framework is the most appropriate way to examine the relationship between ICTs and poverty in this country level study. As explained, the SLF allows researchers to acknowledge the interconnectedness of assets, strategies and external context(s) to the changes within households in South Africa. Specifically around the changing course of deprivation, the external ICT system and the ICT assets are components that can be emphasised. The SLF pinpoints several linkages to the research questions. Firstly, the concept of digital capital responds to one of the research questions as to whether ICTs can be theoretically constituted assets. The current literature on digital capital at a household level remains limited, and this chapter further advances the theoretical underpinnings. Given the exceptionally unique features of integrated functionality and the blurred lines of tangible and intangible characteristics, I have illustrated the appropriateness/need for presenting ICTs as their own asset category within the SLF.

Moreover, the second research question about developing a ICT group and sub-groups is addressed by uniquely augmenting the conventional five capitals in the SLF with a sixth capital, the construction of a ‘digital basket.’ Within the digital basket, ICTs would be categorised into four sub-groups: digital content, physical ICT capital, human capital for ICTs and social capital for ICTs make apparent the extensiveness and rapidly changing nature of ICTs in contemporary society. From the pathway of livelihood strategies, ICTs are contributing to new activities and this framework helps to reflect on the quality of life improvements for the wider population. In updating Warschauer's 2003 taxonomy, the discussion further substantiates the need to better theorise ICTs as constituted assets, as today's ICTs are vastly diverse and numerous.

The following chapter details the methodology approach and methods used in this study, which is followed, in Chapter 6, by an illustration of how the enhanced SLF which emphasises ICTs can be uniquely applied to a country like South Africa.

5 CHAPTER FIVE: RESEARCH METHODOLOGY

5.1 Introduction

The South African country context makes for an interesting location to apply the new conceptual components of the SLF, namely the digital basket and ICT systems concept. The country's high level of communication technologies diffusion, the availability of ICT infrastructure, as well as a highly unequal population would make South Africa an interesting study to analyse the digital basket. The South African environment also remains ripe with historic complexities, both within its economic and social context, and these realities bring to light unique perspectives around ICT consumption, particularly amongst the poorest.

Building on the discussion in the previous chapters, I argue that primarily using statistical analysis models through quantitative research methods would be appropriate for understanding the relationship between ICTs and poverty at a nationally representative level. Having established the enhanced sustainable livelihoods framework and a focus on assets as the pillars of my poverty analysis approach, I argue that the suggested Ordinary Least Squares (OLS) would be a logical way to proceed in understanding the household's digital basket in relation to various marginalised segments of households in the country.

5.2 Research Design

In theoretical considerations, working within the paradigm of positivism refers to knowledge production or theory testing through the use of verifiable observations for relatively objective means (Mackenzie & Knipe, 2006). Positivism commits to the empirical ability to predict and control specific natural phenomena and thereby allow for generalisations (Guba, 1990). This study in question takes a post-positivist approach, which means the researcher primarily takes on an objective epistemological lens, while at the same time, is well aware of various contexts and realities, the limitations of quantitative methods (Mackenzie & Knipe, 2006). Post-positivism concedes that absolute objectivity may not be possible, however the idea is to strive towards maximising neutrality (Guba, 1990). Through the post-positivist viewpoint, this study examines the composition of the digital basket as well as the relationship of ICT and poverty, while combining a detailed description of South Africa's context. These components all operate within the guidance of the enhanced sustainable livelihoods framework. The post-positivist paradigm is thereby appropriate since the ultimate objective of the study is to provide the empirical relationship of ICTs to households' welfare within a holistic state-of-the-country overview.

The national estimates of the digital basket, particularly amongst the poor are utilised as one mode of inquiry, the quantitative research method, emulating a similar methodology adopted by May *et al.,* (2014). This study aims to address the paucity of country level representative data in ICTD studies (Gomez, 2013a), and thereby provide some country-level generalisation, in this case South Africa. Using a large and high quality secondary dataset provided by the national statistics agency, the study would allow for comparability and analysis to a degree of statistical significance. The aim of the study could also inform national policy around ICTs or more broadly digital inclusion; it is largely descriptive in nature, allowing for objective national estimates of the South African population around their standard of living, as well as their evolution around ICT asset ownership.

5.3 Data Sample

The data used to support this methodology is mainly derived from two numerical data sets from Statistics South Africa (Stats SA). The unit of analysis is the South African household. For this study, the Income and Expenditure Survey 2010/2011 (IES 2010) and the Living Conditions Survey 2014/2015 (LCS 2015) are the two survey instruments which were carried out by Stats SA, and for this study, used for analysing household digital baskets. The choice of the IES 2010 and LCS 2015 as my two secondary data sets rests on their suitability for providing sufficient national socioeconomic statistical information at two points in time during which the prevalence of ICT access were increasing rapidly in South Africa. Specifically, there is a possibility of data disaggregation based on the collected socio-economic national data such as geographical location of household, gender of household head, and province of household as well as an inventory of ICTs. The data sets were chosen for its large and randomly selected sample size which has sufficient statistical power to draw inferences on the entire South African population, even when disaggregated by particular social characteristics as well as to test the finally hypothesis. These data sets are thereby fitting for its empirical application and to fit within the enhanced sustainable livelihoods framework in studying the relationship between ICTs and poverty.

5.3.1 Time Period and Data Sets

The data collection for the IES 2010 occurred for 12 months between August 2010 and September 2011, while the LCS 2015 happened between October 2014 and October 2015, both conducted by the national statistical agency (Statistics South Africa, 2012d). The Income and Expenditure Surveys gathered data in the years 1995, 2000, 2005 and 2010. The IES methodology had changed in 2010 (differences in the of survey and duration of survey periods), therefore comparability becomes limited; it is the rationale for this study not utilising the IES data prior to 2010 (Statistics South Africa, 2017d). The Living Conditions Surveys were undertaken in 2009 and 2015. This thesis makes use of the latest data available, IES 2010 and LCS 2015 which use similar data collection methods and provides the most updated list of ICTs. At the same time, the two data points provide a historical cross-sectional reference, giving a comparison of how ICTs have changed during the five-year period.

5.3.2 Data: Income and Expenditure Survey (IES 2010)

The IES 2010 was prepared using a two-stage stratified design with probability-proportional-to-size sampling of the primary sampling units (PSU) (Statistics South Africa, 2012c). The sampling frame is based on Statistics South Africa's master sample and uses the 2001 population census enumeration areas. The master sample allows for full national coverage of households in the country and includes 3 254 PSUs. Within the sampled PSUs, the IES sought to administer the survey to 33 420 households as the ideal sample size, but the final sample dataset included 25 328 households. Some households were removed due to being out of scope, or missing at least the minimum personal or diary information. Nevertheless, the survey had a high response rate (averaging 91,6% nationally) (Statistics South Africa, 2012c).

Survey Weights

In order to draw inferences of the South African household population, the sample dataset is weighted, using sample weights provided by Stats SA and analysed using Stata 12. Several elements are assumed where constructing the appropriate weights for this probability-proportional-to-size sample, including the following: a base weight per province, adjustments for informal PSUs, growth PSUs, EAs with fewer than 25 households and adjustments for non-response. Stats SA then constructs a final survey weight [in the Stata file, it is called 'full_calwgt'] up to known population estimates using a 'Integrated Household Weighting' method, specifically the mid-March 2011 population estimates. In order to calculate the poverty per capita headcount in alignment with the Stats SA 2018 poverty report, Stats SA provided me with the adjusted person-adjusted weight [in the Stata file, it is called 'persns_wgt']. Using this person-adjusted weight, the total South African population is 51,32 million persons or 13,38 million households.

The IES 2010 data were obtained directly from Statistics South Africa and the shared files included the survey instrument, the code list, the meta data document, and the three data sets on: a) household information, b) the individual information and c) the detailed expenditure information. In the IES 2010, three instruments were utilised: household questionnaire, the weekly diary, and the summary questionnaire. As mentioned above, the full sample composes of 25 328 observations on South African households which are representative and contain various individual and household socio-economic variables and ICT variables. The IES 2010 household survey section has several elements around ICTs, collecting observations on household level ICT asset ownership, which is the main basis of this thesis. Specifically, the ICT asset variables are derived within the household asset and acquisitions module (IES - Section 5.10) which asks about the acquisition of 22 household assets over the last 12 months (Statistics South Africa, 2012c). From the 22 asset items reviewed, 10 of them can be identified as ICTs.

Missing Data

The study analyses the ownership of ten ICTs in 2010 and further detail on these variables is described in next section below titled 'digital baskets'. It is noted that of the 25 328 household observations, all households had reported on their total expenditures (therefore no missing households), as well as fully responded to a number of the household characteristics (e.g. gender of household head, household size, settlement type, province, etc). One limitation is that some households are unable to answer the question around ICT ownership fully and their response thereby is marked as 'missing'. For the ten household assets identified as ICTs, I derived 426 households (1,7% of the total sample) who did not indicate 'yes' or 'no' on at least one of their ICT assets, and therefore was marked as 'missing'. These households are dropped and remaining households form the basis of the restricted sample. For the purpose of the digital basket descriptive and regression analysis, the research design is confined to the restricted sample of households (or 24 902 households) that have fully answered questions on ICT ownership.

The missing households were analysed and information provided in the two tables below. For example, in Table 7, of the 426 households that are not included in the restricted dataset, the majority or 291 households (68,3%) had left only one ICT unspecified or unanswered. Just over 20% had either 2 or 3 ICTs left unanswered.

Table 7: Households with Unspecified ICT responses, IES 2010

# of unspecified ICT responses	n	% of missing sample households
1	291	68,3%
2	51	12,0
3	45	10,6
4	5	1,1
5	7	1,6
6	5	1,1
7	3	0,1
8	3	0,1
9	3	0,1
10	12	2,8
Total	**426**	**100,0%**

Source: Own calculations, derived from the Income and Expenditure Survey 2010/11

In comparing some of the socio-economic features between the full sample dataset, the restricted data set and the missing information data set (see Table 8 below), I analyse some of the differences in characteristics of households. The study considers the expenditure variable in the study, and as observed in the Table below, the mean annual expenditures of both the sample population and the South African household population estimates for both the full sample and restricted sample are very similar.

The same can be said by the very similar figures of 3,84 for the average household size and between 30-32 for the average age of household. As for the households with missing data, in comparison to the full sample, there is the difference of nearly R8 500 in the expenditures, with missing data households having a lower expenditure average compared to the full sample. The average size of the households with missing information is slightly larger and slightly older compared to the full sample. This could introduce some bias, with the restricted sample dropping a number of households identified in the lower income level as well as those with a larger household size and an older average age household membership. However, given that the missing data sample is small relative to full sample dataset and that the averages between the full sample and restricted sample are fairly similar, estimates of the restricted sample remain representative of South African population estimates.

Table 8: Expenditure, Household size and Age statistics by sample type, 2010

	Full Sample		**Restricted Sample**		**Missing data sample**	
	#	n	#	n	#	n
Annual expenditure of sample population	R 67 838,64	25 328	R 67 960,29	24 902	R 60 727,73	426
Annual expenditure of SA pop estimates	R 83 050,70	25 328	R 83 189,31	24 902	R 74 746,19	426
Average household size sample population	3,75	25 328	3,75	24 902	3,85	426
Average household size (South Africa population estimates)	3,84	25 328	3,84	24 902	3,84	426
Average age of members in the household (sample population)	31,92	25 328	31,92	24 902	32,12	426
Average age of members in the household South Africa population estimates)	31,22	25 328	31,21	24 902	31,82	426
South African household population estimates (millions)	13,38	25 328	13,16	24 902	0,22	426

Source: Own calculations, IES 2010, data is weighted for South African population estimates

As for other welfare outcomes, the data is also available to assess the multiple socio-economic dimensions collected or derived from the household survey. Some of the indicators include race, education, province, settlement type, electricity availability, dwelling type, drinking water access and toilet infrastructure.

5.3.3 Data: Living Conditions Survey 2014/2015

In this thesis, the Living Conditions Survey 2014/15 (LCS 2015) is utilised for its descriptive statistics on the contemporary trends around the ICT asset ownership and the digital baskets amongst households and allows for a cross-section time comparison to the IES 2010. The LCS 2015 is similar to the IES 2010 using again a two-stage stratified design with probability-proportional-to-size sampling of primary sampling units. Utilising a similar procedure as IES means that within the sampled PSUs, the LCS sought to administer the survey to 32 906 as the ideal sample size, but the latest release contains data on a final sample set of 23 380 households, removing households that were out-of-scope (Statistics South Africa, 2017c). At the end, the survey response rate was lower than average and the report attributes to low response due to the additional request for anthropometric measurements in the LCS (Statistics South Africa, 2017c).

Survey Weights

As was done with the IES 2010, the sample data sets use weights provided by Stats SA in order to apply to the sample and provide estimations up to national level representation. The weights take into consideration a base weight per province, adjustments for informal PSUs, growth PSUs, synthetic weight adjustments for excluded population and adjustment for non-response. There is a final sample weight which take the above calculations into consideration (in the Stata file, it is called 'hholds_wgt') In using this sample weight file, the estimated South African population estimates for 2015 approximately 16,6 million households (Statistics South Africa, 2017c).

The data file was retrieved from the University of Cape Town DataFirst repository and contained four Stata data sets for the public: a) individuals within a household data, b) household level data, c) individual income data and d) household asset data.[11] As noted on the DataFirst website[12], the data file labeled,

[11] The four file names provided were: 1) LCS2015_persons_final, 2) LCS2015_households_final, 3) LCS2015_Personsincome_final, and 4) LCS2015_Household_assets_final.

[12] https://www.datafirst.uct.ac.za/dataportal/index.php/catalog/608/study-description "The Living Conditions Survey 2014-2015 is missing most of the data collected on expenditure. Both income and expenditure data were provided in the LCS 2008-2009. The expenditure data was provided in a data file called "Total LCS". This data file is missing from the LCS 2014-2015. DataFirst has notified

LCS2015_Total_lcs_final, which consists of all expenditures and weekly diary information, was not available in the public domain at the time of thesis writing.

In the available household survey data, the full 23 380 observations allow for statistics on household socio-economic characteristics and ICT variables. The ICT ownership assets can be found under Module 6.9: household ownership assets, whereby there is a list of 36 assets. Of the 36 assets, 12 items can be identified as ICT ownership assets (Statistics South Africa, 2015b, pp. 42-43). In allowing for a comparison between the IES 2010 survey and this LCS 2015 survey, I derive a new computer variable combining the three computer ownership indicators -desktop, laptop and tablets- into one variable. This is consistent with ITU guidelines in measuring the proportion of households with a computer (International Telecommunication Union, 2014). The 10 ICT variables from the LCS then becomes comparable to the 10 ICT variables from the IES. Further details on the ICT variables are described in depth in the next section. Unlike IES 2010, while a variable for consumption and income is provided in the dataset, the full expenditure module and person weights are not publicly available which would allow for the same analysis that is possible with the IES 2010.

Missing Data

It is noted that of the 23 380 household observations, all households had reported on their total expenditures (therefore no missing households), as well as fully responded to a number of the household characteristics (e.g. gender of household head, household size, settlement type, province, etc). In order to be comparable to the IES 2010, I again analyse an ICT ownership variable to determine the composition of the household's digital basket (Statistics South Africa, 2015b). A respondent who does not answer the question is marked as 'unspecified'. This analysis treats responses of 'unspecified' as missing data and are dropped from the data set. For the ten household assets identified as ICTs, 1 181 households (5,1% of the total sample) did not indicate an answer for at least one of their ICT assets, and therefore was marked as 'missing'.

Statistics SA of the missing data. Anthropometric data collected during the survey are also not included."

5.3.4 Other Surveys

Aside from the IES and LCS, Stats SA provides other ICT indicators through other national survey work. I make reference to these reported statistics in Chapter 6 as part of the findings section on the general description of ICTs in South Africa. I have chosen to use the latest IES 2010 and LCS 2015 data sets primarily for this study as opposed to other available South Africa survey data for a number of reasons. In reviewing the other surveys conducted in South Africa, some surveys include a smaller number of ICT asset variables which then reduces the report of actual ICTs. For example, Stats SA's General Household Survey (GHS) is an annual survey and provides a set of household goods and services, including on ICT ownership in the latest year (in this case GHS 2018 is the latest public release). The GHS 2018 collects ICT ownership data on eight assets (television, DVD, PayTV, computer, home theatre system, radio, landline telephone and cellular phone) (Statistics South Africa, 2019a). The purpose of the GHS however does not match the needs for this study on ICT and poverty. The GHS is used to broadly monitor levels of national development as well as extent of service delivery and quality of services, and thereby does not list all the ICTs (that are available in the IES 2010 and LCS 2015) and poverty indicators required for analysis.

Research ICT Africa also collects data across a number of African countries. In their South African data, information is gathered around ICT ownership as well as detailed ICT usage data, but they also collect a limited number of ICT indicators (eight ICT ownership indicators: desktop, laptop, tablet, mobile phone, fixed line telephone, radio, television and internet connection) and income indicators for their purpose of understanding ICT demand (Research ICT Africa, 2017). The income indicator could be compared to poverty headcount, however Stats SA notes in best practices that reported income has a tendency of respondents to under-report, compared to using household expenditure estimations. There is a question on expenditures for the mobile phone and internet data.

The IES and LCS have the specific purpose to reveal household living conditions, provide accurate figures of poverty (through use of both income and detailed expenditure data) and specifically help to understand poverty in a multi-dimensional way, while providing a full set of 10-12 ICT ownership variables. The chosen IES and LCS datasets thereby become the appropriate tools for this study which aims to understand ICTs and poverty.

5.4 Methodological Framework

This chapter presents an overview and description of a non-experimental research design as its methodological framework as well as the micro-level data in detail that is used to understand the levels of poverty and ICTs amongst South African households. The methodology was divided into three parts: 1) the rationale and the description of ICTs which makes up the digital basket, 2) the national poverty line and its respective statistics and 3) the construction of the regression analysis which through prediction, provides the relationship between ICTs and poverty.

5.4.1 ICT Expenditures: COICOP in relation to the Digital Basket

Now that I have rationalised the use of the IES and LCS for this study, there are two possible approaches in producing a digital basket. One approach is identifying and examining the household consumption items related to ICTs and the other approach is by identifying and examining the reported ICT ownership items. In the first approach, the questionnaires track the household consumption of itemised goods and services. Specifically, there is a possibility of identifying goods or services that relate to ICTs, which could be aggregated into a household digital basket. At the global level, the Classification of Individual Consumption According to Purpose (COICOP), based at the United Nations Department of Economic and Social Affairs, Statistics Division, provides an international best practice and standard survey template for the measurement of household expenditures at the national level (United Nations, 2018). The uses of the COICOP include analysis of living standards, establishing the consumer price indices and gross domestic product (United Nations, 2018). Currently, the South African income and expenditure surveys follow the categorisations set out in the COICOP.

Since 2011, a major overhaul of the COICOP system has been taking place. As it stands, the current template in place for countries was ratified in 1999 and a revised

COICOP 2018 version is only set to be published in 2019 (United Nations, 2018). With the 2018 publicly available draft online, I compare some of the major changes being proposed between the 1999 version and the proposed 2018 version (see Annex G, Table 65). The 2018 report recognises the imperative to update the classifications in the COICOP to reflect the newest consumption items, yet at the same time, tries to limit breaks for countries to still be able to conduct time series comparisons (United Nations, 2018). The most extensive changes made between 1999 and 2018 were specifically on ICTs and many of the meetings leading up to the new COICOP reflect on the every-changing nature of these ICTs and their respective convergences (United Nations, 2018). In 1999, many of the ICT consumption products and services fell into two categories. Firstly, the Communications (Division 08) category mainly includes expenditures related to postal and telecommunications services. Secondly, the Recreation (Division 09) category includes consumptive digital appliances such as computers and other digital services. For 2018, Division 08 is renamed "Information and communication" and the most salient moves include re-locating Division 08 items around postal and courier services to Division 07 Transport, and moving certain Division 09 equipment and recording media, their respective repair and license affiliations to Division 08. The report also recognises that recreation and communication will still have cross over of particular goods and services which serve both divisions (United Nations, 2018).

The COICOP clarifies definitions for internet-enabled services and software, distinguishing between those services which are classified as rental (e.g. streaming of movies and game subscriptions) versus those which are purchased outright, as well as distinguishing where services paid for via an application would be classified (e.g. taxi-hailing app services would be classified under 'passenger transport') (United Nations, 2018). With that said, such services are embedded within its respective category, and not separated out as an ICT, and it would be difficult to fully capture all ICT expenditure items. Items embedded with ICT firmware such as large appliances like refrigerators would not be distinguished as an ICT, given its function is not the primary use, but rather add complementary features.

Until the finalisation and global ratification of these recommended changes to the latest version of COICOP categories and consumption items, a substantial gap exists for countries in using the current 1999 COICOP survey template. As a result, there not be a consistent application of ICT expenditure capture across all countries for appropriate comparison. In analysis with the current 2019 ICT inventory list that I proposed in Chapter 4 which utilises the Warschauer 2003 taxonomy, the diversity of ICTs that exist is clear. In revealing the data which is currently not collected around ICTs in the household, the gaps can distort the ability to gain a true reality of a household's digital basket or inventory. While the 2018 COICOP covers a majority of the ICT goods and services, in future, the ICT expenditure items may fall short in fully capturing a household ICT inventory. For example, new ICTs, such domestic drones, virtual assistant within a smart speaker, like Google Alexa, electronic vacuums, electronic gadget trackers are not included as expenses in the survey template. The limitation of data reporting on new ICTs may affect the accuracy of household consumption within countries. Even in reshaping this 2018 COICOP international classifications, there may remain slight inadequacies in ensuring countries keep up to date with the rapidly changing portfolio of ICTs that can be held within a household.

5.4.2 ICT Expenditure items in South Africa

Despite the limitations of the 1999 and 2018 proposed COICOP survey template, it is still useful to propose a household's ICT consumption template in South Africa and whether it has adapted this template over time as I have done with the COICOP comparison. I review both the IES 2010 and LCS 2015 instruments to see the listed ICT items and identify the survey changes (see Annex F). Both the IES 2010 and LCS 2015 use the guidelines from the United Nations' Classification of Individual Consumption According to Purpose (COICOP) code list for collecting expenditure items. As mentioned previously, household expenditures are collected using weekly diaries that indicate the purchase of various household goods and services during the survey period, including food, education, health care, and telecommunications (Statistics South Africa, 2012c).

I review and list all the possible ICT expenditure items found within the LCS 2015, and at the end there is a total of 56 possible ICT expenditure items (see Annex F, Table 64). The majority of the ICT items can be found either under Module 14: audio-visual equipment or Module 20: computer and telecommunication equipment (including communication services costs) (Statistics South Africa, 2015b). In the same review of the IES 2010, I find there is a total of 58 possible ICT expenditure items for the IES 2010. The IES 2010 has the majority of its ICT expenditures from the last 12 months under Module 4, Section 16: computer and telecommunication equipment, which includes costs of communication use (Statistics South Africa, 2011, pp. 55-57). In comparing the two sets of ICT expenditure items, a majority of the goods and services are reported in the same format in the two periods. At the same time, new additions are noted in 2015 (e.g. online subscriptions for newspapers and magazines, e-books and cell phone accessories, internet costs from mobile devices, ADSL, to name a few), some expenditure items are removed or altered (e.g. magnetic tapes are removed), and some goods from IES2010 are consolidated into one item for the LCS2015 (e.g. all CDs, DVDs, Blu-Ray, etc are consolidated into one variable). By listing the possible ICT expenditures, it is possible see where the various ICT items are found in the different COICOP categories as well as to get a more accurate calculation for ICT expenditures in a given period. The limitation of using this variable to create an ICT inventory for a digital basket is that it reports on goods that is purchased in the household within a 12 month period, and therefore any good or services which are owned or purchased outside of the 12 months will be missed. In other words, a household could be in ownership of several ICT assets, but may not be counted if the expenditure inventory is solely used and if no money was spent on the good within the year. Also, while the IES 2010 and LCS 2015 had collected fairly detailed information on asset ownership and expenditures including around ICTs, the recall period for this set of variables is 12 months. Given this long recall period, households can be at risk of underestimating their acquisitions, income and expenditures. While the ICT expenditures in a given year could give an indication of a digital basket, the limitation listed above would see this type of digital basket fall short in understanding the inventory and value of the digital basket, when related to aspects like poverty reduction.

5.4.3 Rationale for use of an ICT Ownership Variable in South Africa

Using the IES 2010 and LCS 2015 data, there is an alternative opportunity to designing a digital basket by identifying the ICT ownership data. More specifically, an inventory count of ICT asset types owned by households could apply the digital basket framework. It is through this bundle of ICTs that the household's contemporary value for the digital is revealed. One 2018 study on South Africa provides a similar asset index, identifying a set of 36 assets from the LCS 2015, including all the assets identified as ICTs (The World Bank, 2018). In this case, the World Bank report used both non-ICT assets and ICT assets such as the radio, stereo/HiFi, satellite TV, television, DVD/Blu-ray player, desktop, laptop/notebook/netbook, tablet, camera, cellular telephone, telephone and connection to the internet. From the 2015 study, they found the richest decile had an average of 19 out of 36 asset types, while the poorest decile only held around 6 out of the 36 asset types (The World Bank, 2018). From the list of durable assets presented in IES 2010 and LCS 2015, a set of ten assets can be identified for this ICT analysis over the two time periods for comparability purposes. The next section describes the steps I took in producing a digital basket using the IES and LCS.

5.5 South Africa's ICT Ownership Variables

This section reviews asset ownership data in South Africa, with specific emphasis on ICTs acquired by South African households. The South African asset ownership has a range of products identified to be common within a South African's household portfolio and cross-sectionally comparable over time. In better understanding ICT assets in South Africa, I review the availability of data and classification of ICT ownership over the 2005-2015 period. Given their use of the common household asset question, I use the Statistics South Africa reports for the two Income and Expenditure Surveys for 2005/2006 and 2010/2011 and the two Living Conditions Surveys for 2008/2009 and 2014/2015. In the IES 2005 and IES 2010, the variables used are derived from the question posed around ICT ownership: *"Does the household own any of the following items?"* (Statistics South Africa, 2012c, p. 51). Those who respond to the question of marking yes or no are counted, while those who do not answer the question are marked as 'missing.'

As for the LCS 2009 an LCS 2015, the question is posed slightly differently: "*Does the household own or have access to any of the following items?"*(Statistics South Africa, 2015b, pp. 42-43). There are three choices of response: a) owns, b) does not own, but have access, and c) neither owns nor have access (Statistics South Africa, 2015b). In this case, those who respond positively to the ownership aspect are included for ownership, while those who either answer that they have non-ownership but have access to the ICT or say no to ownership or access to the ICTs are marked as ‘non-ownership’. Those who do not answer the question for any of the ICTs are classified as ‘missing’ and dropped from the sample. The aspects around the responses around access in the LCS 2015 is further analysed in the findings section. These four survey reports are appraised below for their ICT ownership items because of the similar survey questions and techniques used for all surveys. Overall, the changes made over time on the ICT items are negligible and results are therefore suggested to be comparable.

5.5.1 Types of ICTs observed for Household Ownership

In looking at the report on ICT ownership during the 2005-2015 period, Statistics South Africa show ten consistent types of ICT durable goods. The table below provides an overview of the ICT ownership variables over the ten year period. During the period, while there are some standard ICT goods, some of the goods have the variable name slightly altered. In three cases–radio, stereo/HiFi, and camera–nothing is fully altered across the period. In four cases–television, computer, cellular telephone, and landline phone-one word is altered. The one-word change for these four examples do take into account the technological changes. For example, what was previously called landline telephone is now called ‘telephone’ in the LCS2015. This change makes the term inclusive of emergent technologies. Some physically attached handset may still use fixed line or wired connections, however, the connection service may now be from sources other than the conventional Telkom landline.

In South Africa’s case, Neotel remains the sole competitor to Telkom, however their “telephone” service is offered through a mix of fixed line infrastructure and wireless technologies. South Africa also has a range of emerging establishments seeking to use Voice over Internet Protocol (VoIP) services to provide to consumers, whereby phone calls can still be made on a handset. This service further blurs the classification of internet-based or landline services. The change to “telephone” in the LCS 2015 suggests accountability for these emerging changes. The computer, which covered all information processing equipment, is now disaggregated into three variables in LCS 2015: Desktop computer, Laptop/Notebook/Netbook and Tablets. Such information provides an improvement of the types of computer equipment now available within households. ‘Cellular telephone’ and ‘television’ were changed in IES 2010 to ‘cellphone’ and ‘television set’, and then reverted back in LCS 2015 to the IES 2008/09 form. One durable good, tape recorder, was removed from the IES 2010 and LCS 2015 list. The three goods which have changed substantially over the period are: DVD players, satellite TV and internet service. The DVD player category had changed in all four periods as seen in Table 9 below.

Table 9: Comparison of Variables for ICT Household Ownership: 2005-2015

IES 2005/06	LCS 2008/09	IES 2010/11	LCS 2014/15	Chosen ICT variables for thesis
1. Radio	1. Radio	1. Radio	1. Radio	1. Radio
2. Stereo/HiFi	2. Stereo/HiFi	2. Stereo/HiFi	2. Stereo/HiFi	2. Stereo
2a.Tape recorder	2a. Tape recorder	*[absent]*	*[absent]*	
3. Television	3. Television	3. Television set	3. Television	3. Television
4.Satellite Dish	4.DStv	4.DStv	4.Satellite TV	4. Satellite TV
5.Video cassette recorder/DVD	5. DVD player	5. DVD player	5. DVD/Blu-ray player	5. DVD
[absent]	5a. Video cassette recorder	*[absent]*	*[absent]*	
6. Computer	6. Computer	6. Computer	6. Desktop computer	6. Computer*
[absent]	*[absent]*	*[absent]*	6a. Laptop /Notebook/Netbook	
[absent]	*[absent]*	*[absent]*	6b. Tablets	
7. Camera	7. Camera	7. Camera	7. Camera	7. Camera
8. Cellular Telephone	8. Cellular Telephone	8. Cellphone	8. Cellular Telephone	8. Cellular Telephone
9. Landline telephone	9. Landline telephone	9.Landline telephone	9. Telephone	9. Landline telephone
10. Internet service	10. Internet	10. Internet service	10. Connection to the internet	10. Connection to the internet
11 ICT types	**12 ICT types**	**10 ICT types**	**12 ICT types**	**10 ICT types**

Source: Author
*Note: the computer variable – Given the LCS 2015 has 3 possible ‘computer’ options, this variable is derived by including any household that indicates ownership of either a desktop, laptop, or tablet.

This change accounts for the popular media video player technology for each of the time periods. The satellite TV was previously the satellite dish and then changed to be named after the main satellite service provider at the time, DStv. By the time of the LCS 2015, the term satellite TV takes into account not only the satellite dish, but the suite of service providers offering the service. Finally, what was previously 'Internet service', in LCS 2015, is now labelled 'connection to the Internet;' this expands the inclusion of the various service offerings of the internet whether it be via mobile modem, ADSL, WiFi or any other emerging service. Given these variable label changes, this reveals possible inconsistencies in reporting on ICT ownership specifically when attempting to report on ICT data over time. The slight changes could see varied interpretations which can thereby alter the results over time. This is particularly the case for the variable label, 'computer', since this variable in the LCS 2015 is now disaggregated into three types of computer. Prior to the 2015 survey, 'computer' was the only available ICT label. The internet service is also better described, yet the results may account for a change in interpretation. More broadly, as mentioned when analysing the ICT expenditure list, this ICT ownership list is limited in the possibilities for a household's possible digital basket. It misses out digital content, social ICTs and human ICT resources in a household's digital basket. Yet at the same time, this application allows for the first attempt to digital basket which can be applied across countries. This entry point also allows room for improvement in measures. Overall, Statistics South Africa has re-labelled variables over the period to ensure that relevant categories for durable goods ownership is taken into account within households, while at the same time, it is designed to minimise changes in order to remain comparable over time.

5.6 Construction of the Digital Basket

As mentioned above, the digital basket is constructed using an inventory count of ICT asset types owned by a household, thereby creating of an additive index and all of which hold equal weighting. The development of an index of ICTs are modelled after ICT indicators used for the digital poverty studies conducted by May (2012c) and Barrantes (2010). This study takes ICT ownership variables from the IES 2010 and LCS 2015 in South Africa and applies the theoretical suggestion by Warschauer's 2003 social inclusion work. In this case, the ICT resources as separated out from the larger pool of asset indicators and bundle together as the ICTs for this study, which for the purpose of this study is called the household's 'digital basket'. Of the ICTs, the technological trends of households include some previously analog devices transitioning into digital forms and thereby requiring a slight terminology changes within the surveys. As mentioned above, the small changes allow for surveys to be comparable over time. Yet, I note that with the numerous technological changes of household ICTs, there could be a limitation to a digital basket measure that could be comparable in future. Nevertheless, in the findings section, the descriptive statistics are presented through the aggregate digital baskets in South Africa from 2010 to 2015 using national estimations.

Based on the above ten ICT assets, the researcher first derives all possible ICT asset combinations that the sample households could possess. For example, a household can have absolutely zero ICT assets in their possession, a household can have all ten ICT assets in their ownership or a household can have a range between one to nine ICT assets as combinations. All in all, there are 1024 possible ICT asset combinations which could compose of a household's digital basket. As explained earlier in the description of the IES 2010 and LCS 2015, there is also recognition that some of the households who did not fill in a response of at least one of the ten ICT assets were dropped off the sample. I thereby proceed with the restricted sample.

Through analysing of the digital baskets, the study reveals the composition of ICT bundles owned by a majority of South African households as well as the statistics when disaggregated by variable demographic characteristics. In order to illustrate the information above, I create a digital basket taxonomy (see Table 10 below) which is used for the descriptive statistics analysis against the range of demographic characteristics of South African household. Each of the household digital baskets are classified within one of the four groupings: a) no digital basket (NDB), b) small digital basket (SDB), c) medium digital basket (MDB) and d) large digital basket (LDB). NDB is made up of zero ICT assets, SDB is composed of one to three ICT assets, MDB has four to six ICT assets and LDB makes up for seven to ten ICTs in the digital basket.

Table 10: Digital Basket Taxonomy

Name of Digital Basket	Description
No Digital Basket (NDB)	Households with zero ICTs
Small Digital Basket (SDB)	Households with 1-3 ICTs
Medium Digital Basket (MDB)	Households with 4-6 ICTs
Large Digital Basket (LDB)	Households with 7-10 ICTs

Source: Author

The findings section in Chapter 7 provides the digital basket descriptive analysis and trends across various segments of the population and then provides a theoretical application, testing the relationship between the digital basket and poverty reduction.

As for analysing the regression, the IES 2010 ICT household ICT asset ownership is used due to access to accurate poverty line statistics. To construct the additive digital basket index, I take the observations of the positive or negative responses to the ownership of the ten ICT assets, each are assigned equal weights to avoid normative judgment on any of the ICTs, and finally the aggregates of each present the digital basket index.

5.7 National Poverty Line in South Africa

Now that the ICT ownership variable is the appropriate choice to analyse the digital basket amongst South African households, the next step is to apply it against levels of poverty in South Africa. As discussed in detail in Chapter two, poverty can be examined in a multitude of ways, but in this case, I wish to differentiate between the poor and non-poor households through the total household expenditure variable. In the available data, two approaches to analyse income poverty can be considered: a) using relative poverty lines of the lowest income quintile of the population or b) using the poverty lines set by Statistics South Africa. While characteristics of the lower twenty percent in the income distribution is well utilised (see ICT studies described in Chapter 3 using the "bottom of the pyramid" approach to measure the poor) provided in the research findings section, there is a possible opportunity to influence public policy around digital inclusion, and therefore the nationally determined poverty line is used. This use of the national poverty line is consistent to a previous study which also looked at ICT demand by the poor in South Africa and that used the poverty line set by the National Planning. Commission (infodev, 2012b). I was able to obtain from Statistics South Africa the needed person weights and consumption data to align with the national poverty reports. In the case of this study using the IES 2010, I apply the same poverty line utilised by Statistics South Africa in their reports, in this case, it is the 2011 national poverty lines, adjusted for inflation. In Annex C, the South African poverty lines between 2006 to 2018 adjusted to inflation are presented as a reference point. In the case of 2011, the food poverty line (FPL) is set at 335 Rands, lower-bound poverty line (LBPL) at 501 Rands and upper-bound poverty line at 779 Rands (Statistics South Africa, 2018b). Each of the poverty lines are defined in the 2018 National Poverty Lines report, but the Republic of South Africa adopts its official poverty line to be the LBPL (National Planning Commission, 2011). The LBPL takes a cost-of-basic-needs approach (e.g. using both basic food and non-food expenditures in its calculation), but identifies an austere minimum expenditure to be included as non-food basic needs (Statistics South Africa, 2018b). In order to calculate the poverty head count, I utilise an aggregate of all the expenditure items for each household that is derived from the IES 2010 expenditure data set titled "total_ies.dta", which was permitted for use by Stats SA. The range of the aggregate expenditures is R218,89 – R1 828 338,30 within 25 328 households and there is no missing or zero aggregate expenditure observations.

One must note that the IES 2010 household data also provides a derived total expenditure variable called 'consumptions.' I also observe that this variable has no data for missing and no zero expenditure observations, and the valid range of the annual consumption is R219 – R3 615 313 (Statistics South Africa, 2012c). This variable, however, would provide you with an under estimate of the poverty headcount by approximately 3% (in comparison to the official Stats SA poverty lines), therefore I used the derived aggregate figure from the full expenditure data set. From here, I derive the per capita per month consumption and compare them against the three poverty lines for 2011. Below, in Table 11, are the 2011 per capita per month poverty headcounts, which are the same as those reported in the Stats SA 2018 poverty report.

Table 11: Individual and Household Poverty Lines using IES 2010

% of n	n	Percentage (%)	se
per capita level			
At the Food Poverty Line (335 Rands or less per capita per month)			
Yes	95042	21,43	0,1603
No	95042	78,57	0,1603
At the Lower Bound Poverty Line (501 Rand or less per capita per month)			
Yes	95042	36,45	0,1899
No	95042	63,55	0,1899
At the Upper Bound Poverty Line (779 Rands or less per capita per month)			
Yes	95042	53,20	0,2022
No	95042	46,80	0,2022
% of n	n	Percentage (%)	se
per household level			
At the Food Poverty Line ((335 Rand x household size) per month)			
Yes	25328	13,47	0,2568
No	25328	86,53	0,2568
At the Lower Bound Poverty Line ((501 R x household size) per month)			
Yes	25328	25,03	0,3306
No	25328	74,97	0,3306
At the Upper Bound Poverty Line ((779 Rand x household size) per month)			
Yes	25328	40,4	0,3851
No	25328	59,6	0,3851

Source: Own calculations from the Income and Expenditure Survey 2010/11

In this case, the LBPL poverty headcount is 36,45%. As this study is analysing the household as the unit of analysis, I then derive a per household per month expenditure figure and compare them to a per household per month poverty line. This household poverty line is calculated by taking the current poverty line per capita and multiplying it by the number of household members. For this study, poverty will be defined by the lower-bound poverty line at a household level. In this case, the household poverty head count is 25,03%.

In Table 12, I go further to provide the descriptive statistics on the restricted sample (households who report digital baskets) against households identified as poor (using the LBPL). In the estimates of the counted households, around 3,29 million households are identified as poor.

Table 12: Descriptive Statistics of Poor Households, 2010

	Poor Sample		Restricted Sample	
	#	n	#	n
# of South African households (millions)	3,29	6 574	13,15	24 902
Mean hh expenditure per month of sample population	R1643,65	6 574	R5663,36	24 902
Mean hh expenditure per month of SA pop estimates	R1703,13	6 574	R6932,44	24 902
Average household size sample population	5,3	6 574	3,75	24 902
Average household size (South Africa population estimates)	5,6	6 574	3,84	24 902
Average age of members in the household (sample population)	26,18	6 574	31,92	24 902
Average age of members in the household (South Africa population estimates)	24,78	6 574	30,97	24 902
Male-headed hh, mean expenditure per month SA pop estimates	R1661,10	2 861	R8298,81	14 051
Female-headed hh, mean expenditure per month SA pop estimates	R1740,35	3 713	R4715,73	10 851
Male-headed hh, household size (South Africa population estimates)	5,4	2 861	3,6	14 051
Female-headed hh, household size (South Africa population estimates)	5,8	3 713	4,2	10 851
Male-headed hh, Average age of members in the household (South Africa population estimates)	26,5	2 861	32,5	14 051
Female-headed hh, Average age of members in the household (South Africa population estimates)	23,2	3 713	29,1	10 851

Source: Own calculations from the Income and Expenditure Survey 2010/11

In the estimates of household expenditure per month amongst the poor, the average is far below the average, with approximately R1 700 per month being the average aggregate expenditures amongst the poor and national expenditure average being around R6 930 per month. Of those households identified as poor, female-headed households represent around 53% of this poor household population. Poor households also tend to have a larger household size and have a lower average age amongst its household members compared to the national average. Poor female-headed households also tend to be larger and have a smaller average age compared to poor male-headed households.

This study demonstrates the relationship between ICTs and poverty by using the information around household expenditure per month levels and subject this to an regression analysis around the relationship between digital basket ownership and poverty levels. When comparing these two data sources, the study allows for the quantification of the contribution of the ownership of ICTs to the observed poverty level trend.

5.8 Determining the Nexus between ICTs and Poverty

The data is interpreted against various household characteristics to provide context and includes statistical models in relation to poverty and well-being. Specifically, I closely examine characteristics amongst households with no or low digital baskets and provide some insight as to how such ownership is distributed across homes in South Africa. Using one South African dataset (specifically the IES 2010), I propose testing the hypothesis that there is relationship of digital basket ownership and improved welfare in South Africa. Few studies on ICTs have measured against levels of poverty in South Africa, despite the high value placed upon ICTs by low-income individuals and households (Allen, 2018; infodev, 2012b). There also remains a few studies which have looked at the relationship of ICTs and poverty and can help to decide on model specifications and regression analysis (Barrantes, 2010; May *et al.*, 2014a; May, 2012c) as well as look at reducing data to improve its validity through exploratory factor analysis (Ragnedda *et al.*, 2019). Correlational research go beyond the description by systematically investigating the extent of a relationship between two variables, in this case, an additive digital basket index and income poverty (via the use of household expenditure per month). In other words, I report the likelihood that as the score of the digital basket index increases within the household, the level of income also increases and therefore the risk of poverty is reduced.

5.9 Model specification

In order to estimate the relationship of variables on poverty levels, given a household's digital basket, a brief overview on model specifications is provided in Table 13 below. This multivariate analysis identifies the relationship between ICTs and poverty, but controlling for three main dimensions under each model: demographic characteristics, locality and other welfare dimensions.

The sample is the restricted sample of all households in South Africa that provided full answers to ICT ownership and the data is weighted to produce estimations at the national scale. A description of each of the derived variables are found in the table below as well as the original variables used from IES 2010 in Annex D.

Table 13: Model Specification: Variable Description

Variable	Description	Expected sign
Dependent variable		
Log of household monthly expenditures	Continuous variable. Range is 2,90-11,93.	
Independent variable		
Digital Basket	Continuous variable. Range is 0-10.	
Demographic Characteristics		
Gender of household head	Dichotomous variable. Value of 1 = Male-headed household; 0 = Female-headed household	+
Population group of household head	Nominal categorical variable. Value of 1 = African/Black (base), 2 =Coloured, 3 =Indian/Asian, 4 = White	+
Maximum education level completed by any household members	Nominal categorical variable. Value of 1= No education completed (base), 2=Primary, 3= Secondary, 4=Tertiary	+
Household size	Continuous variable. Range is 1-21.	-
Locality Characteristics		
Province	Nominal categorical variable. Value of 1 = Limpopo (base), 2=Eastern Cape, 3=Northern Cape, 4=Free State, 5=KwaZulu-Natal, 6=North West, 7=Gauteng, 8=Mpumalanga, 9= Western Cape	+
Settlement type	Nominal categorical variable. Value of 1 = Urban informal (base), 2 = Urban formal, 3 = Traditional area, 4 = Rural formal	+
Other welfare dimensions		
Formal dwelling	Dichotomous variable. Value of 1 = Yes ; 0 = No	+
Access to drinking water on-site	Dichotomous variable. Value of 1 = Yes; 0 = No	+
Connection to main electricity supply	Dichotomous variable. Value of 1 = Yes; 0 = No	+
Home ownership	Dichotomous variable. Value of 1 = owning home; 0 = Rent or Occupy for free	+

Source: Author

To estimate the likelihood that a household has a monthly expenditure increases (the proxy for poverty reduction) with positive change to the digital basket, an ordinary least squares regression model is constructed and is estimated as:

$$Ln(expendhh_i)=a_0 + b_1X_1 + b_2X_2 + \dots b_kX_k + e_i$$

Where the $Ln(expendhh_i)$ is the natural logarithm of a household's expenditure per month and the dependent variable; a_0 is the constant and represents the value of Y when variables X_1 to X_k are equal to zero. The explanatory variables are those described in the Table above. Each b_k represents the change in Y associated with a unit increase in the X_k by which it is multiplied, holding all other X's constant. The variable e_i accounts for all other unobservable errors.

5.9.1 Regression Analysis: Dependent Variable

In this section, I further describe the choice of the dependent variable, the natural logarithm of the monthly expenditure per household. The dependent variable in this OLS is continuous, and in this case, the unit of analysis is the household, the expenditures per month remains at a household level. The expenditure variable was transformed to take its natural logarithm in order to make its distribution more normal. The choice to use the household expenditure variable as opposed to the income variable is aligned with Statistic South Africa's practice of using expenditures to better approximate self-reported household income as well as a more appropriate measure for poverty. Both variables remain prone to measurement and non-response errors, however the income variable is particularly problematic for a survey due to the trends of non-reporting of the income of the very rich (non-response error) as well as the systematic under-reporting (measurement error). This is the rationale for the use of the household expenditure variable. The IES is advantageous for its comprehensive approach to prepare a full collection of expenditure items and it is the dataset used by Statistics South Africa to calculate national poverty levels. This household expenditure per month is inflated/deflated to March 2011 prices based on the Consumer Price Index (CPI) (Statistics South Africa, 2012c).

5.9.2 Regression Analysis: Independent Variable

The digital basket uses an additive index based on a continuous variable, using the number of ICT assets within a household. The range is from 0 ICT assets to 10 ICT assets. In further estimating the correlates of poverty, some of the descriptive analysis and previous literature guided the decisions around independent variable choices. A number of independent variables are captured, particularly in the three dimensions of demographic characteristics, locality and other welfare dimensions.

In controlling for certain demographic characteristics within the estimation, mainly gender of household head, the race of household head, maximum education level completed amongst household members, and the household size are utilised.

Previous studies are used as guidance in the choice of explanatory variables. Previous work which control for gender-based headship variables show that female-headed households are at a higher risk to poverty compared to their male headship counterparts (Rogan, 2011). As for population group of household head, the suggestion that the historic legacy of racial discrimination continues to influence the wider society and controlling for the headship of White, African, Coloured and Indian households is used in other studies, including this thesis (Hoogeveen & Özler, 2005; Rogan, 2011). The education level can be influential with the variable whereby the higher education level of at least one household member is measured, with the likelihood of being able to earn higher income (Allen, 2018). The household size may also influence the relationship negatively, as a larger household are more likely to be at risk to poverty (Rogan, 2011). It would mean more resources to be spent on necessities like food for each person and therefore a smaller ability to acquire ICT assets.

1) Gender of household head is a binary variable and was divided as male head of household (assigned value 1) and female head of the household (assigned value 0).

2) Population group of household head: each population group is assigned with its own separate dummy variable: White, Coloured, and Indian. African/Black is the omitted (or reference) variable.

3) Maximum education level completed amongst household members: this is a nominal categorical variable, assigning separate dummy variables for each group: primary school completion, secondary school completion, and tertiary education completion. No education completed is the omitted (or reference) variable.

4) Household size: this is a continuous variable of the number of household members noted in the survey, and the range is from 1 household member to 21 household members.

Another dimension included in the modelling is locality, mainly through two features, province and settlement type of household, all of which are held constant. The gross domestic product of a province may well influence the type of external ICT infrastructure investments are available in the area. For example, provinces with big cities like Gauteng, Western Cape and KwaZulu-Natal are observing major investments in WiFi infrastructure. The same regional development can apply to settlement type, where urban formal will likely to have more ICT infrastructure investments than other areas such as the traditional area, urban informal or rural formal.

1) Province: Each province is assigned its own separate dummy variable and the provinces include: Western Cape, Eastern Cape, Northern Cape, Free State, KwaZulu-Natal, North West, Gauteng, and Mpumalanga. Limpopo is the omitted (or reference) variable.

2) Place of residence: the settlement type is divided into three categories and each type is assigned a dummy variable: urban formal, rural formal, and traditional area. Urban informal is the omitted (or reference) variable.

The final dimension is other welfare variables, specifically the following four variables: dwelling type, access to on-site drinking water, connection to main electricity supply and home ownership.

In the data analysis, the thesis provides four other socio-economic household welfare indicators (besides income which is the dependent variable) which may influence the relationship. Those living in informal dwelling may have a negative influence as there is no safe storage for ICTs and poor protection from the elements, which increases the likelihood of ICT damage. As for those with good sanitation and good drinking water access, the reflection of an improved socio-economic status alone may mean better income status and thus improved likelihood of ICT ownership. Electricity would have a positive influence on the relationship, as having a way to charge digital devices would increase changes to have an ICT than those who have no electricity. Finally, home ownership defines the ability to afford assets and therefore improved likelihood to own ICT assets. The definition of these welfare indicators are adopted from either the IES 2010 metadata or retrieved from the

Development Indicators report which used the General Household Survey. Each of the welfare indicator definitions are described below as well as reference to its application using the IES 2010 data:

1) Formal dwelling –Dwelling type is a derived binary variable and was divided as those classified with formal dwelling (assigned value of 1) and those dwellings which are informal (assigned value of 0). The definition of informal dwellings "…refer to shacks or shanties in informal settlements or in backyards." In application to this study, the households include those in the above definition as well as those who state living in tents and caravans.

2) Access to drinking water – Water is a derived binary variable as those household with access to on-site (assigned value of 1) and those who do not (assigned value of 0). The definition to water include access to 'Piped water in dwelling or in yard'. Using the IES 2010, the same question, 4.5 is used to define water access and includes the terms piped water, borehole or communal tap on-site.

3) Electricity – Electrification is a binary variable and was divided as a household with electricity (assigned value of 1) and household without electricity (assigned value of 0). The definition is in regards to whether the household has electricity for cooking, heating and/or lighting and is connected to the main electricity grid or "refers to electricity from the public supplier." In the IES 2010, question 4,9 is used and defined using option 1.

4) Home Ownership – Those who state that their home is owned is assigned a value of 1, while those who state that they rent or occupy the property for free as assigned a value of 0.

5.10 Ethics Statement

This research makes use of various secondary data sets which have undergone their own respective institutional code of research ethics. Ethical procedures for the IES collected by Statistics South Africa are legislated by the Statistics Act (6/1999). Only secondary data have been used in this thesis. As per the ethical requirements of the

University of Western Cape, the researcher is mindful of ethical issues within the study and all policies will be upheld during this study. This thesis obtained ethical approval from the University of the Western Cape through the Research and Ethics Committee. The Statistics South Africa confidentiality policy falls under Section 17 of the Statistics Act, 1999 (Act No. 6 of 1999)[13]. The researcher will be responsible in attempting to report findings accurately and truthfully.

5.11 Limitations

As mentioned in the section above around digital baskets, I recognise the limitations of measuring ICTs or applying the 'digital basket' concept using the ICT ownership variable, especially due to the limit of available indicators. The coverage of ICT tangible assets in South Africa's current survey tools allows for comparison over time which is one advantage. Nevertheless, in applying the Warschauer theory, the absence of intangibles elements such as digital content, social ICTs and human ICTs limit this study. The critiques of measuring the intangibles are ongoing and producing the right indicator or measure depend on a well-developed inquiry by researchers.

Particularly in regards to digital and social ICTs, another limitation come to mind, namely the absence of a mechanism that accounts for ICTs which are acquired for 'free.' Specifically, individuals or households can obtain intangible ICT assets which are produced or created by the household or individual themselves without monetary exchange. In terms of accounting for an item within this digital basket application, an ICT item is only counted if relates to an ownership variable or an expenditure variable and indicates if the good or service was physically acquired or purchased. There are various offerings of ICT products and services which are currently framed as 'free' such as social media accounts or recorded content. This non-monetary digital content could be deemed problematic, as the ownership or expenditure variable would not account for it and thereby be under-represented in a digital basket. Yet there are several cases where social media content developed for free can help to generate work or income earnings and in some cases they remain personal

[13] The Statistics Act can be found here: http://www.statssa.gov.za/about_statssa/statistics_act.asp

goods. As with unpaid child care by family members, there are digital services being undertaken by household members which are being done without wage or payment and within the current household survey, are thereby unaccounted for.

This study utilises a unit of analysis of households which could underestimate the true possession of ICTs, compared to a measure that utilises an individual unit of analysis. This study is also limited to an analysis based on household ownership of ICTs and it is not designed to analyse questions around technology use. The study had no intention to look at use, therefore it does not look at the extent, intensity or characteristics of use. The study is also unable to segment the differences within a particular ICTs (for example, the distinctions between an entry level mobile phone and a high-end smart phone).

Despite these shortcomings, the application of the digital basket using available indicators at a household level is an appropriate starting point and illustration of where South Africa stands as being part of the 'networked society'. No other South African study has tried to look at a portfolio of ICT assets at either an individual or household level. Finally, the depth of study remains on the relationship of ICTs and poverty reduction by looking at the coefficient outputs and statistical significance. This study by no means is being used to demonstrate causality, which remains a limitation to the study. However, the ever changing nature of ICTs would also limit the use of panel data to analyse ICT portfolios in South Africa as already shown from the different ICTs available between the IES 2010 and LCS 2015. More broadly, the ICTs for a household's digital basket in 2008 would likely be substantially different from those ICTs within a 2019 digital basket. Given this predicament, this study is compelled to proceed with a sufficient starting point until improved survey tools become available.

5.12 Conclusion

The research methodology chapter describes the design and choice of data sets which are used to help answer the main research question of this thesis, what is the association between ICTs and poverty reduction in South Africa. This analysis incorporates a quantitative analysis methods using available survey data for the ten year period between 2005 and 2015 in South Africa. The chapter highlights the data used to inform the three following chapters as well as details the variables that are used for the regression analysis. One of the original contributions of this thesis is to apply the digital basket or portfolio of ICTs amongst South African households. The IES 2010 and LCS 2015 are suitable for the study because the data set provides adequate information on the acquired assets of households particularly around ICTs. Once the ICT items are established, the various items can be aggregated together and that would allow for a better understanding of what ICTs that South African households currently possess.

There is also a possibility to assess ICT items in a household expenditure diary or questionnaire, however with limitations. At the international level, it is observed that the COICOP survey template for household consumption has not been changed since 1999. The currently proposed 2018 COICOP update will soon be officially adopted and the new ICT items provides a contemporary reflection of ICT expenditures to be captured across countries. However, in seeing the extent of digital evolution taking place, this current COICOP list as well as the household ICT ownership items listed within the next IES and LCS surveys may fall short in capturing a full inventory of ICTs held by today's households. This shortcoming could thereby underestimate the extent of a household's digital basket and misrepresent the true nature of change within a household in a contemporary society.

As of the empirical analysis, the ICTs and poverty in South Africa is limited, however, this study uses the IES 2010 data as a sufficient starting point to answer the main research question by applying ICT analysis through the digital basket concept and its association to poverty reduction. The digital basket analysis is also holistic, placing the empirical findings within the South African external context and includes the elements of vulnerability and the ICT system which can influence ICT ownership. By adopting the enhanced sustainable livelihoods framework, the elements of policy, competition and other external factors are described. In revealing an overview of the South African context, the digital basket is understood in-depth at the household level, and specifically the study remains human-centred, yet with a nuanced understanding of this contemporary society.

6 CHAPTER SIX: LIVELIHOODS & ICTS IN SOUTH AFRICA

6.1 Introduction

This chapter applies the sustainable livelihoods framework (SLF) components to address the research question 'how does the digital basket fit within internal and external factors of South African digital society?' The chapter is a new contribution to knowledge because first, I apply the ICTD perspective to the enhanced SLF using the South African context, specifically these three SLF components: 1) vulnerability context, 2) transforming structures and processes, and 3) the ICT systems. Secondly, I report on South Africa's reported livelihood strategies—specifically, ICT outputs and activities in the second half of the chapter. The empirical evidence is derived from available reports and data on ICTs in South Africa, specifically on the physical ICTs, and their measures of access, ownership time usage, and expenditures. Finally, the last section focuses on the main thrust of this thesis, the ICT assets. Household ownership of ICTs are examined in-depth specifically against some demographic characteristics. The section primarily examines ICT ownership through Stats SA reports within a ten-year period from 2005 to 2015. The chapter closes with an analysis of the sustainable livelihood components in South Africa.

6.2 South Africa and Vulnerability

Vulnerability in the context of the sustainable livelihoods framework is defined as the ability for households to cope and recover when faced with either stress or shock (Scoones, 1998). South Africa has not been spared from economic instability and recession. While South Africa is classified as an upper middle-income country with a nominal GDP of R4,9 trillion in 2018 (Statistics South Africa, 2019b), its economic growth prospects remain relatively moderate at only 1,5% growth for 2019 (Republic of South Africa, 2019a). Even with relatively substantial country wealth, the slow growth rate is worrying and may further reveal country-wide issues of support for the large proportion of the population who are poor and unemployed.

In South Africa, vulnerability can be found amongst those who lack income or basic needs. The measure of income poverty can be viewed from three perspectives: 1) national poverty line; 2) multi-dimension poverty headcount; and 3) poverty dynamics or chronic poverty. In review of the national poverty line, South Africa first identifies three types of income poverty lines: extreme poverty via the food poverty line (FPL); the lower-bound poverty line (LBPL); and the upper-bound poverty line (UBPL). South Africa uses the lower-bound poverty line as its official national poverty line at R785 per person per month using 2018 inflation-adjusted prices (Statistics South Africa, 2018b). As illustrated in Table 14 below, nearly 21,9 million persons in South Africa were poor in 2015 (using the LBPL and adjusted to 2015 prices); this sits at 40,0% of the population (The World Bank, 2018). While this rate was seen to decrease from 2006 to 2010, there was a slight poverty rate increase between the period of 2010 to 2015. As for the global comparison of using USD $1,90 (PPP) a day as the extreme poverty rate, South Africa has 18,8% of its population who live below this international poverty line in 2015 (The World Bank, 2018).

Table 14: Poverty Headcounts and the Number of Poor Persons (2006, 2009, 2011 and 2015)

Poverty headcounts	2006	2008	2010	2015
Percentage of the population that is UBPL poor	66,6%	62,1%	53,2%	55,5%
Number of UBPL poor persons (in millions)	31,6	30,9	27,3	30,4
Percentage of the population that is LBPL poor	51,0%	47,6%	36,4%	40,0%
Number of LBPL poor persons (in millions)	24,2	23,7	18,7	21,9
Percentage of the population living in extreme poverty (below FPL)	28,4%	33,5%	21,4%	25,2%
Number of extremely poor persons (in millions)	13,4	16,7	11,0	13,8

Note. Adapted from “Poverty Trends in South Africa: an examination of absolute poverty between 2006 and 2015” Statistics South Africa., 2017d, *Pretoria: Statistics South Africa, p.*14.

Using the LBPL, the profile of the poor reveal households that are female-headed had a higher poverty headcount than male-headed households (The World Bank, 2018). Households headed by black South Africans had higher headcount compared to households headed by a person identified as Coloured, or household headed by an Indian/Asian South African (The World Bank, 2018). In terms of completion of education, households living with a head who did not have formal education had a much higher poverty headcount than that of a household whose head had acquired secondary school education and further studies (The World Bank, 2018). Finally, poverty headcount is highest amongst households based in the rural areas compared to urban areas of South Africa.

South Africa has also measures for multi-dimensional poverty, whereby indicators beyond income are analysed for household well-being[14]. Over the period from 2001 to 2016, there was a decrease in South African households who were multi-dimensionally poor, with the headcount at seven percent in 2016 (The World Bank, 2018). One intervention that has mitigated the country from having a higher poverty headcount is the provision social grants to older persons and households with children (Woolard & Leibbrandt, 2010).

Poverty dynamics is when one observes a sample of the same population over time such as through a longitudinal panel survey and the data reveals households or individuals who transition above or below a set poverty line (Jalan & Ravallion, 1998). The chronically poor are a specific group who are at high risk of being persistently below the poverty line and are primarily income poor during the observed time periods (Jalan & Ravallion, 1998; The World Bank, 2018). In a close look at chronic poverty in South Africa from 2008 to 2015, one quarter of the population are found to be stably middle class or elite during the time period, and another quarter are identified as transient or vulnerable (as in, they straddle just above or below the poverty line over time and are at high risk of being on either side of the line) (Schotte *et al.,* 2018). The remaining half of the population are identified to be chronically poor (Schotte *et al.*, 2018).

Unemployment is another persistent issue of vulnerability for the country, with many in the population without paid work. From the latest quarterly labour force survey (Q1: 2019), the unemployment rate stood at 27,6% during the first quarter of 2019 (Official Unemployment Rate) (Statistics South Africa, 2019c) and is found to be at a higher rate amongst South African youth. The low economic growth rate results in low new job creation added per year and therefore there remains a large group who enter the job market for the first time or are currently unemployed without job matching success. There is also worry that the trend of stable work for low- to semi-skilled workers in non-agricultural work is on a decrease, and a transition towards

[14] The South African Multidimensional Poverty Index (SAMPI) uses the global guideline to measure the dimensions of health, education, standard of living and economic activity and derive aggregated estimations (The World Bank, 2018).

more highly skilled work, leaving South Africa further vulnerable with labour market inequality (Anwar, 2019; The World Bank, 2018).

There are various government services which have helped smooth out vulnerability found from the multiple dimensions of poverty, and to some degree, unemployment. South Africa provide a social redistribution program which contribute to no-fee schools, feeding schemes, free basic service for poor households, social transfers or grants to older persons and for children (The World Bank, 2018). Just under 45 percent of households received one or more grants in 2018 (Statistics South Africa, 2019a). The government spends 3,3 percent of GDP on such social transfers, which contributes to the lowering of income poverty and inequality (Inchauste *et al.*, 2015). One policy recommendation to end the poverty trap, including the support for stable work for the vulnerable (or those just above the poverty line) in combination with social transfers or safety nets to support the chronically poor (Schotte *et al.,* 2018).

Aside from poverty and unemployment, South Africans are highly exposed to rising food costs, some items of which rose higher than inflation, as seen in 2013 (SAPA, 2013). These high costs filter down to the home, increasing the cost of commodity household good–spending amongst the poorest (Leibbrandt *et al.*, 2016). In comparing those at the bottom of the income distribution (or bottom 20%) and the prices of their goods bundle to that of an average consumer price index (CPI) adjustment, there is evidence that the poor spend more than others (Leibbrandt *et al.*, 2016). The poor are overexposed to high-inflation goods such as bread as well as on other basic foodstuffs and electricity. While increases in the typical expenditures of the poor can be interpreted as the ability to buy more particular goods and indicate a proxy of improved well-being, in this case, it does not mean that households are buying more. Rather, this expenditure pattern implies that the poor must pay a higher price for the exact same bundle of goods.

Taken together, the issues of low economic growth, high poverty, unemployment and inflation reveal that poor South Africans are exposed to long-term vulnerabilities. At the same time, government provisions and social transfers have helped to ensure that the population have some essential needs and poverty headcounts are mitigated. This precarious context can highly influence the ability for poor households to gain access to a broader set of assets, including ICTs, all of which appear as difficult conditions to retain a wide set of such durable goods.

6.3 South Africa's Transforming Structures and Processes

Addressing this vulnerability context requires appropriate transforming structures and processes, particularly through government institution and policy. Institutions have "regularised practices (or patterns of behaviour) structured by rules and norms of society which have persistent and widespread use" (Scoones, 1998, p. 12). The Constitution of the Republic of South Africa provides the citizens of the country with the democratic and political guidelines and opportunities of engagement with the government under a human rights perspective (Republic of South Africa, 1996). The constitution comes under the context of national priorities to redress the racial inequalities of the past. Prior to 1994, development infrastructure occurred in very unequal mechanisms, with some regions such as cities being provisioned with water, sanitation and facilities, whilst other regions such as townships were given less than sufficient resources.

While the country is working towards upholding the overall constitution, specific national, provincial, and local institutions and policies specify government implementation. The current South African government is administering its socio-economic strategies, goals, and mission through the guidance of the National Development Plan (NDP) (National Planning Commission, 2011). The NDP is an overall framework that prioritises increasing employment, improving education quality, and building the capacity of the state (National Planning Commission, 2011). Departmental policies are expected to be aligned with the development planning strategies.

The most relevant development policy around ICTs is the application of the NDP to policies within the Department of Communications. Guided by the NDP, South Africa acknowledges the importance of ICTs within its development policy strategy, making the following statement within the information and communications infrastructure section:

> By 2030, ICT will underpin the development of a dynamic information society and knowledge economy that is more inclusive and prosperous. A seamless information infrastructure will meet the needs of citizens, business and the public sector, providing access to the wide range of services required for effective economic and social participation – at a cost and quality at least equal to South Africa's competitors (National Planning Commission, 2011, p. 170).

Critique of the NDP points out that while digital inclusion is included in the policy document, the premise of ICTs to provide further economic development was not prioritised and mainly retained a position dependent on the market (Gillwald, 2012). This argument is consistent to the latest strategy, since April 2019, the Department of Communications adopted a discourse of the fourth industrial revolution (4IR). The idea is to implement an advisory commission under the Presidency who "will identify policies, strategies and plans that are needed to position South Africa as a leading country in the evolution and development of the 4IR" (Republic of South Africa, 2019b, p. 6). Since the South African president's 2019 inaugural State of the Nation Address, activities such as the 4IR digital economy summit have been undertaken to start tackling the coordinated policy actions (Gavaza, 2019). Gillwald (2019a) argues that should this new commission lack critical engagement by being absent of civil participatory mechanisms and lack of evidence-based research to inform this commission, the result could be an increase in digital inequality. In other words, without critical civil society and research engagement, the 4IR and its new technologies could misguide policy that benefits mainly a targeted group of elite, while the rest of the population are left behind with little digital skill or affordable access (Gillwald, 2019a).

The revived effort for ICT policy coordination operates under a set of existing strategy and policy papers which are aligned to the NDP. The National Integrated ICT Policy White Paper (2016) further grounds the basis of the NDP. It describes the ways in which government will implement communications infrastructure (e.g. spectrum allocations and licensing frameworks) and enhance the digital society through ensuring government information is online and digital literacy and economy activities are supported (Republic of South Africa, 2016). To complement, the

Presidency's Infrastructure Development Act includes the Strategic Integrated Project (SIP 15) to expand the access to communication technology, including access to fibre-optic networks (Republic of South Africa, 2014).

6.3.1 Broadband Policy of South Africa

The 2013 Broadband Policy for South Africa, also known as South Africa Connect is the main policy for providing sufficient connectivity to citizens (Republic of South Africa, 2013b). The 2020 vision statement for broadband promises "100% of South Africans will have access to broadband services at 2.5% or less of the population's average monthly income" (Republic of South Africa, 2013b, p. 12). The Broadband Policy operationalises the coordination of internet infrastructure, holistically integrating its strategies into four component categories: digital readiness, digital development, digital future, digital opportunity. This integrated "broadband ecosystem" approach framework connects a wide range of policy strategies, from expanding telecom infrastructure through the development of its undersea cables to the advancement of basic human capacity through skills training.

Reviews of South Africa's ICT policies before 2005 found them to be techno-centric (Moodley, 2005) or to have slowly developed to include participatory approaches to ICT policy development (Diga *et al.,* 2013). The previous policy frames attempted to meet quantitative minimum standards from a supply-side perspective. The 2013 Broadband Policy and 2016 National integrated ICT policy white paper, on the other hand, are policy improvements through the inclusion of demand side needs, such as e-skills and e-government services.

In areas that are not lucrative for private sector to build infrastructure, the Universal Services and Access Agency of South Africa (USAASA) is the government agency mandated to help extend these digital services and infrastructures to the communities of the most under-serviced areas. It is provisioned with the Universal Service and Access Fund, which, according to the white paper (2016), should be renamed the Digital Development Fund (Digital-DF) (Republic of South Africa, 2016). The USAASA work overlaps and integrates with the current broadband plans or the South Africa Connect strategy plans. The USAASA work concentrates on communication infrastructure provision to two of the most underserved local municipalities, Nyandeni local municipality and Impendle local municipality. In 2018, USAASA reported connectivity in 151 public schools, 29 clinics, 20 public free WiFi hotspots, 10 government facilities and 2 municipal offices (USAASA, 2018).

Also aligned with these policy mandates are the local implementation for urban developments such as city-run or community-operated Wi-Fi networks (Geerdts *et al.*, 2016). For example, the city of Tshwane (Pretoria) partnered with Project Isizwe[15] (since June 2018, the Wi-Fi network is wholly operated and owned by the city as TshWi-Fi[16]) to accelerate the delivery of free public Wi-Fi in schools, clinics and libraries. The province of the Western Cape has also partnered with private sector, Liquid Telecommunications SA to run a similar programme to 1600 of their government buildings (Geerdts *et al.*, 2016; Western Cape Government, 2018). The initiatives are meeting the policy mandates of ensuring free internet connectivity in public buildings, however it operates with limits. There is limitations on its geographical reach (as in, Wi-Fi access is restricted to around 100 metres from the connected buildings), unreliability of the internet connection, and security issues, all of which may deter general usage (Geerdts *et al.*, 2016). In rural areas, the emergence of community-owned telecommunication cooperatives such as those under the non-profit, Zenzeleni Networks, show partnerships with the national Department of Science and Technology and a local university, to deliver broadband internet (Rey-Moreno *et al.*, 2016).

There are concerns of missing the digital inclusion goals due to lack of infrastructure in specific impoverished areas and the high cost of broadband internet connectivity, all of which are factors which would exclude low-resourced citizens from participation (National Planning Commission, 2011, p. 23). With this latest communications policy revival, South Africa's broadband infrastructure gap have been pushing policies that are enacting national and local government initiatives of broadband rollouts throughout the country with some human-centred focus.

[15] https://projectisizwe.org/projects/
[16] http://www.tshwane.gov.za/Pages/WIFI.aspx

6.4 Context: ICT Systems in South Africa

To focus on the realities of ICTs in the hands of South Africans, an analysis on the external ICT system would be appropriate. Specifically, the technical, economic, and social ICT sub-systems are described as an application of the adapted SLF components in order to understand the conditions in which ICT assets are maintained within a household (May *et al.*, 2014b).

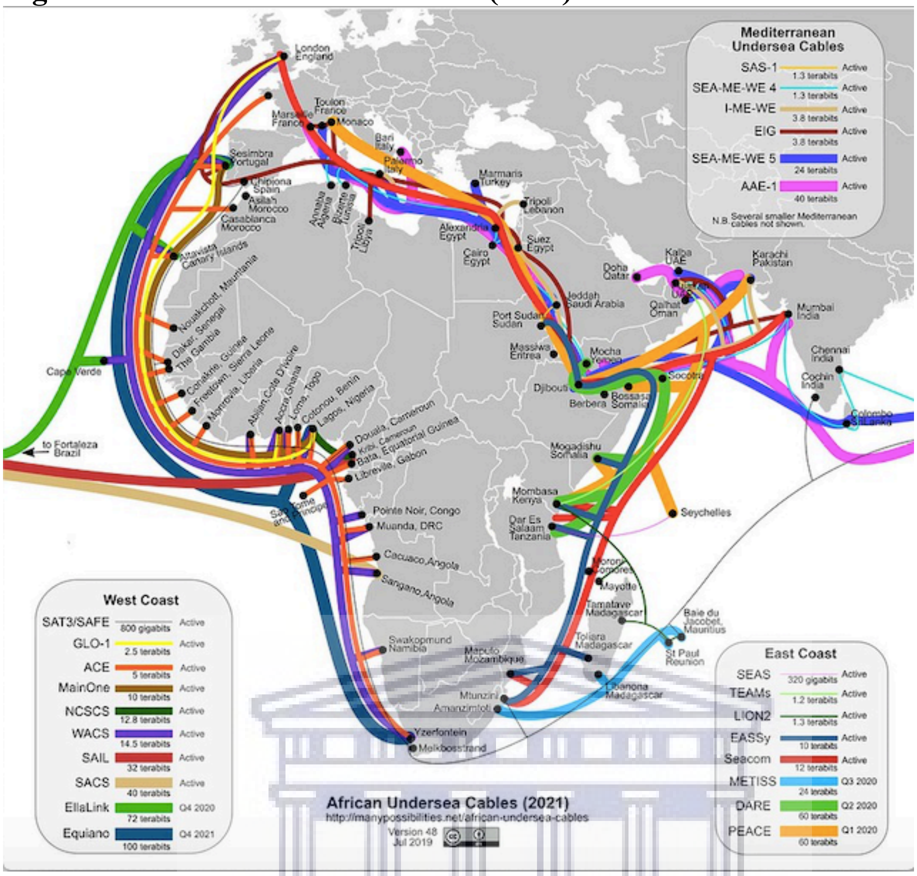
6.4.1 Technical Sub-System

This technical section concentrates on telecommunications and specifically describes the broadband infrastructure, including mobile telephony and fixed line network services, and some of the end-user technologies, including online applications, platforms, and content providers (May *et al.*, 2014b). In terms of the technical ICT system aspects in South Africa, the 2005 Electronic Communication Act (ECA)[17] provides the policy guidelines for the broadband infrastructure, specifically the coordination of the telecommunications infrastructure and networks of multiple operators (e.g. FibreCo, Neotel and Broadband Infraco) (Republic of South Africa, 2005). The three main components of telecommunication infrastructure are the undersea cables, terrestrial fibre, and licensed spectrum (which is broadband used by mobile operators). As observed in Figure 5 below, the fixed broadband is delivered by a variety of undersea submarine cables which land in parts of South Africa (Song, 2019b), all of which have improved the reach of broadband and the quality of bandwidth capacity.

Complementing the multiple undersea cable entrants is the increase of terrestrial broadband infrastructure across the country and cities through fibre optic cables. Broadband players such as FibreCo and Dark Fibre Africa are digging trenches and installing fibre optic cables and infrastructure (for example, for fibre-to-the-home connections) within major and secondary cities and between large cities.

[17] The Economic Communication Amendment Act, 2013, provides changes to the ECA, 2005.

Figure 5: African Undersea Cables (2021)



Note. Reprinted from "African Undersea Cables. By Song, S., 2019b. (https://manypossibilities.net/african-undersea-cables/) Copyright 2019, Steve Song.

This increased in this fixed broadband infrastructure have allowed for further competition within South Africa, and there is high hopes that costs of fixed broadband will lower (Gillwald *et al.*, 2018). As a result of this fibre optic supply, Telkom, the previous fixed line monopoly, is seeing declines in fixed-line subscriptions (specifically, the ADSL subscriptions which uses copper line infrastructure) (McLeod, 2018).

As for the third component of telecommunications infrastructure, mobile base station infrastructure and its respective mobile telephony service offer its digital services using licensed radio spectrum (such as 3G and 4G networks). The Global System for Mobile communication (GSM) signal coverage reports to be nearly 100% in the country.[18] The majority of the South African population connects to the internet and phone calls through the mobile phone. In addition to licensed spectrum, mobile

[18] view the current Vodacom 3G coverage map: http://www.vodacom.co.za/vodacom/coverage-map

network operators in South Africa are also diversifying their portfolio by also building fibre optic fixed infrastructure and other Wi-Fi technologies within urban areas (Gillwald *et al.*, 2018).

Aside from these three main telecommunication components, there are other commercial internet service providers that facilitate the fixed line and Wi-Fi infrastructure services, including routing internet traffic and maintaining the data network. The Internet Service Providers Association (ISPA)[19] in South Africa have 185 small, medium, and large members (own calculations from ISPA website, as of 20 May 2019). The Wireless Access Providers Association (WAPA) has a total of 216 commercial members, along with 22 non-profit association members. Besides commercial entities, emerging players are utilising Wi-Fi technologies for connectivity that are operated and owned by communities. There are examples of these community networks using such configurations to connect neighbourhoods, a decentralised approach of connectivity (Mitchell & Siebörger, 2019). In South Africa, there are at least 17 community-owned and operated networks that offer an alternative mechanism for rural connectivity since 2016 (Rey-Moreno, 2017). One example has been Zenzeleni Networks, based in rural Mankosi within the Eastern Cape province where the quality of mobile services are poor. Run as a community cooperative, the local team manages Wi-Fi and digital services as the community internet service provider and provides the village with much needed internet connectivity (Luca de Tena & Rey-Moreno, 2018). With that said, South Africa have an advanced level of technical infrastructure around telephony and internet services which enable the use of ICTs.

There still remains an telecommunications infrastructure gap in South Africa whereby national government are mandated to address the telecommunication infrastructure needs, such as where pockets of deprivation in rural or poorly covered urban areas exist. The latest 2019 parliamentary committee progress report states that the 2018/19 funding of R9,7 million was used to build telecommunications infrastructure in order to connect 63 public facilities, bringing its total of annual

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[19] Internet Service Providers Association members website: https://ispa.org.za/membership/list-of-members/

connections to 129 out of the targeted 570 (Parliamentary Monitoring Group, 2019). There is also a supplier database for contractors to help follow up on infrastructure service and maintenance work, and government provided ICT training to 100 of those contractors in the database (Parliamentary Monitoring Group, 2019). Government efforts to ensure wide broadband infrastructure reach, especially in rural areas, are modest, but it is a starting point to ensure more equitable digital inclusion.

6.4.2 Economic Sub-System

The economic element addresses the South African market on ICTs, economic institutions such as enterprises, cost structures and regulatory frameworks, all of which are elements that bring about demand, affordability, and access issues (May *et al.*, 2014b). The South African market reflects the commercial business standing of the ICT sector. In a global mobile industry study, the economic value of mobile technologies and their respective services were estimated to be \$3,9 trillion, or 4,6% of the world's gross domestic product in 2018 (GSMA, 2019a). In South Africa, the size of the ICT sector in regards to its contribution to the GDP was 2,7%, or 93 billion Rands in 2014 (Statistics South Africa, 2017a). The sector size is larger than South Africa's agricultural industry, but smaller than its tourism industry.

In South Africa, the commercial stakeholders who made up the ICT system layers were dominated by a few incumbent actors who were the sole providers of internet or fixed telephony services (Vermeulen, 2014). Telkom and Neotel (now acquired by Liquid Telecom)[20] were the main providers, but emergent groups are numerous, offering fibre optic links within major cities (such as fibre-to-the-home) and providing selection for internet services. Such diversified services hope to improve the number of households and businesses connected to fixed wired broadband.

In the meanwhile, the majority are connected through mobile services. The multiple mobile phone and satellite television operators contribute to the GDP in the ICT sector through their communication services, including mobile telephony and broadcasting services for businesses and residents. The mobile network operator market is dominated by two providers of licensed radio spectrum, mainly offered

[20] https://www.liquidtelecom.com/news-events/news/acquisition-of-neotel.html

through 3G or LTE networks: Vodacom and MTN. There are also two smaller players: Cell C and Telkom Mobile. Satellite television is dominated by the company, Multichoice (better known as DSTV) and there is a smaller competitor called StarSat. Complementing satellite services is the new emerging over-the-top television internet streaming services such as Netflix and YouTube. South Africa's ICT exports consist primarily of providing the larger African market with broadcasting satellite television services and mobile phone services. There remains a substantial gap between these ICT exports compared to South Africa's substantially larger proportion of ICT imports (Statistics South Africa, 2017a).

In terms of pricing regulation, Independent Communications Authority of South Africa (ICASA) is mandated to monitor and ensure the affordable telecommunications services to all South Africans. Gillwald (2018) remains critical of ICASA in their less than sufficient review of data and telephone service pricing and the overall state of the mobile telephony market. South African mobile service providers align with global practice in reaching a wide market share, and they include a diversity of services such as "please call me" free SMS services and pay-as-you-go or pre-paid options for airtime and data which allow low-income consumers to participate (Christiaensen & Raja, 2019). Recent benchmarking work by the Competition Commission questions the level of competition around data services provided by the service providers. The Commission states that South African data prices are high compared to other countries of similar GDP and within Africa (Competition Commission of South Africa, 2019). The Commission goes on to describe the lack of transparency on data packages offered by operators as undermining competition and the available data show anti-poor prices (Competition Commission of South Africa, 2019). While, there is competition and a range of services provided in the mobile and internet markets, the affordability of service remain in question and are being closely monitored by South Africa's respective regulatory bodies.

6.4.3 Social Sub-System

The social sub-system is made up of the actors or stakeholders (as in, communities, business people, households, and individuals) who help drive social interactions, networks and content within the ICT ecosystem (May *et al.*, 2014b; Song, 2019a). The previous sections have already highlighted some of the commercial entities that are supplying telecommunication infrastructure and services as well as some of the political institutions which regulate these services.

In addition, civil society organise in diverse ways to determine which technologies to use and further establish the meaningful use of ICTs. For example, communities provide the demand for appropriate digital content as is seen done by the 40 commercial/public radio stations and 256 community stations providing broadcasted programmes of local audio content in 2016 (Business Tech, 2016). There are also non-commercial community television stations, where citizens gather and provide local language television programmes and operate despite the adverse push by ICASA to promote commercial broadcasters (Duncan, 2017). This section concentrates on the people working in the sector as well as some community-based initiatives.

Online platforms are facilitating social interactions as well as promoting value-added services to households and individuals in South Africa. The gig economy is defined by the linkages between clients to labour workers who freelance and complete various short-term tasks or 'gigs,' all of which is facilitated by an online platform (De Stefano, 2015; Fairwork, 2020). For example, AirBnB home owners, the network of domestic cleaners of SweepSouth or the drivers of UberEat or Mr D are examples of the people involved in the gig economy and grouped by their respective online platform. In South Africa, adults working on these platforms remain small, with only 2% of the population deriving income from platform work (Gillwald, 2019b). Yet from the responses of those gaining income from the platform work, around 60% state the income are crucial to meeting their basic needs (Gillwald, 2019b). As for the work, contract workers in the gig economy can be found in a wide variation of quality work and protections, some of which can be low paying, provide dangerous working conditions or give individuals the inability to organise and bargain for reasonable working conditions (Fairwork, 2020). At one extreme delivery drivers are found to be, in some cases, undocumented migrants, who operate without health protection. Many drivers are only protected from work-related injury if they take up health insurance, otherwise, no protection is offered should they get hurt on the job (de Greef, 2019).

In socially engaging with platforms, online users of such services as well as digitally-enabled government services can be affected by issues of data protection and privacy. For example, controversy around the digital implementation of social transfers and scrupulous data sharing arose around the South African Social Security Agency (SASSA). Unauthorised deductions for airtime and third party access to the social grant holder's information affected the privacy of data of the most vulnerable recipients (mainly of whom are children and old age pensioners) (United Nations, 2019). Such concerns around privacy and trust are also raised in the potential of implementing GovChat, a government service delivery tool for citizen to retrieve information through the use of Artificial Intelligence (AI) (Plantinga *et al.*, 2019). With greater ICT availability, there is a growing possibility for citizens to gain improved social interactions whether it be through food or domestic services or government services. However, the systems require in-depth scrutiny to ensure that when using these platforms, there is data protection of citizens.

In places where internet access at home is lacking, a community-led or public approach to access means developing participatory consultations to identify the internet needs and creating a shared establishment or space where community members can gather and utilise affordable digital services. Telecentres or multi-purpose community centres (now named Thusong Service centres, now coordinated by the Government Communication and Information System) are some of the universal access programmes previously undertaken by the Department of Communication (USAASA, 2011). The Thusong Service Centre is where citizens can access various government information and address service delivery issues in one place, blending online and face-to-face interaction as well as telecentre internet and computer access (USAASA, 2011; Vivier *et al.*, 2015).

This telecentre intervention has not come without its criticisms. In the past, challenges in terms of cost and policy for non-profit delivery of service (Gomez *et al.*, 2012) and ineffective operations have been barriers for telecentres to deliver the digital services to citizens (Benjamin, 2001; Parkinson, 2005). Lessons from South

Africa reflect the need to incorporate multiple structural components (human, political, and technical) rather than solely installing an internet connection as an indicator of successful telecentre use by citizens (Attwood *et al.*, 2013). When the components are not integrated, telecentres have been seen to operate poorly (Hulbert & Snyman, 2007; Parkinson, 2005). Community-designed training (both in computer and goal-setting training) has been shown to effectively improve the lives of telecentre users in KwaZulu-Natal, South Africa (Attwood *et al.*, 2014). A mixed or blended approach (both online and offline interaction) appears most appropriate to ensure meaningful ICT use by citizens using online government services (Diga, 2017). South African communities are embedded in the ICT social sub-system through the interactive choices of broadcast content, the emergence of online platforms and the availability of public centres. This social sub-system complements the advanced technical and economic system within South Africa that are enabling the demand and supply of ICTs which reach the population as well as the affordability to gain access to the ICT equipment.

6.5 Livelihood Strategies: ICT Outputs in South Africa

For the most part, the ICT system context above reveals that South Africa has overall integrated technical, economic and social aspects of ICTs within society. This ICT system makes way for the demand of household ICTs and the next section observes the livelihood strategies of South Africans, proxied through the ICT measurable outputs. This thesis argues that, as a result of some of the telecommunication investments and ICT systems, some outputs can be observed through ICT access and ownership measures. These outputs can provide an initial glimpse of actions taken upon South African households to participate with the set of digital supply and infrastructure now available.

6.5.1 South Africa's Household ICT Index

As noted in Chapter Two's comparative review of the global ICT Development Index (IDI), South Africa ranks relatively high amongst its Africa peers and on par with its GNP comparable peers (e.g. Peru and Indonesia) in regards to its ICT indicators. Stats SA has taken the global IDI further to construct its own ICT Access Index (IAI) for South Africa. The IAI is a constructed composite index using three sub-indices: active ICTs, passive ICTs, and ICT readiness and it is a mechanism to help monitor South Africa's ICT trends on a cross-regional basis. This South African list is composed of similar IDI variables, such as the computer and telephone indicators, but it is different from the global IDI for inclusion of other ICT indicators such as postal services, radio, and television (Statistics South Africa, 2015a).

Using the data from the General Household Survey 2013 and Census 2011, Stats SA applies the ICT Access Index to create a national benchmark. The report then provides comparisons to this benchmark at the provincial (using GHS 2013) and district municipality level (using Census 2011) (Statistics South Africa, 2015a). In Table 15, the 2013 IAI national average was 4,36, and the Western Cape and Gauteng had the top IAI provincial scores that were above this average at 5,18 and 4,94, respectively. At the bottom end, the Eastern Cape and Limpopo had the lowest IAI scores that were below the national average at 3,59 and 3,57, respectively (Statistics South Africa, 2015a). Regional disparity of the wealthy and poor mirror that of IAI scores with urban dense provinces clearly having a higher average IAI score compared to provinces with a more rural population.

Table 15: Comparison of IAI scores using Census 2011 and GHS 2013 data

	Census IAI	**GHS IAI**
Western Cape	4,78	5,18
Eastern Cape	3,49	3,59
Northern Cape	3,77	4,21
Free State	4,18	4,50
KwaZulu-Natal	3,93	4,08
North West	3,70	4,07
Gauteng	4,67	4,94
Mpumalanga	3,83	4,03
Limpopo	3,50	3,57
South Africa	**4,13**	**4,36**

Note. Adapted from "GHS Series, Volume VI, Information and Communication Technologies (ICT), 2002–2013." by Statistics South Africa (2015a). Pretoria. *Statistics South Africa.*

Also in Table 15, the 2011 national IAI score is reported at 4,13. Given the finer grain data collection from the Census 2011, Stats SA was able to examine IAI scores at a municipality level, again revealing urban – rural digital disparities. There were 15 district or metropolitan municipalities that had IAI scores that were above the national average. For example, the city of Cape Town (in the Western Cape province) and city of Tshwane (in the Gauteng province) are the top ranked IAI scores of 5,01 and 4,87, respectively (Statistics South Africa, 2015a). Other large metropolitan municipalities were also at the top of the index, while smaller and rural-based district municipalities like Alfred Nzo and OR Tambo (both in the Eastern Cape province) had the lowest IAI scores, with the below-average scores of 2.76 and 2.93, respectively (Statistics South Africa, 2015a). Twenty-seven of the poorest district municipalities were identified with low below average IAI scores, and are now targeted for development assistance (Statistics South Africa, 2015a). Only one of the 27 poorest district municipalities, the West Rand, scored above the IAI benchmark average. From a policy perspective, pinpointing precise rural areas where ICT infrastructure is required can help design targeted government programmes to bring digital inclusion to the unconnected South African population. Overall, the IAI score has been useful in understanding the nature of digital disparity by region in South Africa, again reinforcing the need to address the disadvantages found in rural areas.

6.5.2 Critique of the South Africa Composite Index Indicators

Compared with the IDI, Stats SA's ICT Active Index has some strengths as well as presents some limitations. The IAI uses, to a larger extent, the household's ICT ownership indicators, and they include measures for radio and television ownership. Stats SA does however measure several other ICTs, which are not included in their IAI and they could be included. While the IAI includes some ICT ownership variables, there can be particular issues with using the frame of "active" and "passive" within the two sub-indices. Given the disruptive convergence of various technologies, some of the identified "passive" ICTs (such as television and radio) may soon be absorbed to interact more like "active" ICTs. Both the radio and television ICTs may also exist, however, they may converge within another device. For example, both radio and television–both identified as 'passive' for its previously basic broadcasting services–can now be accessed digitally through an internet connection to a computer device (e.g. tablet or computer). Some television programs may soon allow for interaction for a full entertainment experience. DSTV, the satellite services provider, offers its subscribers mobile access to programs on their app and other applications have become available in South Africa that permit active management of the service. This includes the online television networks, such as Netflix and Showmax, or the radio application, Spotify. The same can be said with the availability of satellite radio such as SiriusXM. Such convergences make the use of the term ‘passive’ questionable for certain ICTs.

As for the readiness sub-index, this description appears with appropriate proxy indicators when describing population preparedness in terms of education levels when adopting ICTs. In other words, the higher the education level completed (for use in the enrolment ratio), the better the population will likely adopt ICTs. Similarly to the global IDI, the readiness sub-index provides no ICT skills or digital literacy level measures that would help convey a precise measure of ICT readiness and competence. Finally, in both the ITU index and Stats SA ICT Active Index, there is a glaring absence of comparable information on the contribution of social or networked interactions, or the contribution of digital content produced or created at the household or individual level. Aside from the above critique, both indices (the IDI and IAI) provide some comparable benchmark indicators to assess ICT provisions at international, national, regional levels, as well as provide ICT access levels within household socio-economic disaggregation.

6.5.3 Household Level ICT Access

In looking more in-depth at the indicators of the IDI and IAI, this section reports on the livelihood output of ICT access in South Africa. In ITU reports, the terminology of access refers to household level access to ICT which is in working condition and operational (International Telecommunication Union, 2014). The ICT may not necessarily be owned by the household, but the ICT can be deemed accessible should it be available for use by all household members who reside at the home. ICT access data is complemented with indicators of ICT usage, which ITU refers to as individual household member use, and refers to a reference usage period of the last three months (International Telecommunication Union, 2014, p. 37).

In some cases, the concepts of access, ownership and usage are used interchangeably in ICT studies. For the definition used by ITU on ICT access, when a household has access to ICT equipment, it may or may not be owned by the household[21]. Yet Stats SA is moving towards specificity in the use of the two terms. For example, in the 2015 Living Condition Survey, the question is posed "does the household own or have access to any of the following items?" The respondent has three choices of response, either: 1) they do own the item, 2) they do not own, but have access to the item and 3) neither owns nor have access to the item. In this section, the recent release of Stats SA reports and data present some of the updated ICT access and usage information. The Stats SA Community Survey 2016, GHS 2018, the GHS 2002-2013 ICT report, Income and Expenditure Survey 2010/11 and Living Conditions Survey 2014/15 reports along with other ICT research reports provide some of the latest South African information on ICT access, usage and ownership.

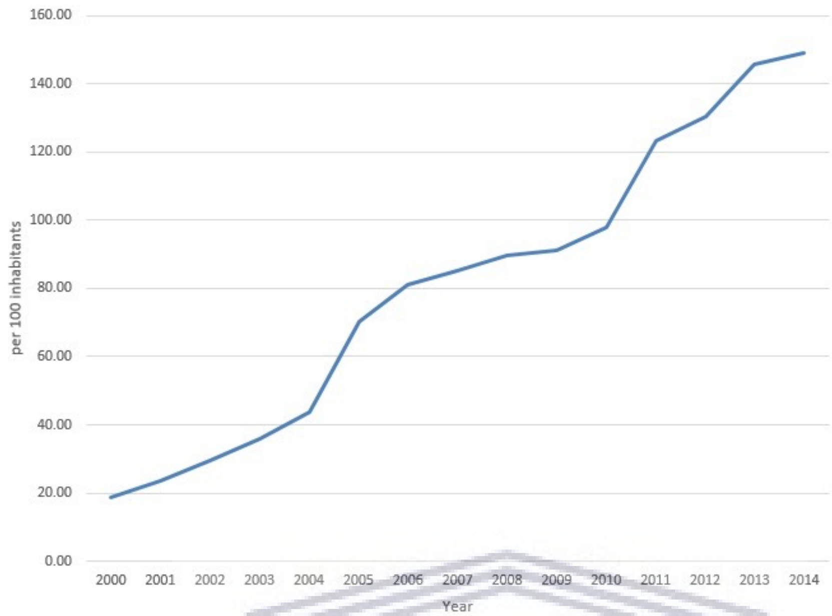
6.5.4 Mobile Phone and Landline Telephone

The ITU states that there were an estimated 88,6 million subscriptions of mobile-cellular telephone in South Africa in 2018; this subscription rate far exceeds its current population numbers (ITU, 2019). As is revealed by Figure 6 below, there has been a phenomenal growing trend of mobile telephone subscriptions per 100 inhabitants in the country. This mobile phone subscription growth suggests that South Africans take advantage of access to the available services on its various mobile phone networks. This subscription data reveal that South African citizens own multiple SIM cards; for example, consumers can use one SIM card for data purposes, while another SIM card can be used for telephone voice use.

In 2018, one study complements the multiple SIM card subscription, showing that a majority South Africans adults hold mainly one active SIM card, and around one-fifth of adults only have a maximum of two to three SIM cards (LIRNEasia, 2019). The consumer can benefit from competitive pricing or service of voice offerings of each provider.

[21] The ITU write their list of core indicators on access as "Proportion of households with [add ICT equipment here]".

Figure 6: South Africa – Mobile Telephone Subscriptions per 100 Inhabitants (2000-2016)



Source: Own calculations from ITU's mobile-cellular telephone database, 2019

In terms of costs, the ITU reports on a country's mobile-cellular sub-basket[22], and in South Africa, the average cost for this mobile phone basket of goods and services is $8,33 USD per month or 1,84 percent of GNI per capita in 2017 (International Telecommunication Union, 2018a). Research ICT Africa also tracks the cheapest prepaid voice/SMS basket[23] across several African countries under its RIA Africa Mobile Pricing (RAMP) index. In this index, South Africa's cheapest voice/SMS basket was found at $3,40 USD in Q1 2019 (Research ICT Africa, 2019).

Data from Stats SA's General Household Survey 2002-2013 ICT report complements the mobile subscription growth with reports on high growth of mobile phone access and ownership data. Under 40% of households in 2002 had access to mobile phones, and 10 years later, nearly 95% or 14,3 million South African

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[22] According to the ITU report methodology on ICT price data, "The mobile-cellular sub-basket refers to the price of a standard basket of mobile monthly usage for 30 outgoing calls per month (on-net/off-net to a fixed line and for peak and off-peak times) in predetermined ratios, plus 100 SMS messages" (ITU, 2016: p. 231).

[23] The prepaid mobile voice basket is made up of 30 calls and 100 SMS. https://researchictafrica.net/ramp_indices_portal/

households now have access in 2013 (Statistics South Africa, 2015). The distribution of mobile phone access is equally distributed by province and socio-economic status compared to landline telephones. Even the lowest quintile (per capita household income) had 95,6 percent with access to mobile phones, whereas landlines are non-existent amongst the poor, and mainly held with higher income households. Research ICT Africa through the After Access initiative also supports the high percentage of mobile phone access figures, and, at an individual level, mobile phone and SIM card ownership in South Africa is just under ninety percent from their 2017 data (LIRNEasia, 2019). In the same survey, it is one of the few countries that reported more female than males own mobile phones in 2017 (Gillwald & Mothobi, 2019).

While mobile phones are widely owned by South Africans, their usage would determine ongoing demand for services. In 2018, half of mobile phone users stated owning smart phones, which suggests a positive adoption of internet use (Gillwald & Mothobi, 2019). The top three applications (or apps) on South Africa smart phones are social networking apps, messaging or chat apps, and voice apps (LIRNEasia, 2019). When asked about social media use, the top use is around chatting, staying in contact with friends and family, and making calls (LIRNEasia, 2019). With the relatively high cost of mobile telephone calls, the use of internet-based voice and messaging apps can lower costs and can explain why they are one of the top used applications.

In 2018, around one-fifth of mobile phone adult owners in South Africa stated that they use their phone to send or receive money (LIRNEasia, 2019). This percentage may remain at the lower end of the mobile money usage scale due to the availability and high use of bank accounts in the country. In the case of government payments such as social grants and pension, the majority of beneficiaries will receive the grant through a bank account (Demirgüç-Kunt *et al.*, 2018). In 2017, the slight increase of those who have both mobile money and bank accounts over a three year period show that adults use the two platforms for their complementary features, rather than replacing banking accounts for mobile accounts in South Africa. As for online financial activities, under 20% of adults state using the internet to pay bills or shop online (Demirgüç-Kunt *et al.*, 2018).

In regards to fixed telephone access, South Africa has a small and declining rate of subscribers (6,4 subscribers per 100 inhabitants). This rate is comparable to its neighbouring countries, Botswana and Namibia, where each of the countries average 6,2 and 7,6 subscribers per 100 inhabitants respectively (International Telecommunication Union, 2018b). Stats SA's General Household Survey 2002-2013 ICT report reveals alignment to the declining ITU fixed line figures, finding that fixed-line telephones have been on an ongoing decline since 2002. In 2013, the access to fixed telephony was 13,1% or around 1,96 million South African households, compared to a quarter of households who had a fixed line in 2002 (Statistics South Africa, 2015a). By 2013, most of the remaining landlines are found mainly in households of formal dwelling as well as urban areas (Statistics South Africa, 2015a). Landline phones remain accessible by higher income decile or wealthy households, with nearly 40 percent of the upper wealthy quintile still retaining landline telephone service (Statistics South Africa, 2015a).

The closest observation of bundling of ICTs is Stats SA's report on households with both mobile phone and landline telephone. The GHS 2002-2013 ICT report demonstrate the substitution effect over time as households replace the previous activity of having only landline access to now only having mobile phone (Statistics South Africa, 2015a). In regards to households with both mobile phone and fixed lined telephony, in 2002, it was 15,6 percent, while by 2018, it had declined to 7,1 per cent (Statistics South Africa, 2015a;2019a). There were only around 3,4 percent of households without either mobile phone or landline phone by 2018, a vast difference from the over fifty percent of households with neither mobile or fixed line access in 2002 (Statistics South Africa, 2015a;2019a). Overall, South Africans have shown a high adoption rate of mobile phone technologies, and at the same time, are releasing their services of the fixed line telephony.

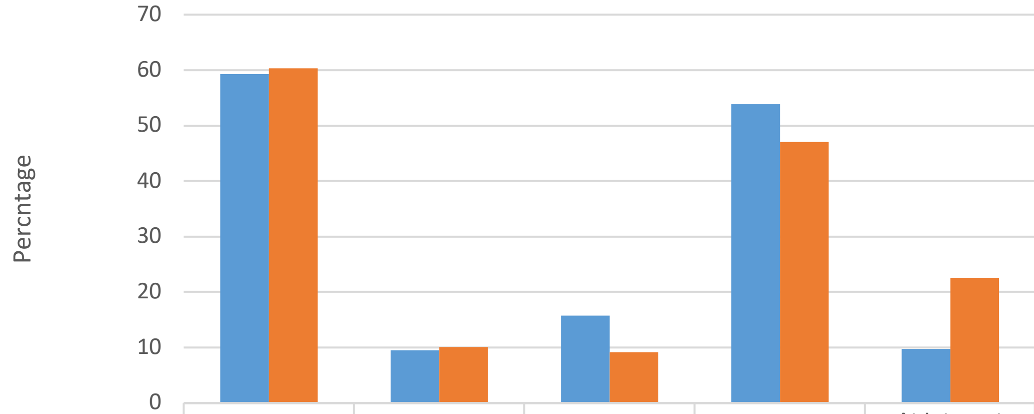
6.5.5 Internet and Computer Access

Internet and computer access have not been as profound as mobile phone access, however, recent years have seen high growth, much of which could be attributed to the drop of equipment and service costs. As for internet connectivity supply, both through fixed line broadband to mobile broadband, South Africa surpasses access compared to its African neighbours. Based on the latest ITU data, South Africa has an international bandwidth per internet user at 17,4 kbit/s (International Telecommunication Union, 2018b). South Africa also has the highest percentage of household internet users and households with computers from the African mainland. Amongst adult South Africans in 2018, nearly two-thirds are aware of the internet in the LIRNEasia study (LIRNEasia, 2019). In regards to demand, South Africa's internet access is defined by "the percentage of households with access to the internet at home or for which at least one member has access to, or used the internet" (Statistics South Africa, 2019a). Using this definition, 64,7 percent of South African households had internet access in the GHS 2018 (Statistics South Africa, 2019a). Complementing this statistic is a 2018 survey done by Research ICT Africa, where South African adults responded to the question "have you ever used the internet (Gmail, Google, Facebook, email, etc), and just over fifty percent of adults had responded positively (LIRNEasia, 2019).

Of those GHS 2018 households stating they have internet access, most of this access occurred via mobile devices, at just over 60% in 2018 (Statistics South Africa, 2019a). This is supported by ITU data stating active mobile-broadband subscriptions to be as high as 70,0 subscribers per 100 inhabitants in 2018 (International Telecommunication Union, 2018b). Of those GHS 2018 households indicating internet access, just over ten percent state access from home and this home access is largely from households in metropolitan areas (Statistics South Africa, 2019a).

When looking at the GHS and CS surveys conducted in the same year (2016), there are some slight differences of national estimates, despite having similar response choices. The slight discrepancy could be in regards to methodology (e.g. individual versus household question) as well as the question being asked slightly differently. As seen in Figure 7 below, between the GHS 2016 and CS 2016, internet access anywhere, at home, at work and using mobile devices results were similar. There is a slight discrepancy on internet usage at internet cafes or educational facilities between the two surveys (over 12% difference).

Figure 7: The Distribution of Households by Internet Access, 2016



	Internet accessed anywhere	At home	At work	Using mobile devices	At Internet cafes or educational facilities
GHS 2016 (%)	59,3	9,5	15,8	53,9	9,8
CS 2016 (%)	60,3	10,1	9,2	47,1	22,6

Source: Own calculations from the General Household Survey 2016 and Community Survey 2016. Note: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa.

Those who access internet at home would refer to subscription of fixed broadband subscriptions which is low and continues to drop, now at 3,0 per 100 inhabitants (International Telecommunication Union, 2018b). The 2018 Research ICT Africa data complements high mobile internet use, stating that of the adult population who state mobile phone ownership, half of them state a capability of browsing the internet (LIRNEasia, 2019). A quarter of the same mobile phone owners use social networking platforms like Facebook (LIRNEasia, 2019). Less than 17 percent of users read and wrote emails on their mobile phone (LIRNEasia, 2019).

In terms of affordability, South Africa's Gross National Income (GNI) per capita was $5430 USD in 2017 and when compared in proportion to the cost of fixed-broadband sub-basket[24], the offer is 2,7 percent of GNI per capita, which is below the 5,0 percent of GNI per capita threshold (International Telecommunication Union, 2018a). As for mobile broadband for a pre-paid handset of 500mb of data, ITU states the mobile broadband cost is 1,64 percent of GNI per capita (or $7,42 USD) for

[24] According to the ITU methodology report, "The fixed-broadband sub-basket refers to the price of a monthly subscription to an entry-level fixed-broadband plan" (ITU, 2016: pg 234).

South Africa in 2017 (International Telecommunication Union, 2018a). In another comparison of the cheapest 1GB basket of mobile prepaid broadband, Table 16 shows that South Africa's prices for this basket is $7,14 USD in Q1, 2019 (Research ICT Africa, 2019). Compared to other African countries, the cost is relatively high, with exception to its Botswana neighbour, where the cheapest 1GB basket is $9,16 USD (Research ICT Africa, 2019).

Table 16: Cost of the Cheapest Voice/SMS Basket and 1GB Basket

	Voice/SMS Basket* (Cheapest) ($ USD)		**1GB Basket (Cheapest) ($ USD)**	
	Q1, 2018	**Q1, 2019**	**Q1, 2018**	**Q1, 2019**
South Africa	$3,99	$3,40	$8,29	$7,14
Kenya	2,15	2,34	2,47	2,49
Nigeria	2,01	1,99	2,80	2,77
Botswana	6,36	6,70	13,20	9,16

Notes. Adapted from "RIA Africa Mobile Pricing (RAMP) Indices Portal" by Research ICT Africa, 2019. (https://researchictafrica.net/ramp_indices_portal/). 2019. Copyright by Research ICT Africa.
*The prepaid mobile Voice/SMS basket is made up of 30 calls and 100 SMS.

As for computer or laptop use, there were 29,1% of adults that use the computer in 2012 (Gillwald *et al*., 2012). Of those with computers, the highest individual response for the location of their computer was at their home (61,1%) or at work (40,2%) (Gillwald *et al.,* 2012). Not all computer users own their device, with the latest GHS 2018 figures showing only around one-fifth of South African households own one or more computers (Statistics South Africa, 2019a). Similarly, of the households with computers, under ten percent are owned by rural households (Statistics South Africa, 2019a) and only 3,5% of households in the poorest quintile had computer access in 2013 (Statistics South Africa, 2015a).

As for the highest three responses for the purpose of individual computer use, the top use was for writing letters or editing documents (74,3%), followed by browsing the internet (71,4%) and playing games (62,3%) (Gillwald *et al.,* 2012). When asked where an individual used the internet for the first time, 65,1% said they were first using the computer (Gillwald *et al.,* 2012).

In an analysis of individual ICT use using the Afrobarometer individual survey, three-quarter of South African respondents stated that they never use either a computer and the internet in 2011 (Bornman, 2016). Of the same population, just over ten percent state using either the internet or the computer every day (Bornman, 2016). In analysing GHS 2016 data, Table 17 covers the main reason the South African households had no internet at home. The main reasons from respondents not having internet access at home were due to a lack of interest or need (38,6%) followed by a lack of knowledge or confidence (28,6%). In a different 2018 LIRNEasia study that asked individuals about reasons for limiting their internet use[25], South African adults were held back by the high expense of internet service, the high cost of equipment, and that the internet would be very slow (LIRNEasia, 2019; Gillwald & Mothobi, 2019).

Table 17: Reasons for not having Internet Access at Home, by Non-Users, 2016

	%
1. Lack of interest/no need	38,6
2. Lack of knowledge /skills/confidence	28,6
3. Cost of equipment too high	24,6
4. Cost of subscription too high	4,7
5. Have access to internet elsewhere	2,8
6. Concern about exposure to inappropriate	0,3
7. Do not know	0,5
Total	**100,0**

Source: Own calculations from General Household Survey 2016.
Note: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa.

6.5.6 Radio and Television

Radio and television remain important ICTs within a South African household. In 2018, there were over eighty percent of households stating that they owned a television set and this percentage has grown over time (Statistics South Africa, 2019a). Even those in rural areas have television set ownership of nearly three-quarters of these households (Statistics South Africa, 2019a). The growth of television is complemented with the greater ownership of satellite television services with under fifty percent of households owning this dish, most commonly known as

[25] After Access questionnaire used a scenario question around internet use and its limits: "I'm going to read some phrases that other people have mentioned as limitations to the use of internet. For each one, please, tell me if you consider it a limitation or not." (LIRNEasia, 2019, p. 43).

DSTV (although the lower costing competitor, StarSat, also operates in South Africa) (Statistics South Africa, 2019a). Just under fifty percent of households also own a DVD player, again complementing the television set ownership (Statistics South Africa, 2019a). Television is widespread across South Africa, with offerings of various pricing packages and complementary peripherals suitable to various demographic ownership.

As for radio, there were 62,1% of households who stated having access to a radio and since the Census 2001, there is an observed decline in radio ownership. The listenership of radio still remains high amongst South Africans, stating there to be an over ninety percent reach or over 36 million listeners on a weekly basis (The Broadcast Research Council of South Africa, 2019). While South Africans are stating lesser ownership of analog radio devices, digital convergence sees radio access to become a component of streaming within satellite television packages (e.g. DSTV), or available within a particularly mobile phone or tablet device. The internet has also allowed for radio stations to be broadcasted through websites, podcasts and other online platforms. The latest BRC of South Africa report complements Stats SA work, with most still accessing radio on solely radio devices, despite the emergence of mobile phone, vehicle radio, television and computer access to radio. In the measure across socio-economic segments, the lower 10% of the segment are rural and using analog radio to listen to radio, followed by mobile phone (The Broadcast Research Council of South Africa, 2019).

6.6 Livelihood Activities: ICT Activities

This section addresses the SLF pathway process, livelihood activities, however, there is specific emphasis around ICT activities. Some observations have already been made on usage of the specific ICTs in Section 6.5 above. Other ICT activities that have been measured by national surveys include time use budgets. The act of spending on ICTs can be a proxy to ICT activities, implicitly stating that households will use ICTs that they have purchased or bought services for. The expenditure surveys also have dedicated sections to ICTs. Finally, digital literacy are generally measured by education proxy variables (like highest level of education obtained), but some limited measures in South Africa are discussed as an ICT activity.

6.6.1 Time Usage

Two measured aspects that are available around ICT are the ways in which a household budgets their time. In the time use surveys, there is reference to using ICTs and specific individual time usage for television, radio and computer. The available data comes from a time use survey conducted in South Africa in 2010 (Statistics South Africa, 2013)[26]. In terms of participation rates in ten major activities, mass media use had the third highest participation rate, 77,4% of females and 79,5% of males (Statistics South Africa, 2013). As to the average time spent on the activity, this mass media use translates to around 131 mean minutes per day for females and 145 mean minutes per day for males (Statistics South Africa, 2013).

In considering ICTs such as television and radio, the social or entertainment purpose of the television find South Africans engaging in over two hours of television or video viewing a day (Statistics South Africa, 2013). In the survey, they also look at simultaneous activities and the mass media usage (as in, TV watching or radio listening), with the two most common combinations of simultaneous time use being: a) watching TV and socialising with family and 2) watching TV and eating and drinking. Listening to the radio was also a common activity to be combined with socialisation or cooking or cleaning. Very few respondents state accessing information by computer as a mass media activity.

6.6.2 ICT Expenditures

In South Africa, the consumption of information and communication technologies can be measured at the household level. Both the South African Living Conditions Survey (LCS) and Income and Expenditure Survey (IES) produce data on spending of digital good and services within a household. In Chapter 5, the methodology section provides an in-depth review of ICT expenditures identified in both the LCS and IES. The ICTs can be primarily derived by disaggregating the ICT expenditures within two primary expenditure group categories: 1) Communication and 2)

[26] According to the 2013 Stats SA report, the South African Time Use Survey conducted a survey in 2010 with 39 896 respondents who were 10 years old or older. A “yesterday” diary methodology was used recording what the respondent did for a period in the 24 hours of the day preceding the survey interview (Statistics South Africa, 2013).

Recreation and Culture[27]. Within Communication, the two secondary expenditure groups that relate to ICTs are: a) telephone and telefax equipment; and b) telephone and telefax services. Within Recreation and Culture, the secondary expenditure group that relate to ICTs in IES 2010 is 'audio-visual, photographic and information processing equipment'[28] and a majority of the ICT expenditures fall within this sub-group. The proportions below discuss the primary expenditure categories and have not been further disaggregated to the secondary expenditure group level.

The IES 2010 shows that the largest proportion of estimated expenditures of South African households are spent on 'Housing, water, electricity, gas and other fuels' at 32,0% of total household expenditure. In terms of Rands, the annual average spending of this category is R30 505 in 2011 (Statistics South Africa, 2012d). This expenditure is followed by transport with its expenditure proportion at 17,1%. As for the category 'Communication,' it contributes to 2,8% of total average expenditures while the category 'Recreation and culture' contributes 3,1% (Statistics South Africa, 2012d).

In the LCS 2015, the largest proportion of expenditures allocated to 'Housing, water, electricity, gas and other fuels' saw a slight rise to 32,6% compared to IES 2010 (Statistics South Africa, 2017b). 'Communication' expenditures rose to 3,4% of total household expenditures and category 'Recreation and Culture' expenses also rose to 3,8% of total household expenditures. Statistics South Africa reported that the largest growth (in real terms) between 2010 and 2015 was from the 'Communication' category (increasing by 67,6%), followed by the 'Recreation and culture' categories (increasing by 57,9%) (Statistics South Africa, 2017b).

Stats SA disaggregated the categories of expenditure by a group of household characteristics in order to provide a more in-depth look at consumption. In Table 18

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[27] As noted in the Methodology chapter, Section 5,4,1 refers to future international changes to rename the category "information and communication" and shift into this category any ICT equipment and recording media, their respective repair and license affiliations and out of Recreation.
[28] In the LCS 2015, the Recreation and Culture categories expand to four secondary expenditure groups: 1) Equipment for the reception, recording and reproduction of sound and pictures, 2) Photographic and cinematographic equipment and optical instruments, 3) Information processing equipment, and 4) Recording media (Statistics South Africa, 2017b).

below, the selected characteristics of settlement type, expenditure deciles, sex of household head and population group of household head were reviewed.

Table 18: Categories of Communications Expenditures, 2010 and 2015

COICOP categories	2010 distribution of hh expenditure (%)	2015 distribution of hh expenditure (%)
COMMUNICATION (Total)	**2,8**	**3,4**
Settlement Type		
Urban formal	2,9	3,3
Urban informal	3,7	4,6
Traditional area	2,4	3,5
Rural formal	3,1	3,0
Expenditure deciles		
Lower	4,0	5,0
2	3,6	4,8
3	3,5	4,6
4	3,4	4,5
5	3,2	4,4
6	3,2	4,4
7	3,1	4,0
8	3,1	3,8
9	3,1	3,6
Upper	2,5	2,7
Sex of household head		
Male	**2,9**	**3,4**
Female	**2,7**	**3,4**
Population group of hh head		
Black African	**2,9**	**3,6**
Coloured	**3,1**	**3,4**
Indian/Asian	**3,3**	**3,5**
White	**2,7**	**3,1**

Note. Adapted from "Income and expenditure of households, 2010/2011" by Statistics South Africa, 2012d, *Statistics South Africa,* Pretoria and "Living Conditions of Households in South Africa: an analysis of household expenditure and income data using the LCS 2014/2015" by Statistics South Africa, 2017b, *Statistics South Africa.* Pretoria.

In looking at the reported settlement types, households located in urban informal areas spend a larger proportion of their household expenditures to communication compared to the average as well as compared to the other settlement types in both periods, 2010 and 2015. Amongst the lower expenditure decile or poorest ten percent segment of the population, the average of communication spending is higher than the national average in 2010 and 2015 as well as compared to the other expenditure deciles (Statistics South Africa, 2012d;2017b). As for the sex of household head, both male and female household heads, the communication spending are at par with the national average in both 2010 and 2015. As for population group of household heads, Black South African, Coloured and Indian/Asian household heads had expenditures above the national average in 2010. By 2015, only Black South African and Indian/Asian household heads spent above the national average.

In Table 19 that reviews the Recreation and Culture expenditure group, the households based in rural formal settlements report higher than average spending in 2010, but by 2015, the urban formal is the only settlement that reports above average spending. In regards to expenditure deciles, the wealthiest two decile groups are reported with above national average expenditures in 2010. By 2015, the top four wealthiest decile groups are reporting above national average expenditures.

As for Recreation and Culture expenditures by sex of household head, the male household heads are found to spend above the national average in both 2010 and 2015 while female household heads have expenditures below the national average in both time periods. As for population group of household head, Black South African heads report below the national average in their spending, while the other three population groups are above the national average. In further inspection of the reported information, the expenditure proportions show how particular target groups are found to have higher than average proportions of their expenditures allocated to recreation and culture.

As for other reports beyond the IES and LCS household data, ICT costs per individual have been examined through the cost of an ICT service compared against gross domestic product or total per capita expenditure. There is caution noted to determining averages, noting that upper income households could push higher GNI and thereby disguise the larger proportion of the low-income population with higher internet costs in relation to income (compared to the elites) (Garrido & Wyber, 2017).

Table 19: Categories of Recreation and Culture Expenditures, 2010 and 2015

COICOP categories	2010 distribution of hh expenditure (%)	2015 distribution of hh expenditure (%)
RECREATION	**3,1**	**3,8**
Settlement Type		
Urban formal	3,2	4,1
Urban informal	1,9	2,9
Traditional area	1,9	2,5
Rural formal	4,0	3,1
Expenditure deciles		
Lower	1,3	1,4
2	1,5	1,7
3	1,8	2,2
4	1,8	2,3
5	2,1	2,7
6	2,2	3,3
7	2,3	4,1
8	2,8	4,1
9	3,5	4,3
Upper	3,5	3,9
Sex of household head		
Male	3,2	4,0
Female	2,6	3,4
Population group of hh head		
Black African	2,4	3,3
Coloured	3,5	4,2
Indian/Asian	3,7	4,4
White	3,6	4,4

Note. Adapted from "Income and expenditure of households, 2010/2011" by Statistics South Africa, 2012, *Statistics South Africa,* Pretoria, and "Living Conditions of Households in South Africa: an analysis of household expenditure and income data using the LCS 2014/2015" by Statistics South Africa, 2017b, *Statistics South Africa:* Pretoria

Research ICT Africa report on individual data at national estimates, through stratified self-reported monthly expenditure on mobile phones with individual males spending $31,51 USD per month and females spending $16,54 USD per month. In the 2018 survey $10,20 USD was reported as the average monthly spending on mobile services, with more spending found amongst urban adults, male, those between the ages of 36-45 and those owning a smart phone (LIRNEasia, 2019). In a 2018 cross country study on affordability which looks at expenditures as well as government policy, South Africa ranked 19 out of 61 countries (Alliance for Affordable Internet, 2018).

In one economically depressed community in South Africa, the household respondents who earned a monthly income of between R300 to R5 000 ($37 - $625 USD) state that they on average use 26 per cent of their income on mobile phones (being both a combined cost of handsets and airtime) (Duncan, 2013). Majority of the study's respondents from this same township perceived both the mobile and the airtime to be expensive (Duncan, 2013). While the growth of data services and online content are both reflective of the increased use of such services by some households, there will be a pool of South Africans unable to afford the cost. The South African Competition Commission has recently reported on the anti-poor behaviour of mobile operators in providing data prices which are segmented for lower income customers at much higher costs than other packages (Competition Commission of South Africa, 2019). If the recommended changes to lower data costs for the poor are not taken up, there can only be poor results in terms of affordability and therefore the exclusion of internet use by the most poor.

6.6.3 Digital Literacy and Skills

The South African government has made a commitment to monitor the digital literacy and skills of the population, but the public plans of implementation and measurement are forthcoming (Republic of South Africa, 2013a). The National eSkills Plan of Action (NeSPA) supports the iKamva National e-Skills Institute bill which provides the direction around monitoring the transformation of ICT skills in the country (Republic of South Africa, 2013a). The plan of action proposes the creation of an eSkills inventory with provincial hubs, as well as specific indicators around institutions building on training participation (NEMISA, 2019a). ITU has set questions for national governments to implement digital literacy indicators within their household surveys with the hope to report country level comparisons. At the moment, proxy indicators are used to measure digital literacy, mainly using a query on the number of years of completed level of education by an individual (Deen-Swarray, 2016). In South Africa, there are just over 45% of adults aged 20 years and older who have at least a grade 12 qualification in 2018, and there are under five percent of adults who have no education at all (Statistics South Africa, 2019a).

There is some reported data on digital literacy available. The Department of Higher Education and Training analysed the annual 2018 Global Competitiveness Report published by the World Economic Forum, and the report mainly consists of survey perception responses from selected business executives in 140 economies. In the perception question on digital skills[29], South Africa was ranked at 116 out of 140 economies, indicated as the worst indicator in terms of the country's competitiveness (Republic of South Africa, 2018). Across six universities, over 3500 students participated in a survey in 2007 and the findings showed there was only a small group of well skilled 'digital elites' and a wide range of experiences (in terms of years of experience and usage (Brown & Czerniewicz, 2010). There was also less than a quarter of students who were identified as lacking experience and opportunity (e.g. no off-campus ICT access, knowledge of computer is less than four years, etc). Educators who are designing appropriate digital course material would need to take into consideration.

Within the National Electronic Media Institute of South Africa (NEMISA), they have a programme on "e-astuteness development" which works with existing service providers on digital skills and have set annual targets, such as training 6500 learners in digital literacy per year and training 2500 sector users per year (NEMISA, 2019b). These numbers will not be enough; targeted efforts to digital skills acquisition appear to be an imperative for South Africa, in order to mitigate job losses predicted (35% of all jobs in South Africa are predicted to be disrupted) with increased automation in the country (Accenture, 2018). Some country level recommendations has included re-skilling existing staff with new digital skills, enable tools and online training of new skills such as coding, and other subject areas such as blockchain and create training opportunities specific to unskilled labour and academia (Accenture, 2018).

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[29] The digital skills survey question to business executive is "In your country, to what extent does the active population possess sufficient digital skills (e.g. computer skills, basic coding, digital reading)?"

There have also been some household level analysis of digital literacy and skills data. In the previous section, 6.4.5. Internet and Computer access, the second largest reason for non-users having no internet access in 2016 is due to lack of knowledge, skills and confidence. In Govindasamy's 2013 dissertation titled "Computer literacy, employment and earnings: A cross-sectional study on South Africa using the National Income Dynamics Study (NIDS) 2008", the study interrogates the characteristics of those who are computer literate in South Africa. In Table 20 below, the results of a self-reported question to adults[30] from the first wave of data (National Income Dynamics Survey of 2008) is presented, and Govindasamy (2013) found that out of the working age population (18 to 65 years old), 30,4 percent in this sample report themselves as computer literate in 2008.

Table 20: Individual Computer Literacy by Demographic Information, 2008

	Computer literate
By Gender	(%)
Male	32,81
Female	28,58
By Race	
African	21,94
Coloured	41,48
Indian	50,92
White	82,87
By Geographic	
Rural	11,06
Tribal	11,34
Urban Formal	46,58
Urban Informal	17,90
Total	**30,42**

Source: Adapted from "Computer literacy, employment and earnings: A cross-sectional study on South Africa using the National Income Dynamics Study (NIDS) 2008" by Govindasamy, P., 2013. *University of KwaZulu-Natal: Durban.*

In the same study, there were distinct differences by particular demographics, such as female adults had a lower proportion reporting computer literacy compared to male adults. There were major differentials of the low proportion of African adults (just above twenty percent) who were computer literate compared to the high

[30] The digital literacy question posed in the survey was "Are you computer literate?"

proportion (above eighty percent) of White adults. Geographic differences were clearly made between the low proportion of adults who were computer literate and living in rural areas compared to the higher proportion of computer literate adults living in urban formal areas.

Govindasamy (2013) further suggests that low income individuals had a lower likelihood to be computer literate. Overall, adults who are most marginalised (based on race, geographic location, and income) were less likely to be computer literate, a continuity of the inequality in South African society. In a study using Research ICT Africa 2012 data, there remained high levels of mobile phone ownership regardless of one's ability to read or ability to write, however there was a pronounced difference in internet adoption between those who read or write easily (with over 40% internet adoption) to those who read or write with difficulty (Deen-Swarray, 2016). One of the major limitation of these studies is that the indicator for computer literacy is based on self-assessment. Self-reported data have been found to be overestimates of actual ability due to the desire for socially acceptability (Bunz *et al.*, 2007).

From the available statistics, the studies suggest that those with some lower socio-economic characteristics (e.g. living in urban informal settlements, have lower expenditure or income quintiles), the proportion of spending in relation to their total expenditure is greater than the average. These disaggregated demographics are discussed in further detail in the section around ICT ownership.

6.7 Livelihood Assets: ICT Ownership in South Africa

ICT ownership is the main indicator that is empirically applied in understanding the relationship between ICTs and poverty in this thesis. I, therefore, provide an in-depth description of digital possessions which can make up a household's digital basket. Stats SA surveys provide appropriate indicators specific to asset ownership, which is defined by a wide range of tangible household goods that are in working condition, such as a television, refrigerator, or bicycle. These assets are accumulated through various channels and some of the assets gathered by the poor are wide-ranging. As mentioned in the vulnerability section, social transfers, such as child support grants, have helped many in South Africa to remain out of poverty (Woolard & Leibbrandt, 2010). There are also financial instruments within communities, some of which are informal, such as the stokvels (or savings groups). Stokvels are made up of a collective that are starting to use ICTs to support the cash liquidity of low income households (Biyela *et al.*, 2018). South African poor households can be supported by the provision of some free or subsidised basic services (such as electricity and water). Human capital provisions include free primary health care and primary education (The World Bank, 2018). At the physical capital level, some social housing is also supported or subsidised by government which are meant to reach poor households (Statistics South Africa, 2017d).

Specifically about ICT assets, household ownership in South Africa is one aspect of the physical ICT resources that can be examined in-depth. Only a few data and reports in South Africa, specifically collected by Stats SA, have given attention to ICT ownership variables from a household level perspective. This section examines data from government or research reports available on ICT ownership for the ten year period between 2005 to 2015. The reports specifically look at the data and descriptive summaries of nationally representative ICT ownership sourced from mainly two institutions: Stats SA and Research ICT Africa.

Table 21 reviews the ten identified ICTs in the four Stats SA surveys which are available for the ten year period between 2005 to 2015: radio, stereo/HiFi, television, satellite dish (DSTV), DVD/Blu-ray, computer, camera, mobile telephone, landline telephone and connection to the internet. When looking at the cross-sectional statistics of ICTs, mobile telephone ownership within households are seen be the ICT with the highest ownership percentage from 2005 to 2015. Mobile telephone ownership was already high at over seventy percent in 2005, yet it further increased to near universal ownership at just below 94% by 2015. The increase is noted to be statistically significant as with all the other ICTs, with exception to the camera.

Table 21: Household Ownership of ICT Assets in South Africa: 2005 – 2015

ICT	IES 2005 (%)	LCS 2008 (%)	IES 2010 (%)	LCS 2015 (%)	Relative % change (2005-2015)
1. Radio	75,0 (0,4292)	59,2	55,6	54,9 (0,4160)	-20,1*
2. Stereo/ HiFi	41,6 (0,4976)	28,9	28,0	30,8 (0,3912)	-10,8*
3. Television	66,6 (0,4622)	74,3	77,9	83,1 (0,3105)	+16,5*
4.Satellite dish (e.g. DSTV)	5,7 (0,2876)	18,2	23,0	40,8 (0,4187)	+35.1*
5. DVD/Blu-ray player	35,6 (0,5025)	54,8	61,1	50,8 (0,4195)	+15,2*
6. Computer	14,7 (0,4229)	20,4	19,5	-	-
7. Camera	19,1 (0,4371)	18,1	14,9	19,6 (0,3605)	-0,5
8.Mobile Telephone	70,4 (0,4422)	85,7	91,2	93,6 (0,1925)	+23,2*
9. Telephone	22,0 (0,4580)	21,5	15,0	19,1 (0,3545)	-2.9*
10. Connection to the internet	6,5 (0,3249)	12,1	8,8	22,8 (0,3844)	+16.3*

Source: Own calculations from Income and Expenditure Survey 2005/06, Living Conditions Survey 2008/09, Income and Expenditure Survey 2010/11, and Living Conditions Survey 2004/15
* Denotes a significant change in the percentage of households estimate difference between asset ownership in 2005 and the same asset in 2015 at the 95 percent confidence level.
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.
In 2015, the computer indicator is broken down into 3 ICTs and separately reported.

The second ICT with the largest household ownership is the television with just over 83% of households in possession by 2015. In terms of highest growth over the ten year period, the satellite dish or satellite services called DSTV that saw an over 35% increase in ownership between 2005 and 2015. The growth trends of television, the media player and satellite TV are reminders that ICTs changes are not only occurring amongst newer ICTs such as the mobile phone and the internet. During the period, there was a larger diversity of market offerings for satellite TV service, a wide price range of satellite equipment, as well as increased diversity in television programming which is now available through both satellite and the internet.

There are also several ICTs on the decline (e.g. radio, stereo, camera, and fixed line telephony), and the largest relative decline of ICT ownership was seen with radio, with just over 50% having ownership in 2015. This may well be the result of older radio technologies becoming obsolete and being not replaced. Radio may also be converging digitally within other existing devices and no longer being counted as being owned by the household.

Research ICT Africa's household survey complements the above Stats SA data with their timeline on ICT ownership ranging over the 2007 to 2012 period. Table 22 presents their results on South African ICT ownership[31], and their findings on radio ownership was aligned with the above Stats SA findings. The findings show a similar downward ownership trend between 2007 to 2012, and resulting with just over sixty percent of radio ownership by 2012 (Gillwald *et al.*, 2012). As for television, the RIA survey saw a similar upwards trajectory as Stats SA, with just under eighty percent ownership by 2012 (Gillwald *et al.*, 2012). Fixed line telephone ownership under both Stats SA and RIA data revolved at twenty percent ownership during the same 2012 period. As for computer ownership, the relatively close percentages see ownership between 20 to 25 percent for the RIA and LCS 2015 surveys by 2012 (Gillwald *et al.*, 2012).

Table 22: Summary of ICT Access in South Africa from Census and RIA ICT Survey data

	Census		RIA	
	2006	2011	2007	2012
Households with fixed line	18,5%	14,5%	18,2%	18,0%
Households with computer	15,6%	21,4%	14,8%	24,5%
Households with radio	76,5%	67,5%	77,7%	62,3%
Households with television	65,5%	74,5%	71,1%	78,2%
Households with internet		35,2%	4,8% (household) 15,0% (individual)	19,7% (household) 33,7% (individual)
Mobile phone ownership (household)	72,7%	88,9%	62,1%	84,2%

Note. Adapted from "Understanding what is happening in ICT in South Africa" Gillwald, A*., et al.,* (2012), *Research ICT Africa: Cape Town*, p. 49.

[31] The RIA ICT survey data 2012 question is slightly different from that of the IES 2010/11: "Does your household have a working…"

6.7.1 New ICT Ownership

New ICT ownership is another aspect of understanding changes of household ICTs. Within the household asset section around ownership in 2010, a question around new asset acquisition asks: "Was the item (or service) acquired in the 12 months prior to the survey period?" (Statistics South Africa, 2011). Of those households owning a certain ICT asset, Table 23 shows the percentage of household stating that the ICT asset was obtained within the year prior to the survey.

Table 23: New Acquisitions: ICT Assets acquired in the last 12 months, 2010

ICT asset	% of new acquisition	Estimated # of households (millions)
Mobile telephone	25,3%	3,02
Computer	19,1%	0,49
Satellite dish/DSTV	17,6%	0,53
DVD Player	16,7%	1,34
Internet	14,0%	0,16
Camera	13,2%	0,26
Television	13,2%	1,35
Radio	8,4%	0,61
Stereo	6,2%	0,23
Landline telephone	3,3%	0,06

Source: Own calculations from Income and Expenditure Survey 2010/11.
Note: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa.

The mobile phone was the most mentioned ICT as being newly acquired by one quarter of the respondents, followed by the computer and satellite TV/DSTV. This may mean that households are now able to afford these ICTs for the first time. While television had high household ownership, only around thirteen percent stated that they newly acquired this ICT asset. Televisions may be existing ICTs in the household for a longer duration. In another survey, around 30% of South African adults reported having been a mobile phone owner for over 15 years in 2018 (LIRNEasia, 2019). This result could mean South Africans are now replacing and updating their phones as opposed to owning a new phone for the first time.

6.7.2 ICT Ownership by Gender

Each ICT can also be examined by gender over the period between 2005 to 2015. In regards to ICT asset ownership by the gender of household head, Table 24 below reveals that both types of households experienced growth on all ICT assets except for the radio and DVD player. distributions on specific assets as compared to male-headed households. Overall, however female-headed households remain lower in absolute percentage in all ownership categories in 2015 compared to the male-headed households except for the mobile phone ownership. The female-headed household percentage is slightly higher (by 0,2 percentage points) than compared to male-headed households in 2015.

Table 24: Ownership of ICT Asset in South Africa by Gender of Household Head: 2005-2015

ICT	Gender	IES 2005 (%)	LCS 2008 (%)	IES 2010 (%)	LCS 2015 (%)	Relative change (2005-2015)
1. Radio	Male Female	76,3 (0,5752) 72,9 (0,6335)	60,7 57,0	57,7 52,4	57,2 (0,5482) 51,7 (0,6361)	-19,1* -21,2*
2. Stereo/HiFi	Male Female	45,2 (0,6769) 36,0 (0,7120)	32,3 23,8	31,3 22,9	33,7 (0,5283) 26,8 (0,5749)	-11,5* - 9,2*
3. Television	Male Female	68,2 (0,6184) 64,2 (0,6830)	75,8 72,1	78,6 76,8	83,6 (0,4115) 82,4 (0,4724)	+15,4* +18,2*
4.Satellite Dish (DSTV)	Male Female	7,3 (0,4235) 3,1 (0,3146)	21,7 12,9	27,4 16,2	43,9 (0,5559) 36,4 (0,6359)	+36,6* +33,3*
5. DVD/Blu-ray player	Male Female	40,2 (0,6850) 28,4 (0,6959)	58,2 49,6	64,3 56,0	53,5 (0,5541) 47,0 (0,6393)	+13,3* +18,6*
6. Computer	Male Female	18,3 (0,6085) 9,0 (0,4897)	24,7 13,9	24,7 11,4	- -	- -
7. Camera	Male Female	22,8 (0,6156) 13,3 (0,5554)	21,7 12,5	18,7 9,0	22,2 (0,4838) 15,9 (0,5381)	-0,6 +2,6
8.Cellular Telephone	Male Female	71,8 (0,5858) 68,2 (0,6647)	86,4 84,7	91,6 90,6	93,5 (0,2558) 93,7 (0,2916)	+21,7* +25,5*
9. Telephone	Male Female	24,5 (0,6346) 18,2 (0,6184)	24,1 17,5	17,9 10,5	20,9 (0,4714) 16,5 (0,5376)	-3,6* -1,7
10. Connection to the internet	Male Female	8,1 (0,4714) 4,0 (0,3782)	14,6 8,4	11,8 4,2	25,5 (0,5136) 19,0 (0,5777)	+17,4* +15,0*

Source: Own calculations from Income and Expenditure Survey 2005/06, Living Conditions Survey 2008/09, Income and Expenditure Survey 2010/11, and Living Conditions Survey 2004/15
* Denotes a significant change in the percentage of households estimate difference between asset ownership in 2005 and the same asset in 2015 at the 95 percent confidence level.
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.
In 2015, the computer indicator is broken down into 3 ICTs and separately reported.

In terms of growth trends, the overall percentage gains over time are greater amongst female-headed households compared to male-headed households on specific assets:

television, DVD player, camera, and mobile phone. In such cases, the findings suggest that female-headed households could converge to match similar ownership.

In other cases, the male-headed households have greater percentage gains over the ten years compared to the female-headed households, specifically in satellite dish ownership and connection to the internet. As for internet connection in 2015, over a quarter of male-headed households have connection to the internet, while just under twenty percent of female-headed households possess the same services. As seen in Table 25, the three types of computer-desktop, laptop and tablets-show higher ownership amongst male-headed households compared to female-headed households in 2015. In these cases, a large proportion of female-headed households are missing out on acquiring the most advanced communication technologies and are owning these ICTs at a slower rate than their male counterparts.

Table 25: Computer Ownership in South Africa by Household Head, 2015

Gender of household head	**Desktop computer (%)**	**Laptop/Notebook/ Netbook (%)**	**Tablet (%)**
Male	21,7	26,5	18,9
Female	14,0	18,8	14,2
Total	**18,5**	**23,3**	**17,0**

Note. "Living Conditions of Households in South Africa: an analysis of household expenditure and income data using the LCS 2014/2015" by Statistics South Africa, 2017b, *Statistics South Africa:* Pretoria.

This gendered divide may be related to the ability to afford particular ICT assets, especially newer items like computers and internet connection, given that there are a larger proportion of female-headed households who live in poverty (using both UBPL and multi-dimensional poverty indicators) compared to households headed by males (Rogan, 2016; Statistics South Africa, 2018a).

As a caveat, Stats SA data is limited to the gender of the household head and ICT ownership. Other studies complement this household level with their own ICT ownership and usage data at an individual level. One Research ICT Africa study shows that both adult female and male individuals reflected mobile phone ownership gains over the period of their survey from 2007 to 2012 (Gillwald *et al.*, 2012; Gillwald & Stork, 2008). In the latest LIRNEasia 2018 report of mobile phone ownership, female individual ownership surpasses that of male individual ownership, aligning with the above Stats SA findings of female-headed households (LIRNEasia, 2019). In another study on individual use, females had a larger proportion who had not used either a computer or internet compared to their male counterparts in 2011 (Bornman, 2016).

6.7.3 Mobile Phone Ownership by Income

When focusing on specific ICTs, mobile phone ownership by household income deciles can be revealing. As seen in Table 26, in the lowest household income deciles, the percentage gains made from mobile phone ownership between 2005 to 2010 are staggering. In the lowest decile in 2005, less than half of this household population owned a mobile phone, but fast forward to 2010, and this same demographic saw a leap in mobile phone ownership to over eighty percent. In looking at a similar income demographic at the margins, the After Access 2018 study finds that over three-quarters of individual adults in South Africa who self-reported zero income also state owning a mobile phone (LIRNEasia, 2019).

In the top two poorest income deciles, each decile has an over thirty percentage point change in household ownership respectively. These percentage changes lower incrementally when moving up the deciles to reach the wealthiest decile. In the top two wealthiest deciles, there are single digit percentage change between 2005 to 2010 at +8,6% and +3,6% respectively. This small growth trend is mostly likely due to the already high mobile phone ownership level in 2005.

Between household income deciles, 2005 had a large ownership difference between the lowest decile and the highest decile compared to 2010 (over 50% in 2005 compared to 18% in 2010). Given that this ownership gap has lessened between 2005 and 2010, it suggests that there is a convergence or the narrowing of inequalities of mobile ownership between the rich and poor. In other words, poor households are moving at a rapid pace to catch up to the high adoption levels of the wealthiest household decile and thereby narrow the digital divide.

An alternative position would be that those in the lowest decile are certainly catching up with mobile phone ownership, however this catch up may remain uneven in quality as poorer households would likely adopt cheaper basic mobile phones. The wealthiest decile, on the other hand, would own smart phones with high functionality and data processing power. In this case, while the proportion of ownership of mobile phones may even out, the variety and quality of phones could also pay a role in perpetuating the digital divide.

Table 26: South Africa's Household Mobile Phone and Computer Ownership by Income Decile, 2005 – 2010

	Mobile Phone Ownership			**Computer Ownership**		
	IES 2005 (%)	IES 2010 (%)	Percentage change (%)	IES 2005 (%)	IES 2010 (%)	Percentage change (%)
Income Decile						
1 (Lower)	43,3 (1,551)	80,6 (0,9140)	+37,3*	1,3 (0,3933)	3,3 (0,4754)	+2,0*
2	49,9 (1,526)	80,9 (0,8486)	+31,0*	1,7 (0,4612)	2,7 (0,3875)	+1,0
3	56,8 (1,476)	86,3 (0,7644)	+29,5*	1,5 (0,3807)	3,5 (0,4605)	+2,0*
4	61,4 (1,494)	89,5 (0,6712)	+28,1*	1,8 (0,4540)	4,5 (0,5032)	+2,7
5	67,9 (1,388)	92,7 (0,5801)	+24,8*	1,6 (0,3497)	5,4 (0,5409)	+3,8*
6	69,5 (1,462)	93,6 (0,6182)	+24,1*	2,7 (0,5237)	7,7 (0,6878)	+5,0*
7	72,6 (1,397)	95,2 (0,4710)	+22,6*	5,8 (0,7735)	15,0 (0,9691)	+9,2*
8	78,6 (1,335)	96,8 (0,3868)	+18,2*	10,3 (1,058)	24,9 (1,112)	+14,6*
9	89,1 (0,9591)	97,7 (0,3661)	+8,6*	27,5 (1,616)	49,3 (1,342)	+21,8*
10 (Upper)	95,0 (0,6611)	98,6 (0,3473)	+3,6*	64,9 (1,456)	78,2 (1,224)	+13,3*
National	70,4 (0,4422)	91,2 (0,2037)	+20,8*	14,7 (0,4229)	19,5 (0,3541)	+4,8*

Source: Own calculations from Income and Expenditure Survey 2005/06 and Income and Expenditure Survey 2010/11

* Denotes a significant change in the percentage of households estimate difference in each income decile between the time period 2005 and 2010 at the 95 percent confidence level.

Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

6.7.4 Computer Ownership by Income

The differences in computer ownership between rich and poor households are more pronounced compared to those for mobile phone ownership. As seen in Table 26, the poorest decile reported computer ownership at over three percent, while the wealthiest decile have over three-quarters reporting computer ownership in 2010. The differences over time (from 2005 to 2010) across all income deciles are positive, but are relatively low percentage changes, ranging from +1,0% to +21,8%. In the lower decile, the percentage difference is single digit (at +2,0% increase) and each income decile is reported, there is a small percentage increase. At the wealthiest decile, the computer ownership is substantially higher with 13,3 percentage increase between 2005 and 2010. Of great concern is the percentage differential between the lower and upper income decile groups, reflecting a divergence. There is a nearly 64 percentage point difference between the lowest and highest income decile groups in 2005 and this difference climbs to just below 75% in 2010. This widening gap reflects a retention of divergence and this remains worrying, and most likely caused by the lowest decile households unable to afford the cost of computers. Overall, computer and internet services show relatively low overall household ownership amongst the poorest income decile.

6.7.5 ICT Ownership by Settlement Type

In regards to ICT ownership comparing between households in urban or rural settlement, ICT ownership is highest amongst households based in urban areas through all time periods. As seen in Table 27, mobile phone ownership amongst urban households were slightly higher compared to rural households (94,3% versus 91,8%) in 2015. In both urban and rural settlements, cellular telephone ownership had the highest gains between 2005 to 2015 with a twenty percentage point increase for urban households and the higher 28,8 percentage increase in rural areas. This higher percentage gain in rural areas suggests convergence, with rural households matching the ownership distribution of urban households.

As for television ownership, another suggestion of convergence is reflected with larger gains for rural households (just over 26 percentage point increase) compared to urban households (around ten percentage point increase) over the ten year period. As for the persistently low fixed telephone line and connection to the internet in both 2005 and 2015, these findings align with a previous report of clear internet connectivity and affordability gaps in rural parts of the country (Rey-Moreno *et al.*, 2016).

Table 27: South Africa's ICT Household Ownership by Settlement Type: 2005 – 2015

Settlement	IES 2005 (%)	LCS 2008 (%)	LCS 2015 (%)	Relative % change (2005-2015)
Urban				
Radio	75,8 (0,5795)	59,4	55,5 (0,5332)	-20,3*
Television	76,9 (0,5728)	81,5	87,0 (0,3720)	+10,1*
Computer	20,8 (0,6142)	26,3	-	-
Mobile Phone	74,3 (0,5724)	87,5	94,3 (0,2343)	+20,0*
Landline Phone	30,9 (0,6521)	27,6	23,0 (0,4698)	-7,9*
Internet Service	9,6 (0,4870)	15,6	27,0 (0,5073)	+17,4*
Rural				
Radio	73,5 (0,5862)	58,9	53,5 (0,6079)	-20,0*
Television	47,4 (0,6822)	59,1	74,1 (0,5438)	+26,7*
Computer	3,2 (0,2282)	7,8	-	-
Mobile Phone	63,0 (0,6575)	82,0	91,8 (0,3331)	+28,8*
Landline Phone	5,4 (0,3002)	8,4	9,9 (0,4061)	+4,5*
Internet Service	0,7 (0,0871)	4,7	13,1 (0,4352)	+12,4*

Source: Own calculations from Income and Expenditure Survey 2005/06, Living Conditions Survey 2008/09 and Living Conditions Survey 2014/15

* Denotes a significant change in the percentage of households estimate difference of each ICT by settlement type between the time period 2005 and 2015 at the 95 percent confidence level.

Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

In 2018, a study around mobile phone ownership by South African individuals reflect the same trends as the Stats SA household statistics around an ongoing urban-rural gap (LIRNEasia, 2019). As for the type of mobile handset owned by urban adults, the majority acquired feature or smart phones, while rural adults reported a more likely chance to have either a basic phone or a feature phone (LIRNEasia, 2019).

6.7.6 Mobile Phone Ownership by Province

By province, there has been notable changes in household mobile telephone ownership over the ten year period. In Table 28, the findings show all provinces had at least 87%-95% of households ownership by 2015. Over ten years, there were positive trends by province with all provinces showing an over 20% percentage point increase (except Mpumalanga and North West provinces).

Table 28: South Africa's Household Mobile Phone Ownership by Province: 2005-2015

Province	IES 2005 (%)	LCS 2008 (%)	IES 2010 (%)	LCS 2015 (%)	Relative % change (2005-2015)
Western Cape	73,5 (1,415)	86,6	90,2	94,2 (0,4789)	+20,7*
Eastern Cape	63,4 (1,108)	82,2	86,6	90,5 (0,5858)	+27,1*
Northern Cape	60,6 (1,478)	77,4	78,6	87,7 (1,133)	+27,1*
Free State	69,7 (1,340)	83,1	90,1	94,2 (0,5453)	+24,5*
KwaZulu-Natal	69,4 (1,020)	84,8	92,0	94,0 (0,4587)	+24,6*
North West	73,1 (1,525)	83,8	89,7	92,1 (0,6981)	+19,0*
Gauteng	73,9 (1,078)	89,0	94,3	95,4 (0,4108)	+21,5*
Mpumalanga	74,0 (1,178)	87,7	92,1	92,1 (0,7171)	+18,1*
Limpopo	68,5 (1,379)	86,6	91,6	93,3 (0,5486)	+24,8*
Total	70,4 (0,4422)	85,7	91,2	93,6 (0,1925)	+23,2*

Source: Own calculations from Income and Expenditure Survey 2005/06, Living Conditions Survey 2008/09, Income and Expenditure Survey 2010/11, and Living Conditions Survey 2004/15
* Denotes a significant change in the percentage of households estimate difference between asset ownership in 2005 and the same asset in 2015 by province at the 95 percent confidence level.
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

Interestingly, the Northern Cape and Eastern Cape provinces, well known for their mainly rural population, are found with the greatest gains (both gained 27,1 percentage points) over the ten year period. Comparing the province with lowest ownership level (e.g. Northern Cape) to the province with the highest ownership level (e.g. Gauteng), the percentage gap certainly narrows as it moves from 2005 to 2015 (+12,4 percentage change in 2005 compared to +7,7 percentage change by 2015). The poorly resourced and rural provinces are seeing convergence to reaching similar distribution levels as the more resourced provinces like Gauteng and the Western Cape.

6.7.7 Computer Ownership by Province

As for computer ownership, Table 29 shows that all provinces showed small positive ownership grown trends, however provinces with metropolitan centres had greater ownership gains than provinces without such urban centres from 2005 to 2010. For example, the two provinces, Gauteng and Western Cape, hosts of two of South Africa's largest cities, and reflect the greatest ownership gains (+7,6 percentage change and +7,3 percentage change, respectively) between 2005 and 2010.

Surprisingly, the Northern Cape also show a seven percentage point increase between 2005 and 2010, however households remain at a low ownership base of seventeen percent in 2010.

Table 29: South Africa's Household Computer Ownership by Province, 2005 – 2010

Province	IES 2005 (%)	LCS 2008 (%)	IES 2010 (%)	Relative % change (2005-2010)
Western Cape	29,0 (1,637)	33,2	36,3 (1,006)	+7,3*
Eastern Cape	8,5 (0,6209)	12,8	10,5 (0,6345)	+2,0
Northern Cape	9,9 (0,8352)	14,9	17,0 (1,243)	+7,1*
Free State	12,7 (1,016)	14.8	16,7 (0,9565)	+4,0*
KwaZulu-Natal	10,8 (0,9868)	16,3	13,6 (0,7519)	+2,8
North West	13,4 (2,465)	14,4	14,0 (1,000)	+0,6
Gauteng	21,3 (1,016)	30,6	28,9 (0,9718)	+7,6*
Mpumalanga	10,1 (1,065)	14,4	13,4 (0,8387)	+3,3
Limpopo	6,6 (0,6426)	10.7	9,2 (0,5744)	+2,6*
Total	14,7 (0,4229)	20,4	19,5 (0,3541)	+4,8*

Source: Own calculations from Income and Expenditure Survey 2005/06, Living Conditions Survey 2008/09, and Income and Expenditure Survey 2010/11
* Denotes a significant change in the percentage of households estimate difference between asset ownership in 2005 and the same asset in 2015 by province at the 95 percent confidence level.
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

The lowest percentage point change came from the North West province (only +0,6 percentage change) in the five year period (and not statistically significant). In comparing the province with the highest computer ownership (Western Cape) and the province with the lowest computer ownership (Limpopo) in two time periods (22,4 percentage difference in 2005 versus 27,1 percentage difference in 2010), the differential is growing between the two provinces, which suggests divergence in the distribution between the provinces. In other words, over the time period, households in Limpopo are unable to meet the same pace in obtaining computers compared to the Western Cape.

6.7.8 Mobile Phone Ownership by Population Group of Household Head

Of the South African population, the distribution of population groups listed as respondents in 2015 are the majority of household heads identifying themselves of Black African descent (over 80% of the population) and a minority of household heads identifying themselves as 'White' (around 10%), 'Coloured' or 'Indian/Asian' (Statistics South Africa, 2017b). In regards to mobile phone ownership by the population group of the household head, Table 30 illustrates that all population groups showed positive changes, but households with Black African and Coloured heads showed the largest change (+25,7 percentage change and +28,8 percentage change, respectively) between 2005 to 2015.

Table 30: South Africa's Household Mobile Phone Ownership by Population Group of Household Head, 2005-2015

Population Group of Household head	IES 2005 (%)	LCS 2008 (%)	IES 2010 (%)	LCS 2015 (%)	Relative % change (2005-2015)
Black African	67,7 (0,5036)	84,5	90,8	93,4 (0,2159)	+25,7*
Coloured	63,3 (1,603)	81,8	86,1	92,1 (0,5732)	+28,8*
Indian/Asian	78,9 (2,873)	91,1	94,3	94,9 (1,048)	+16,0*
White	89,1 (1,012)	94,7	96,6	95,8 (0,6720)	+6,7*
Total	70,4 (0,4422)	85,7	91,2	93,6 (0,1925)	+23,2*

Source: Own calculations from Income and Expenditure Survey 2005/06, Living Conditions Survey 2008/09, Income and Expenditure Survey 2010/11, and Living Conditions Survey 2004/15
* Denotes a significant change in the percentage of households estimate difference between asset ownership in 2005 and the same asset in 2015 by population group of household head at the 95 percent confidence level.
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

Under all population groups, each had above ninety percent of mobile telephone possession in 2015. Between population groups, there is a 21,4 percentage difference in 2005 between those with a White household head and those with a Black African household. This differential lowers to a mere 2,4 percentage points by 2015, alluding to a convergence or decreasing distribution gaps between the two types of households. This is a large change also considering that households with White household heads have a substantially larger average of annual consumption (average of R350 937 per annum) compared to households with Black African heads (average R67 828 per annum) in 2015 (Statistics South Africa, 2017b).

As a comparison to mobile phone gains, households with Black African heads also had substantial positive change with television and satellite dish / DSTV ownership (+21,7 percentage change and +33,8 percentage change) between 2005 and 2015, as observed in Table 31. In fact, DSTV ownership had overall large changes amongst all population groups, with households with Indian/Asian household heads seeing the largest gain of them all (+62,1 percentage change) in the ten year period.

Table 31: South Africa's Household Television and DSTV Ownership by Population Group of Household Head, 2005-2015

	Television Ownership			**DSTV Ownership**		
	IES 2005 (%)	LCS 2015 (%)	Percentage change (%)	IES 2005 (%)	LCS 2015 (%)	Percentage change (%)
Population Group						
Black African	58,6 (0,5367)	80,3 (0,3662)	+21,7*	1,6 (0,1434)	35,4 (0,4438)	+33,8*
Coloured	85,7 (1,038)	93,0 (0,5910)	+7,3*	4,9 (0,7489)	45,3 (1,226)	+40,4*
Indian/Asian	92,5 (1,983)	96,0 (0,9981)	+3,5*	12,3 (2,396)	74,4 (2,396)	+62,1*
White	97,8 (0,4603)	95,6 (0,6539)	-2,2	29,1 (1,675)	73,1 (1,450)	+44,0*
National	66,6 (0,4622)	83,1 (0,3105)	+16,5*	5,7 (0,2876)	40,8 (0,4187)	+35,1*

Source: Own calculations from Income and Expenditure Survey 2005/06, Living Conditions Survey 2008/09, Income and Expenditure Survey 2010/11, and Living Conditions Survey 2004/15
* Denotes a significant change in the percentage of households estimate difference between asset ownership in 2005 and the same asset in 2015 by population group of household head at the 95 percent confidence level.
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

6.7.9 Computer Ownership and Internet Connection by Population Group

In regards to computer ownership, Table 32 illustrates that there were increases amongst all population groups of any household head between 2005 and 2010, and households with White household heads having the largest computer ownership in 2010 (over 70%). As for ownership trends over the five year time period, the household heads of the Coloured population group showed the greatest gains followed by Indian/Asian population group (+10,8 percentage change and +8,0 percentage change respectively).

Table 32: South Africa's Internet connection and Household Computer Ownership by Population Group of Household Head, 2005 -2010

	Internet Connection			**Computer Ownership**		
	IES 2005 (%)	IES 2010 (%)	Percentage change (%)	IES 2005 (%)	IES 2010 (%)	Percentage change (%)
Population Group						
Black African	1,7 (0,1626)	2,2 (0,1533)	+0,5	5,0 (0,2465)	9,3 (0,2734)	+4,3*
Coloured	4,4 (0,7605)	8,6 (0,6410)	+4,2*	18,5 (1,686)	29,3 (1,035)	+10,8*
Indian/Asian	10,6 (2,951)	23,2 (2,693)	+12,6*	36,6 (3,736)	44,6 (2,913)	+8,0
White	35,8 (1,770)	46,9 (1,447)	+11,1*	65,8 (1,583)	70,3 (1,268)	+4,5
National	6,5 (0,3249)	8,8 (0,2811)	+2,3*	14,7 (0,4229)	19,5 (0,3541)	+4,8*

Source: Own calculations from Income and Expenditure Survey 2005/06, and Income and Expenditure Survey 2010/11.
* Denotes a significant change in the percentage of households estimate difference between asset ownership in 2005 and the same asset in 2015 by population group of household head at the 95 percent confidence level.
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

Despite these gains, the households Coloured and Indian/Asian households heads have below 45 percent computer ownership by 2010. The households with Black African heads had less than ten percentage ownership of computers and less than 3 percent of internet connection to the home in 2010. Over the 2005-2010 period, the lowest percentage point gains were amongst household with Black African household heads and White household heads with under 5% increase between 2005 to 2010. Yet, the computer ownership proportion of households with a Black African household head remained low at under ten percent.

Amongst household population groups, there are substantial differentials between the households with Black African household heads and the households with White household heads, with the gap remaining relatively stationary (around 60 percent) over the time period. These low computer ownership results may relate to the substantial difference in income between households with Black household heads and White household heads.

These household population group results of Stats SA align with an individual survey whereby 84% of African Black population group respondents indicated that they did not use a computer at all in 2011 (Bornman, 2016). In an individual survey on ICT use, those identified in the White population group had just over forty percent using computers every day, while respondents identified as Blacks, Coloureds or Indians using computers daily were 10% or less (Bornman, 2016).

6.8 Analysis on ICT Ownership Trends in South Africa

South Africa households have made major shifts on the individual ICT assets owned by households in the ten year period between 2005 to 2015. Aligned with global trends, South Africans experienced dramatic uptake of mobile telephone ownership over the period from 2005 to 2015. The wide range of mobile phone devices and various pricing options allow for South Africans to choose a suitable package for phone service. The television and its peripherals (in this case, satellite dish or DSTV service) receive major gains across the South African population. The emergence of affordable television sets as well as a set of satellite television service options such as DSTV, StarSAT and OpenviewHD help drive the household demand for television services. Within the strict category of satellite TV, some of the online TV services may be under-reported with the launch of video-on-demand services in South Africa, such as Netflix and ShowMax.

In looking within the stratified population groups, comparable ICT asset gains find previously disadvantaged groups such as female-headed household, households in the lowest income decile, rural households and households with black African household heads to have substantial gains in mobile telephone and television ownership when compared to the percentage gains over the same time period by the other population group counterparts (e.g. male-headed households, urban households, wealthy income decile households or household with White household heads). The convergence or narrowing inequality gap is seen amongst these two particular ICT assets. The gains refer particular ICTs with wider product options and that sell services at various price points which ultimately allow for a diversity of household ICT ownership.

Inversely, amongst the same previously disadvantaged groups, there are much smaller ownership gains in newer individual ICT assets such as computer and connection to internet service, where household ownership remains relatively lower and the gaps of ownership over the 2005 to 2015 period remain wide. There is hope for change with the latest product offerings of computers. Desktop and laptop computers are high cost equipment for households to own, however the crossover of low-cost tablets can bring such computing devices to more affordable levels, particularly to disadvantaged households. Some feature and smart phones are now available with multiple computing features at a low cost for the hand set. Worryingly, the cost of internet connectivity, particularly mobile broadband data remains relatively high for South Africans, which can hinder the extensive use of the internet on either computer or mobile phone devices by a wide variety of South Africans. Given high individual investments required to participate in a digital-enabled society, the pace of citizen use of ICTs for development is slow (Abrahams, 2011). The resource constrained are continuously pushed away from opportunities for a better life including the chance to extend their capabilities through ICT use. Alternative connectivity options require exploration as well as a demand for better competitive data rates.

New ICTs are eminent and with the push for 5G "smart" devices, these are high end costs and this type of future may cater primarily to those already well-connected. The wealthier households can increase the size of their digital baskets and as a result, it can further a digital inequality of the haves and have nots. In other words, should the basic digital technologies or telecommunication infrastructure be unaffordable and remain out of reach of the most poor, while at the same time, this sector of new 'smart' ICTs expand the capabilities of the wealthy, such patterns could possibly see the re-enforcement of inequalities. The ownership gap of these newer technologies also confirm previously mentioned structural constraints, both in the technological supply side as well as societal structures (e.g. high unemployment, persistent poverty and high income inequality), that ICT ownership is not enough to close the welfare gap (Garrido & Wyber, 2017).

6.9 Conclusion

In this chapter, I provide my research findings around ICTs in South Africa, specifically on the current household level ICT statistics in South Africa for the period of 2005 to 2015. The most novel findings from this chapter include the nuances of specific ICT ownership, particularly for those identified as previously disadvantaged groups over this time frame. For example, in the ten year time period, South African households have overall greater ownership to mobile phone, television and satellite services over time, and previously disadvantaged groups were also able to own the same devices, allowing them to catch up with the larger population, and further closing the digital ownership gap. Yet, with other ICTs, the same South African households show much lower ownership gains. For example, within the same time period, computer ownership and connection to internet services show relatively lower uptake and computer ownership and previously disadvantaged population groups remain divergent and far from obtaining these devices. This is worrying as the results suggest that low income households are not able to expand their asset portfolio to include more advanced ICTs and thereby the end to the digital divide is not as pronounced as it could be.

In most cases, population segments with historical disadvantages, mainly households in rural and historically poorer provinces, households in lower expenditure deciles and female-headed households still have the lower proportion of individual ICT asset access and ownership when compared to their counterparts. At the same time, the same historically disadvantaged groups encounter higher proportion of ICT spending compared to the national average.

In terms of digital literacy, South Africa is absent of consistent national level measures, but the limited existing data shows low levels of digital literacy amongst adults. In order to see the same high adoption as mobile phones for advanced ICTs, diversified and affordable supply side options are needed for the internet and computers, complemented with digital literacy training. These recommendations can reduce the detrimental effect of a large portion of South Africans missing these technological assets within their asset portfolio. These aspects are particularly relevant to the central analysis on the association between ICTs and poverty reduction.

In this chapter, an overview of the external context of South Africa is also provided as the context within the enhanced sustainable livelihoods framework. The enhanced SLF enables a more focused response to the poor with regard to ICT assets by specifically responding to the research question about what internal and external factors help or hinder a household's ICT portfolio. South Africans are highly exposed to long-term vulnerabilities. Poverty levels and unemployment are relatively high in South Africa and just under half of its population are receiving cash grants and other social initiatives to help mitigate chronic poverty. This highly vulnerable context can affect the efforts towards digital inclusion and the broadening of a household's ICT assets. At the same time, South Africa's national policies are well developed, including the ICT policy and broadband policy. Such plans are set to promote digital inclusion and connectivity, both of which would further economic and social participation. National, provincial and local initiatives (both government or civil society led) are building ICT infrastructure, including developing community-led Wi-Fi or public access points, in some cases, to the poorest, rural villages. The operators and other service providers bring sizable contributions to the economy, yet in areas with less economic incentives, more targeted and possibly subsidised responses and a push for more affordable services are needed for digital inclusion, particularly for the poor. From the social side, the widespread access to ICT services are helping many to gain employment digitally as well as are changing the landscape of community-based centres to include internet access.

7 CHAPTER SEVEN: THE CONTRIBUTION OF THE DIGITAL BASKET TO POVERTY REDUCTION IN SOUTH AFRICA

7.1 Introduction

This section provides an empirical response to the third research question of the thesis, mainly, what are the levels of ICTs and poverty reduction in South Africa and what is the association between ICTs and poverty. Now that the previous chapter provides an overall understanding of ICTs under the context of South Africa, in this chapter, I empirically measure the digital basket, using the Stats SA data available for South African households, specifically the ICT ownership variables. An important caveat is that what can be included in this basket is limited by the highly restrictive set of questions that are included in the surveys undertaken by Stats SA.

This section provides a description of the digital basket against a variety of combinations and socio-economic household characteristics between 2010 and 2015. Specifically, this chapter focuses on the household's digital basket by gender of household head, population group of the household head, household size, province, settlement type, expenditure deciles, poverty level, and other welfare indicators like electricity and water. While primarily one can examine ICTs against the lower bound poverty line set by government, it is also important to observe other non-money metric indicators around well-being for understanding poverty more holistically. The digital basket also allows for a nuanced understanding of the grouped composition of ICTs that households acquire as well as under what conditions households own particular digital baskets. Since little is known around the household inventory of ICTs more broadly, nor has there been previous quantification of ICT assets in South Africa, this analysis will be my unique contribution to knowledge. Finally, I end the chapter with the multivariate regression, controlling for certain features in the association between the digital basket and poverty reduction.

7.2 Descriptive Research Findings

As mentioned above, the descriptive estimations for this study use the IES 2010 and LCS 2015. The explanatory variables include the following: (i) demographic characteristics such as household size, gender of household head, population group of household head, and the highest level of education by any member in the household; (ii) locality characteristics such as province and settlement type, and (iii) other welfare dimensions such as formal dwelling, access to drinking water on-site, adequate toilet facilities, electrification, and home ownership. Details on each of these variables can be found in Section 5.9 and in Annex B. As is shown in the descriptive statistics Table 33 below, the majority of the household have male-headed households in this population (just over sixty percent) and over three-quarters of the households have an African Black household head in both periods.

Table 33: South Africa: Socio-Economic Descriptive Statistics 2010

% of n	2010 South African population Percentage (%) n=25 328	se (2010)	2015 South African population Percentage (%) n=23 380	se (2015)
Gender of Household Head				
Male	61,8	0,3743	58,6	0,4108
Female	38,2	0,3743	41,4	0,4108
Population Group of Household Head				
African/Black	76,8	0,3631	80,4	0,3529
Coloured	8,3	0,1830	7,2	0,1741
Indian/Asian	2,6	0,1438	2,3	0,1328
White	12,3	0,3231	10,0	0,3096
Province				
Western Cape	11,8	0,2321	11,4	0,2522
Eastern Cape	11,7	0,2281	10,5	0,2209
Northern Cape	1,8	0,0560	2,1	0,0697
Free State	5,9	0,1441	5,6	0,1385
KwaZulu-Natal	16,8	0,2985	17,0	0,2977
North West	7,9	0,1854	7,4	0,1905
Gauteng	27,3	0,4207	29,2	0,4488
Mpumalanga	6,8	0,1638	7,3	0,1801
Limpopo	10,1	0,2008	9,4	0,2065
Settlement Type				
Urban Formal	59,1	0,3845	60,4	0,396
Urban Informal	9,0	0,2590	9,8	0,2802
Traditional Area	27,5	0,3175	25,8	0,3090
Rural Formal	4,4	0,1785	4,1	0,1755

Source: Own calculations from the Income and Expenditure Survey 2010/11 and Living Conditions Survey 2014/15

Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in the adjacent column.

The population within each province is representative, with the largest proportion based in Gauteng. Nearly sixty percent of the South African population stay in urban formal settlements, followed by traditional areas.

7.3 Digital Basket: ICT Combinations

Digital baskets reveal the extent to which communication technologies adoption occurs in South African households. As you recollect from the methodology section, there are ten ICT assets which are identified for use in this index analysis and can make up a household's digital basket, namely: 1) radio, 2) stereo, 3) television, 4) DVD player, 5) computer, 6) camera, 7) mobile phone, 8) landline telephone, 9) DSTV, and 10) connection to the internet. In the previous chapter, statistical reports by South Africa can be analysed to reveal the trends of each of the individual ICT assets which are owned by households. Between 2010 and 2015, the results of two surveys, IES 2010 and LCS 2015 by Stats SA show a wide variety of household digital baskets.

7.3.1 2010 Digital Basket Combinations

The analysis assessed two main aspects of digital baskets: 1) the number of ICT assets in a household, and 2) the types of ICT assets or the digital basket composition held by a household. Firstly, the average number of ICT assets held by a South African household in 2010 is estimated to be 3,97 (precisely estimated with a 95,0% confidence interval [3,927, 4,007]). Table 34 below shows the estimated proportion of South African households that own certain combinations of digital baskets and reveals the aggregated counts of such Information and Communications Technology (ICT) assets from 2010 to 2015. As seen in Table 34, out of 13,16 million South African households in 2010, just over one-fifth (or around 2,75 million) had an average of four ICT assets in their ownership. This is followed by just under one-fifth (or around 2,61 million) with an average of three ICT assets in their ownership. In further observing households experiencing no or low digital integration, there are an estimated 2,7% (or 360 000 households) that possess zero ICT assets. Overall, around 12% of South African households had zero-asset or one-asset digital baskets in 2010. On the other side of the digital basket spectrum, there is also a small percentage of households that could be considered digitally wealthy;

around 2,3% (~300 000) of South African households possessed the full ten-asset digital basket in 2010. For each sub-category of ICT asset counts, the proportion of household ownership incrementally rises from zero to four ICT assets. Then from four assets, the percentage of households with the incrementally larger digital baskets drops until it reaches the full ten ICT assets.

Table 34: South African Household (hh) Digital Baskets, by ICT asset count, 2010-2015

	2010			**2015**			
	Sample	Est. number of hhs (millions)	% of hh	Sample	Number of hhs (millions)	% of hh	Relative change 2010-2015
0 ICT assets	843	0,36	2,7% (0,1175)	598	0,36	2,3 (0,1143)	-0,4%
1 ICT asset	2 480	1,24	9,4% (0,2271)	2 554	1,83	11,7% (0,2704)	+2,3%*
2 ICT assets	3 823	1,94	14,8% (0,2780)	3 841	2,55	16,3% (0,3074)	+1,5%*
3 ICT assets	5 207	2,61	19,8% (0,3091)	5 344	3,59	23,0% (0,3528)	+3,2%*
4 ICT assets	5 330	2,75	20,9% (0,3203)	4 228	2,85	18,2% (0,3270)	-2,7%*
5 ICT assets	2 954	1,53	11,6% (0,2575)	2 528	1,80	11,5% (0,2839)	-0,1%
6 ICT assets	1 560	0,87	6,6% (0,2080)	1 452	1,08	6,9% (0,2257)	+0,3%
7 ICT assets	1 017	0,59	4,5% (0,1748)	776	0,68	4,3% (0,1940)	-0,2%
8 ICT assets	764	0,53	4,0% (0,1856)	460	0,45	2,9% (0,1765)	-1,1%*
9 ICT assets	576	0,44	3,4% (0,1775)	271	0,27	1,7% (0,1284)	-1,7%*
10 ICT assets	348	0,30	2,3% (0,1621)	152	0,18	1,1% (0,1108)	-1,2%*
Total	n=24 902	13,16	100,0%	n=22 204	15,65	100,0%	

Source: Own calculations from the Income and Expenditure Survey 2010/11 and Living Conditions Survey 2014/15

* Denotes a significant change in the percentage of households estimate difference between 2010/11 and 2014/15 at the 95 percent confidence level

Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

A more in-depth view of digital basket composition (see Annex D, Table 58) shows the most common in 2010 was the following four-asset combination: one radio, one television, one DVD player and one mobile phone, owned by an estimated 1,46 million South African households. The second most common digital basket (1,22 million households) was a three-asset combination: one television, one DVD player and one mobile phone (see Annex D for an exhaustive list on the most common digital basket combinations). In 2010, these popular analog digital basket compositions suggest a household's preference for ICTs based on available products and price ranges. For example, in 2010, households could purchase affordable television sets with access to analog signals (via the use of an aerial antennae), allowing access to selected channels (du Plessis, 2016). These television sets were then complemented with DVD players for viewing video discs owned by the household, borrowed from friends and family, or those hired from now defunct video shops. DVD players could also be used as alternatives for music players, with the television speaker projecting sound. Radios were an analog standalone device and channels accessed with a radio antenna. The range of available technologies made the four-asset digital basket the most popular amongst South African households in 2010.

The third most typical digital basket combination in 2010 is revealing, with around 920 000 households (~7% of households) owning one mobile phone. This popular composition suggests that there remains a proportion of households unable to obtain a wide digital basket, and the premise of owning an expansive digital basket remains unattainable for many households. This popular one-asset digital basket result supports research that states ICTs are unaffordable.

7.3.2 2015 Digital Basket Combinations

I include the 2015 digital baskets to reveal changes over time. In 2015, the average number of ICT assets amongst South African households was 3,65 (with a 95% confidence interval [3,617, 3,691]), representing a slight drop from the 2010 average. In review of the digital basket counts in Table 34, the largest combination of ICTs was a three-asset digital basket of around 23,0% of households (or 3,6 million out of 15,6 million) in 2015, followed by under one-fifth (18,2% or 2,9 million) had a four-asset digital basket. The proportion of household ownership incrementally rises as it moves from zero- to three-asset digital baskets in 2015. However, the household ownership percentage then incrementally drops as it moves from the three- to ten-asset digital basket. More broadly, there are clear household percentage increases in the smaller sized digital baskets (as in the one- to three-asset digital baskets), with the three-asset digital basket showing the largest positive relative growth when comparing between the two periods. Households with a ten-asset digital basket represent just over 1% (around 180 000) in 2015, a drop from in 2010. In addition, there are decreases in relative change between 2010 and 2015 for the larger size digital baskets, as seen amongst the seven- eight- and nine-asset digital baskets. Some questions are raised as to whether the high costs of living are causing households to forgo particular ICT ownership of what they consider unaffordable to maintain. In addition, ICT can evolve, some becoming obsolete while others evolve and result in the convergence of multiple digital devices into one platform, thereby reducing the need for multiple ICTs in 2015.

In terms of an in-depth look at 2015 digital basket compositions (see Annex D, Table 59) the most popular digital basket is the single mobile phone now, owned by 1,5 million households (or 9,7% of South African household population). In 2010, the single mobile phone was the third most typical digital basket composition. This high increase of the single mobile phone as a digital basket may be the result of those households previously with zero-ICT digital baskets now transitioning to digital inclusion through the acquisition of a mobile phone. The result suggests affordability to poor households to take their first step in attaining their first ICT. The survey show a decrease of households who previously owned zero ICTs between 2010 to 2015. Despite the decreases, there still remains 2,3% of households with zero ICTs in their digital basket in 2015, only a slightly smaller proportion than in 2010.

The change of digital basket composition over the five year time period could also be external, in that the high cost of living and high unemployment, it is the smaller digital baskets, or, in the extreme end, zero-asset digital baskets that households can afford. A change of device preferences and the higher cost of individual multi-functional ICT could influence a household's decision and willingness to forgo individual ICT items for a smaller digital basket. For example, in order to afford a particular ICT of higher quality like a smart phone (as opposed to a cheaper basic mobile phone), a household can forgo a range of multiple ICTs at a cheaper price range. Alternatively, within the context of decreasing income levels by 2015, particularly of lower income households, and rising costs of household necessities like food and electricity, the choice of smaller digital baskets can be the result of an ever decreasing discretionary budget.

In further understanding the 2015 popularity of the single mobile phone digital basket, Table 35 below reveals the price ranges of mobile phones for those households indicating that is the only ICT item they have. For households with only one mobile phone in their one-asset digital basket, the average value was around R336.

Table 35: Mobile phone value within one mobile phone digital baskets, 2015

Value of Mobile phone	Percentage
R0	12,63%
R1 - R200	41,03%
R201-R400	20,29%
R401 - 600	12,70%
R601 - 800	6,09%
R801 - R1,000	3,30%
R1,001 - R1,500	2,08%
R1,501 - R2,000	1,25%
>R,2001	0,62%
Total (n=2 029)	100,00%

Source: Own calculations from the Living Conditions Survey 2014/15

Note: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa.

As seen by Table 35 above, nearly three-quarters valued their phone between R1 to R600. In 2019, it is possible to obtain a feature or smart phone for below R600. In 2015, the cheapest mobile phones were between R100 and R120, and entry level smartphones were just below R600 (mybroadband, 2015). The majority with a single mobile phone as their digital basket would thereby acquire low cost, entry level mobile phones. A smaller percentage could afford phones that cost over R1 000, meaning it was likely a data-enabled smartphone. However, survey respondents do not indicate having a mobile phone and an internet connection, which could be explained by usage in places with free internet access (e.g. at work, a relative's house, or internet café), so no internet connectivity is required at home. Another explanation could be a reporting error whereby social apps like WhatsApp are not identified as connecting to the internet.

Just over 12% of households indicated zero value for their phone, indicating it may have been a gift. The elderly, for example, have mobile phones purchased by their children (Ahlin, 2018; Chen *et al.*, 2013), and may not necessarily know its retail value. South African households are now moving out of digital exclusion through the affordability of low- or no-cost mobile phones. This could suggest an affordability issue with households limited to a single digital device and the inability to afford other synergistic ICTs like internet connectivity and thus miss the opportunity of an enhanced asset portfolio.

The second most common digital basket composition in 2015 was this two-asset composition: one television and one mobile phone (8,8% or 1,4 million households) and the third most common was this three-asset composition: one radio, one television and one mobile phone. When comparing these two digital basket compositions to 2010, one ICT asset has clearly dropped off the most typical digital basket composition in 2015, which is the departure of the DVD player. Such asset withdrawal could be explained by either affordability issues or by evolutionary technological changes. With shrinking discretionary budgets, some households may be unable to afford a DVD player by 2015. Alternatively, a technological convergence could explain the smaller digital baskets by 2015. For example, newer television sets have USB ports or outlets that allow for DVD functions like viewing movies or playing music through the television and therefore eliminate the need for a DVD player. Just as DVD players had taken over VHS cassette players, it was becoming more of an obsolete technology by 2015. In some cases, the DVD player could be replaced by either offline technologies like external peripheral devices that utilise USB sticks for playing movies and music, or online services like video streaming. The declining size of the digital basket could also be explained by the slight increase of household poverty during the period causing them to remain only with either an analog or upgraded television set.

Despite this, many households still had a DVD player in 2015. This is reflected in the fourth most typical digital basket composition (three-asset digital basket: one television, one DVD player and one mobile phone) and fifth most popular (four-asset digital basket: one radio, one television, one DVD player and one mobile phone).

These two digital basket compositions make up around 13% of the population (around 2 million households).

This change in ICT hardware could also be a methodological issue, where the 2015 asset ownership list cannot capture the replacement ICT for DVD players. In some of the statistical South African surveys (for example, refer to the LCS 2015 survey), other peripheral items like the ownership of Blu-Ray players were included. The 2019 digital basket taxonomy table shows the wide range of available household ICTs for 2019, so the possibility of a replacement to the DVD player, which is not listed amongst the ten ICT assets, is high. The ongoing evolution of existing ICT devices and the creation of new ones is a reality and often unpredictable. In its current form, the 2015 survey currently shows an overall decrease in the number of ICTs in South African household digital basket, but further work is required to unpack whether these ten ICT assets sufficiently reflect the digital basket of households, given the enhanced 2019 ICT asset inventory list. This particular aspect points to the difficulties of monitoring the changes in households' digital baskets over time.

7.4 Digital Baskets as a measure of ICT in South Africa

As mentioned in the methodology section (Chapter 5), a digital basket taxonomy was created to further analyse ICTs against certain demographic characteristics of South African households. As illustrated in Table 36, each basket is based on a particular count of ICT assets, whereby No Digital Basket (NDB) has zero ICT assets, Small Digital Basket (SDB) has one to three ICT assets, Medium Digital Basket (MDB) has four to six ICT assets, and Large Digital Basket (LDB) has seven to ten ICTs in the digital basket.

Table 36: Digital Basket Taxonomy

Name of Digital Basket	Description
No Digital Basket (NDB)	Households with zero ICTs
Small Digital Basket (SDB)	Households with 1-3 ICTs
Medium Digital Basket (MDB)	Households with 4-6 ICTs
Large Digital Basket (LDB)	Households with 7-10 ICTs

Source: Author

From the estimates for 2010 (which can be found in Annex D, Table 60), South African households mainly acquired small digital baskets (44,1%), with just under 40% of households possessing medium digital baskets. In 2015, the results retain the majority of households with possession of a small digital basket, representing just over half of the population (7,97 million households), followed by medium digital baskets (36,7% of households). Comparing 2010 to 2015, the acquisition of small digital baskets is a positive growth area. In all other baskets, there was a downward change during the same period. The trends suggest that some households with large digital baskets or medium digital baskets in 2010 transitioned to smaller digital baskets by 2015. Those with zero-asset digital baskets in 2010 comprised a small sub-population, and there was only a small decrease by 2015, suggesting that some households became digitally included by 2015, but there still remains a small minority who remain digitally excluded.

7.5 Digital Basket: by Household Demographics

In a more in-depth examination, the next section looks at cross-tabulations based on South African demographic aspects, specifically the gender of the household head, population group of the household head, the highest level of education of any household member, and household size.

7.5.1 Gender of Household Head

As revealed in Chapter 5 in the descriptive statistics summary, female-headed households in this South Africa population estimate for 2010 have a substantially smaller mean expenditure per month per household, a larger household size, and a younger average age compared to male-headed households. When the digital baskets are disaggregated by gender of household head, the findings (see Table 37) show that the majority of households possess small digital baskets, whether female- or male-headed, in both 2010 and 2015. There are, however, proportional differences, with the ownership of small digital baskets being proportionately higher amongst female- than male- headed households in both time periods. In running the Pearson chi-square test, the 2010 results indicate that there is a statistically significant relationship between the digital basket and the gender of household head (2010 chi-square with 3 degrees of freedom = 678,34, p=0,000).

Table 37: Household (hh) Digital Basket, by Gender of Household Head, 2010 - 2015

	2010			2015		
Description	**Male (% of hh)**	**Female (% of hh)**	**Relative change % (2010)**	**Male (% of hh)**	**Female (% of hh)**	**Relative change % (2015)**
No digital basket	2,68 (0,1483)	2,74 (0,1805)	+0,06%	2,31 (0,1563)	2,32 (0,1654)	+0,01%
Small digital basket	39,85 (0,5210)	50,68 (0,5913)	+10,83%*	47,21 (0,5712)	56,46 (0,6552)	+9,25%*
Medium digital basket	38,99 (0,5214)	39,33 (0,5796)	+0,34%	37,58 (0,5547)	35,38 (0,6297)	-2,20%
Large digital basket	18,48 (0,4672)	7,25 (0,3602)	-11,23%*	12,89 (0,4176)	6,12 (0,4068)	-6,77%*
Total	100,00%	100,00%		100,00%	100,00%	

Source: Own calculations from Income and Expenditure Survey 2010/11 and Living Conditions Survey 2014/15
* Denotes a significant change in the percentage of households estimate difference between male-headed and female-headed households of the same year at the 95 percent confidence level.
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

With previous evidence that female-headed households are more vulnerable to poverty (Rogan, 2016), and that income inequality is a determinant to unequal access to ICTs between male- and female-headed households (Pashapa & Rivett, 2017), the larger proportion of female-headed households with low digital baskets maintains the concern that the digital gap is based on low income. This digital gap does seem to be narrowing for small digital baskets (moving from around 10,8% in 2010 to 9,3% in 2015 for small digital baskets); however, this relative change seems more pronounced due to larger of proportion of male-headed households with small digital basket changes from 2010 to 2015.

A relatively small proportion fall into the large digital basket category, with male-headed households having a considerably larger proportion in both time periods, however the proportion slightly narrowed over the time period (-11,2% relative difference in 2010 and -6,8% in 2015). Again, this is a result of negative proportion change of male-headed households with large digital baskets between 2010 and 2015. From the findings, female household heads have large ownership gaps when disaggregated by both small digital baskets and large digital baskets, lagging behind their male counterparts; however, the gaps are narrowing over time. The major ownership decreases in large digital baskets occur amongst with male-headed households.

When comparing the changes in male-headed households over the two time periods (see Table 38), -5,6% relative change was found in those with large digital baskets. Over the same time, male-headed households saw a significant proportional +7,4% relative change in low digital baskets. For female-headed households, there was a slight decrease in large digital basket possessions between 2010 and 2015 and +5,5 relative change in small digital basket ownership. The relative percentage changes are larger amongst male-headed households compared to female -headed households. Those households with zero-asset digital baskets, either male or female, had small negative relative changes, both under 1%.

Table 38: Household Digital basket, by Gender of Household Head, 2010 – 2015

Description	Male (% of households)			Female (% of households)		
	2010	2015	Relative change 2010-2015	2010	2015	Relative change 2010-2015
No digital basket	2,68 (0,1483)	2,31 (0,1563)	-0,31%	2,74 (0,1805)	2,32 (0,1654)	-0,42%
Small digital basket	39,85 (0,5210)	47,21 (0,5712)	+7,36%*	50,68 (0,5913)	56,18 (0,6552)	+5,50%*
Medium digital basket	38,99 (0,5214)	37,58 (0,5547)	-1,41%	39,33 (0,5796)	35,38 (0,6297)	-3,95%*
Large digital basket	18,48 (0,4672)	12,89 (0,4176)	-5,59%*	7,25 (0,3602)	6,12 (0,4068)	-1,13%
Total	100,00%	100.00%		100,00%	100,00%	

Source: Own calculations from Income and Expenditure Survey 2010/11 and Living Conditions Survey 2014/15

* Denotes a significant change in the percentage of households estimate between male-headed households and female-headed households of the same year at the 95 percent confidence level.

Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

7.5.2 Population Group of Household Head

As mentioned earlier (Section 7.2), over three-quarters are households headed by the African/Blacks population group in 2010. Major differentials remain in monthly expenditures amongst population groups, with African/Black-headed households spending smaller amounts than their counterparts, such as White-headed households in South Africa. As for the digital baskets, Table 39 shows changes over time, again reflecting the small digital basket increase across all population groups. Most African/Black household heads possessed small digital baskets, Coloured- and

Indian-headed households mainly owned medium digital baskets, while White-headed households mainly have large digital baskets.

Table 39: Household Digital Baskets by Population Group of Household Head, 2010 - 2015

Description	African/ Black		Coloured		Indian		White	
	2010	2015	2010	2015	2010	2015	2010	2015
No digital basket	3,18% (0,1426)	2,61% (0,1356)	2,96% (0,3741)	2,22% (0,3041)	0,28% (0,2748)	0,64% (0,3702)	0,03% (0,0280)	0,40% (0,2320)
Small digital basket	52,69% (0,4433)	58,13% (0,4658)	30,57% (1,028)	37,21% (1,169)	11,50% (1,806)	19,28% (2,094)	5,11% (0,5396)	9,70% (0,9914)
Medium digital basket	39,59% (0,4346)	35,11% (0,4514)	46,67% (1,133)	45,47% (1,245)	45,41% (2,852)	55,91% (2,973)	29,67% (1,295)	38,34% (1,6640)
Large digital basket	4,54% (0,2017)	4,15% (0,2043)	19,80% (0,9016)	15,11% (1,004)	42,81% (2,883)	24,17% (2,580)	66,20% (1,346)	51,55% (1,722)
Total	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

Source: Own calculations from Income and Expenditure Survey 2010/11 and Living Conditions Survey 2014/15

Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

Amongst households with White heads and Indian heads, a decrease with large digital baskets occurred between 2010 and 2015 with an increase in medium digital baskets. Previous arguments around technological convergences and decreases in incomes could help to explain this transition. Amongst the Africa/Black-headed households, with the exception of small digital baskets, there are decreases in zero-asset digital baskets, and medium and large digital baskets. The zero-asset digital baskets could mean improvements towards digital inclusion for this population group, but the decreases amongst medium and large digital baskets draw in concerns about affordability and technological convergence. In running the Pearson chi-square test, the 2010 results indicate that there is a statistically significant relationship between the digital basket and the population group of household head (2010 chi-square with 9 degrees of freedom = 9077,89, p=0,000).

7.5.3 Highest Level of Education of a Household Member

From the 2010 summary statistics (Annex D, Table 57), the majority (~80%) of South African households have at least one household member who has completed secondary school education, meaning they likely have the capability to provide technical guidance or assistance to other household members. A higher level of education within a household means the increased adoption of ICTs, due to the spillover effects from one household member to another (Barrantes, 2010). As seen in Table 40, less than 2% have lower than primary school education with most owning a small digital basket (67,1%) and less than one-fifth of households with zero ICTs in these under-educated households. Amongst households with one member completing primary school education, again the majority acquire a small digital basket with proportions higher than the national average. Those households with completion of secondary education remain very similar to the national average. Finally, amongst households with at least one member who has completed tertiary education, the majority have large digital baskets, at levels substantially greater than the national average. This finding again supports that a higher level of education in a household is reflective of greater ICT adoption or digital wealth (Allen, 2018). In running the Pearson chi-square test, the 2010 results indicate that there is a statistically significant relationship between the digital basket and the highest level of education of a household member (2010 chi-square with 9 degrees of freedom = 6574,24, p=0,000).

Table 40: Digital Basket by Highest Level of Education Completed by a Household Member, 2010

	None	Primary	Secondary	Tertiary	National
No Digital Basket	18,7 (1,888)	9,8 (0,6464)	1,7 (0,1093)	0,2 (0,1007)	2,7 (0,1147)
Small Digital Basket	67,1 (2,468)	70,6 (1,048)	44,2 (0,4393)	7,4 (0,7119)	44,0 (0,3957)
Medium Digital Basket	12,4 (1,861)	19,2 (0,9116)	43,1 (0,4406)	30,7 (1,424)	39,1 (0,3911)
Large Digital Basket	1,8 (0,9140)	0,4 (0,1383)	10,9 (0,3106)	61,8 (1,520)	14,2 (0,3250)

Source: Own calculations from Income and Expenditure Survey 2010/11

Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

7.5.4 Household Size

The average household size in South Africa on 2010 was 3,85 persons (precisely estimated with a 95,0% confidence interval [3,807, 3,884]). As seen in Annex D, Table 57, nearly half of the South African households had an average of two to four household members, followed by over 32 percent with a household size of five to ten members in 2010. The smallest household has one member and the largest household has 21 members. When disaggregating to look only at the population who live below the poverty line, the household size is larger (5,6 persons) when compared to the average. There are some differences in digital baskets based on household size as seen in Table 41. The largest proportion of one-member households holds small digital baskets, above the national average. Interestingly, South Africans with larger households of over 10 members appear to also have an above national average proportion that possess small digital basket. This finding does not correspond with previous assumptions that larger households would improve digital wealth due to a larger pool of household members to teach and therefore adopt ICT (Barrantes, 2010).

Table 41: Digital Basket by Household Size in South Africa, 2010

	1 member	2-4 members	5-10 members	More than 10 members	National
No Digital Basket	6,9 (0,4605)	2,1 (0,1365)	1,3 (0,1306)	0,0 (0,0000)	2,7 (0,1147)
Small Digital Basket	57,0 (0,9485)	39,8 (0,5657)	43,0 (0,6734)	53,9 (4,111)	44,0 (0,3957)
Medium Digital Basket	29,3 (0,8872)	38,2 (0,5609)	45,8 (0,6867)	45,0 (4,114)	39,1 (0,3911)
Large Digital Basket	6,8 (0,5319)	19,9 (0,5350)	9,9 (0,4719)	1,0 (0,6530)	14,2 (0,3250)

Source: Own calculations from Income and Expenditure Survey 2010/11
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

A recent study in South Africa appears more applicable, showing that an increase in household size can increase likelihood of falling into poverty (Schotte *et al.*, 2018). This may well translate into the need of increased household spending on essential basic commodities for larger households and thereby constrain their ability to afford and expand to larger digital baskets. The one-member household group also have a comparatively larger proportion with no ICTs in their household, compared with other household size groups. For the 2-4 member households, nearly one-fifth (above the national average) have acquired a large digital basket, which makes this group the largest proportion with this basket type compared to other household sizes. In running the Pearson chi-square test, the 2010 results indicate that there is a statistically significant relationship between the digital basket and the household size (2010 chi-square with 9 degrees of freedom = 1387,62, p=0,000).

7.6 Digital Basket: by Locality

This next section looks at two specific locality aspects, the province of the household and the settlement type of the household. As a result of the historical context of South Africa, there remains an element of urban locales as well as larger metropolitan cities to be well resourced as opposed to rural areas where infrastructure was historically poorly funded and digital supply can be less abundant. This section explores the digital baskets within such locality aspects in mind.

7.6.1 Province

As for households by province, there are differences in digital basket ownership based on whether the province has a metropolitan city compared to more rural-based provinces without a main city. As seen in Table 42 and 43, some of the poorest provinces, Limpopo, Northern Cape and Eastern Cape show household proportions with no digital basket (zero ICT assets) that are above the national average of 2,3%. By 2015, there is only one province which has over six percent with no digital basket, namely the Northern Cape. Compared to the other end of the spectrum, the majority of 2015 households with large digital baskets reside in the Western Cape, where it is far above the national average at over 22%, followed by Gauteng at around 15%. In 2015, the rest of the seven provinces are below the national average in households acquiring large digital baskets ranging from 3,5% to 7,8%.

The results are reflective of clear differentials for large digital basket holders who come from provinces with well-resourced metropolitan centres (by GDP). It could be a reflection of the availability of advanced ICT infrastructure and the range of ICT products available in such centres compared to the rural periphery. The rurality and relatively poor localities of provinces appears to play a role in the small size of the digital basket, which can be an indication of ICT supply and infrastructure availability as well as affordability.

Table 42: Household Digital Baskets, by Province, 2010-2015

	Western Cape		Eastern Cape		Northern Cape		Free State	
Year	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**
No digital basket	1,71 (0,2582)	1,52 (0,2641)	6,05 (0,4675)	5,24 (0,4604)	6,05 (0,6972)	6,52 (0,9561)	2,81 (0,4024)	2,33 (0,3744)
Small digital basket	28,52 (0,9532)	36,25 (1,122)	56,71 (1,017)	63,91 (1,065)	42,48 (1,543)	49,01 (1,678)	40,99 (1,228)	52,17 (1,249)
Medium digital basket	41,47 (1,047)	40,10 (1,166)	30,62 (0,9490)	27,37 (0,9932)	39,43 (1,545)	36,69 (1,590)	44,76 (1,236)	38,71 (1,214)
Large digital basket	28,30 (0,9307)	22,13 (1,073)	6,62 (0,4911)	3,48 (0,4252)	12.04 (1,101)	7,78 (0,9743)	11,45 (0,8367)	6,79 (0,6961)
Total	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

Table 43: Household Digital Baskets, by Province, 2010-2015 (cont'd)

	KwaZulu -Natal		North West		Gauteng		Mpumalanga		Limpopo		National (%)	
Year	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**
No digital basket	2,63 (0,2815)	2,69 (0,3008)	2,93 (0,4258)	2,87 (0,4425)	1,25 (0,2088)	0,90 (0,1822)	2,76 (0,3624)	1,60 (0,3777)	3,16 (0,3429)	2,73 (0,4066)	2,74 (0,1175)	2,32 (0,1143)
Small digital basket	48,80 (0,9803)	58,42 (0,9607)	49,96 (1,206)	57,84 (1,322)	36,14 (0,9244)	42,85 (1,027)	46,57 (1,227)	55,69 (1,275)	56,02 (1,014)	55,38 (1,135)	44,11 (0,3974)	50,95 (0,4312)
Medium digital basket	36,80 (0,9487)	33,10 (0,9162)	39,36 (1,160)	33,51 (1,247)	41,66 (0,9660)	41,03 (1,027)	43,25 (1,218)	36,26 (1,219)	36,86 (0,9807)	37,84 (1,106)	39,03 (0,3925)	36,66 (0,4165)
Large digital basket	11,76 (0,7349)	5,79 (0,4574)	7,75 (0,8273)	5,78 (0,6279)	20,95 (0,8912)	15,22 (0,8023)	7,42 (0,6531)	6,45 (0,7162)	3,95 (0,3629)	4,05 (0,4782)	14,12 (0,3245)	10,07 (0,2975)
Total	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%	100,00%

Source: Own calculations from the Income and Expenditure Survey 2010/11 & Living. Conditions Survey 2014/15
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

7.6.2 Settlement Type

Based on settlement type categories used by Statistics South Africa, the household population is disaggregated into four geographical types: urban formal, urban informal, traditional area and rural formal. As illustrated in Table 44, Iin looking at households with no digital basket, the percentage is low across all settlement types, however, there is a slightly above average proportion staying in rural formal settlements. As for 2015, amongst all settlement types and looking at households with no digital basket, rural formal settlements have the highest percentage, over four percent, which is above the national average of 2,3%.

Table 44: Household Digital Basket, by Settlement Type, 2010-2015

	Urban Formal		Urban Informal		Traditional Area		Rural Formal	
	2010	**2015**	**2010**	**2015**	**2010**	**2015**	**2010**	**2015**
No Digital Basket	1,63% (0,1204)	1,42% (0,1198)	4,39% (0,5660)	2,97% (0,4686)	3,97% (0,2272)	3,74% (0,2481)	5,74% (0,8832)	4,58% (0,9201)
Small Digital Basket	32,43% (0,4968)	41,44% (0,5792)	63,53% (1,484)	69,40% (1,466)	60,52% (0,6125)	63,51% (0,6005)	55,84% (2,120)	64,87% (2,134)
Medium Digital Basket	43,47% (0,5388)	41,66% (0,5852)	31,31% (1,441)	26,20% (1,407)	34,32% (0,5973)	31,10% (0,5747)	26,57% (1,847)	24,64% (1,969)
Large Digital Basket	22,47% (0,5011)	15,48% (0,4693)	0,76% (0,2654)	1,43% (0,4305)	1,19% (0,1363)	1,66% (0,1617)	11,85% (1,645)	5,91% (0,8709)
Total	**100,00%**	**100,00%**	**100,00%**	**100,00%**	**100,00%**	**100,00%**	**100,00%**	**100,00%**

Source: Own calculations from the Income and Expenditure Survey 2010/11 & Living Conditions Survey 2014/15
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

Of those households with low digital baskets, the proportion of households who settle within three settlement types - urban informal, traditional area, and rural formal types - are far above the national average of low digital basket ownership in 2010. In comparing the large digital baskets of all settlement types, urban formal settlements had by far the largest proportion of 22,5% in 2010, well above the national average in this period as well as in 2015. Interestingly rural formal have the second highest percentage of large digital baskets in 2010, albeit the percentage was just below the national average. One study aligns with this finding, with female-headed households in tribal rural areas to have better access to some forms of ICTs compared to female-headed households informal urban places (Pashapa & Rivett, 2017). In running the Pearson chi-square test, the 2010 results indicate that there is a statistically significant relationship between the digital basket and settlement type (2010 chi-square with 9 degrees of freedom = 3269,68, p=0,000).

7.7 Digital Basket: by Poverty Indicators

This section provides the descriptive statistics of the household digital basket by various poverty indicators, namely by poverty line, by consumption type, and by income type.

7.7.1 Poverty Line

The study adopts the official South African poverty line, the lower bound poverty line (R501 per month per capita in 2011 prices), and by doing so, the table below compares the digital baskets between households classified as poor and non-poor using headcount figures. As one recalls, Section 5,7 provided description around poor households in South Africa. As seen in Table 45, those identified within the segment of poor households show that the majority adopted a small digital basket, far above the national average. The mean digital basket size for poor households is 2,67 assets [CI: 2,63 – 2,71]). The non-poor have a majority adoption of the medium digital basket and the mean digital basket size for non-poor households is 4,40 [CI: 4,35-4,45].

Table 45: Household (hh) Digital Basket, by Lower Bound Poverty, 2010

	Poor hh (%)	Non-Poor hh (%)	National (%)
No Digital Basket	5,0 (0,2893)	1,9 (0,1182)	2,7 (0,1147)
Small Digital Basket	66,2 (0,7091)	36,6 (0,4460)	44,0 (0,3957)
Medium Digital Basket	28,6 (0,6855)	42,6 (0,4664)	39,1 (0,3911)
Large Digital Basket	0,1 (0,0351)	18,9 (0,4183)	14,2 (0,3250)
Total	100,00%	100,00%	100,00%

Source: Own calculations from the Income and Expenditure Survey 2010/11
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. The lower bound poverty line is applied per household. Standard errors in parentheses.

Poor households also have above national average adoption of a zero-asset digital basket and 0,1% adopting a large digital basket. A non-poor household have the opposite adoption with few holding a zero-asset digital basket and less than a one-fifth of these wealthier households holding a large digital basket, above the national average. The results confirm that there is a clear digital divide between non-poor and poor households, with those of low income are unable to attain a wide range of ICTs compared to those with higher incomes. In running the Pearson chi-square test, the 2010 results indicate that there is a statistically significant relationship between the digital basket and being a poor household (2010 chi-square with 3 degrees of freedom = 2496,03, p=0,000).

7.7.2 Consumption and Income

Aligned to the poverty headcount figures above, the consumption decile in Table 46 below provides further detail into the distributional differences. For example, comparing across deciles, the lowest 2010 consumption decile has the highest percentage of households (just below fourteen percent) with no digital basket, far above the national average of 2.7%. The same lowest decile has the highest percentage of households with small digital basket (just below three-quarters of these households) compared across deciles. As the consumption deciles increase, the number of households with no digital baskets decline. The same pattern occurs with the low digital basket. At the medium digital baskets, the proportions increase until it reaches the 8th decile, and then it decreases in the 9th and 10th decile. The wealthiest decile captures the largest proportion of households with large digital baskets (over three-quarters of households in this decile) compared to other decile groups.

Table 46: South African Digital Basket, by Consumption Decile, 2010

Description	1	2	3	4	5	6	7	8	9	10	National
No Digital basket	13,8 (0,8)	5,3 (0,5)	2,8 (0,4)	1,8 (0,3)	1,7 (0,3)	0,6 (0,2)	0,6 (0,3)	0,2 (0,1)	0,1 (0,1)	0,1 (0,1)	2,7 (0,1)
Small digital basket	74,2 (1,0)	74,1 (1,0)	67,3 (1,2)	61,6 (1,2)	56,6 (1,2)	44,7 (1,2)	33,9 (1,1)	19,9 (1,0)	7,0 (0,6)	2,1 (0,4)	44,0 (0,4)
Medium digital basket	12,0 (0,7)	20,5 (1,0)	29,7 (1,1)	36,3 (1,2)	41,4 (1,2)	53,4 (1,2)	61,3 (1,2)	64,9 (1,2)	49,2 (1,3)	22,1 (1,3)	39,1 (0,4)
Large digital basket	0,0 (0,0)	0,1 (0,1)	0,2 (0,1)	0,3 (0,2)	0,4 (0,1)	1,3 (0,2)	4,1 (0,4)	15,0 (0,8)	43,6 (1,3)	75,7 (1,3)	14,0 (0,3)

Source: Own calculations from Income and Expenditure Survey 2010/11
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

The digital basket results for households by income decile disaggregation (see Annex D, Table 61) are similar to that of the consumption decile disaggregation. Nearly three-quarters of households in the highest income decile have a large digital basket whereas around three-quarters of the lowest and second lowest income decile have either no digital basket or low digital basket. In looking at the estimates, households with low income appear to hold small digital basket and those with high income hold a large digital basket. These results mirror that of an overall asset ownership index in South Africa, which looked at 36 asset types. The index revealed higher asset ownership for wealthier households compared to poorer households. The report states that the top decile of households held nearly three times the number of assets than the lowest decile of households (The World Bank, 2018).

In a closer look at the stratified digital basket households (see Table 47 below), the income decile breakdown at specifically for those with zero-asset digital basket and one-asset digital basket within the household. Of those with zero-asset digital basket, around one-third fall under the lowest income decile, followed by 29,0% of households with the same basket falling under the second decile. As for households with the one-asset digital basket, just under one-quarter fall under the lowest income decile, while another 21,6% fall under the second income decile. In both digital basket cases, the owners of zero- or one-asset digital baskets are in the poorest quintile range of income distribution of households.

Table 47: Zero- & One-Asset Digital Basket by Income Decile, 2010

	% of households with zero ICTs in their digital basket	**% of households with only one ICT in their digital basket**
Income Decile		
1	33,76	24,60
2	29,04	21,60
3	13,13	16,19
4	9,39	12,89
5	5,58	10,05
6	4,64	6,89
7	2,94	4,18
8	0,42	2,44
9	0,63	0,84
10	0,47	0,32
Total	100,00%	100,00%

Source: Own calculations from Income and Expenditure Survey 2010/11
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa.

The findings show that small incomes of households may very well indicate the unaffordability of ICTs or the limits of digital inclusion for a household. The spread of zero- and one-ICT digital baskets also spread to include those in the lower half of the income spectrum. Higher income households show very few participating in society without ICTs.

7.8 Digital Basket: by Basic Welfare Services

This section analyses the digital baskets of households against access to basic welfare services, specifically against five aspects: 1) formal dwelling, 2) access to drinking water on-site, 3) adequate toilet facilities, 4) connection to the main electricity supply and 5) home ownership. As seen under the summary statistics (Annex D, Table 57), the national average show that the majority of the population stay in a formal dwelling, have access to drinking water on-site, have adequate toilet facilities and connect to the main electricity supply. Finally less than a quarter of the household population own their house. As seen in Table 48, of the households who have no digital baskets, having adequate welfare services to the household is far below that of the national average.

Table 48: Basic Welfare Services by Digital Basket, 2010

	No Digital Basket	Small Digital Basket	Medium Digital Basket	Large Digital Basket	Poor	National
Formal Dwelling	73,1 (2,138)	80,8 (0,5170)	91,3 (0,4002)	98,8 (0,2738)	84,5 (0,3407)	87,3 (0,2948)
Access to Drinking water on-site	47,7 (2,140)	61,6 (0,5653)	84,1 (0,4548)	98,4 (0,2889)	53,4 (0,7523)	75,3 (0,3381)
Adequate toilet facility	75,5 (1,825)	89,7 (0,3639)	97,2 (0,2269)	99,9 (0,3380)	87,1 (0,5011)	93,7 (0,1940)
Connection to main electricity supply	51,3 (2,156)	77,3 (0,5263)	96,4 (0,2954)	99,9 (0,0473)	76,9 (0,6740)	87,3 (0,2858)
Home ownership	66,3 (2,161)	69,9 (0,5596)	75,1 (0,5899)	81,8 (0,9479)	85,8 (0,6041)	73,6 (0,3712)

Source: Own calculations from Income and Expenditure Survey 2010/11
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

Of those with large digital baskets, these households are generally above the national average in securing basic welfare services. Amongst those households with a medium digital basket, they appear to match similar averages to the national average.

As for those who are identified as a poor household, in nearly all cases, the household have a majority receiving welfare services, however, they fall below the national average.

In looking at the minority of households who state having no access to the various of the basic welfare services, the majority of households are found to possess a small digital basket. For example, of the households not connected to the main electricity supply, over three-quarters of these households are found to hold a small digital basket. Given the needed access to electricity in order to power many of the digital devices, the result of households with majority small baskets suggests the need to retain only a handful of imperative ICTs given the constraints in seeking alternative electricity mechanisms or strategies in order to manage their ICT. As seen in Table 49, a similar proportion of small digital basket holders are found amongst households identified with no adequate toilet facilities to their home. Amongst those who identify with no home ownership and thereby primarily rent property, the proportion of small digital baskets amongst households is around half of this group, and over one-third hold medium digital baskets. Amongst households with no or low basic welfare services, the majority hold between one to three ICTs, expressing their desire for some form of communication despite their circumstances.

Table 49: Digital Basket by Households Lacking Basic Welfare Services, 2010

	No formal dwelling (%)	No drinking water (%)	No toilet facilities (%)	No electricity connection (%)	No home ownership (%)	Poor (%)	National (%)
No digital basket	5,7 (0,5476)	5,7 (0,3335)	10,4 (0,8570)	10,3 (0,6669)	3,5 (0,2834)	5,0 (0,2893)	2,7 (0,1147)
Small digital basket	66,2 (1,184)	68,2 (0,7198)	72,2 (1,429)	76,4 (1,020)	50,0 (0,8373)	66,2 (0,7091)	44,0 (0,3957)
Medium digital basket	26,8 (1,113)	25,2 (0,6747)	17,3 (1,281)	11,2 (0,8633)	36,8 (0,8154)	28,64 (0,6855)	39,1 (0,3911)
Large digital basket	1,3 (0,3048)	0,9 (0,1659)	0,1 (0,0762)	0,1 (0,0527)	9,8 (0,5260)	0,1 (0,0351)	14,2 (0,3250)
Total	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Source: Own calculations from Income and Expenditure Survey 2010/11

Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

7.9 Limitations of the Descriptive Analysis

From the descriptive statistics of this section, the results primarily report on a particular set of ICT assets and how households fare in terms of digital basket ownership against demographic information. With that said, there is a limitation to the analysis to these aspects, so there remains unanswered questions, such as why households would choose a particular digital basket over others. For example, the digital basket decrease between 2010 to 2015 could be due to external factors such as the overall downturn of the South African economy and increased unemployment, and such conditions therefore the lessen the ability for households to retain certain digital baskets. The changes could also be due to the methodological difference in the questionnaire in 2015, and the overall evolution of domestic technologies, leading to the convergence of particular household ICTs. The understanding of digital baskets amongst various types of household characteristics brings an alternative measure of digital inclusion, yet further research could be done to gain deeper knowledge as to why particular changes took place. It remains out of scope for this empirical examination.

Another limitation of this study is that by using a count as a measure, there can be qualitative differences within baskets that will not be detected by the study. For example, some digital baskets can be composed of completely analog ICT technologies such as a radio, camera and fixed line telephones, which make up a three-asset digital basket, while another three-asset digital basket can be inclusive of more advanced, multifunctional ICTs such as a smart phone, computer and connection to the internet. Despite the digital basket having three ICTs with multiple functionalities, the latter digital basket could have more synergistic features and provide expansive possibilities than compared to analog three-asset digital baskets, yet both types are given the same weight. Finally, the study is limited to the examination of ten ICTs as these are the assets with information collected and remain common across the survey periods. Given the expansive inventory of ICTs, it could be beneficial to expand the list according to the latest domestic innovations. The data issue will be ongoing given the ever changing nature of technology, yet the availability of today's quality data from Statistics South Africa to develop household digital basket analysis makes this research possible. These limitations are acknowledged, and the results still provide a unique first glimpse into the measure of household digital baskets using nationally representative and cross-sectional data.

7.10 Multivariate Results: Examining the Correlates of Household Poverty

This section applies the asset broadening approach by examining whether there is a relationship between the digital basket and poverty reduction. The research question posed at the beginning of the thesis asks ‘is there an association between ICTs and poverty reduction?’ The theory is that the investment in a larger range of household ICTs would lead to a diverse set of use and activities and such action would lead to improved livelihood or earnings and divert from poverty risk. As discussed in detail in the methodology chapter, particularly section 5,8, the multivariate analysis is based on linear probability model regressions with the dependent variable being the natural logarithm of household monthly expenditure from the IES 2010. The independent variable is the number of ICT assets reported as owned by a household and this can range from 0 ICT assets to 10 ICT assets. The models provided in this thesis control for relevant factors. In this regression analysis, four controlling specifications are used to test the association between the ICT asset portfolio and the likelihood of income level changes as additional possible covariates are included. The covariates include, for example, demographic characteristics (e.g. gender of household head, population group of household head, highest education level of any household member and household size), locality (e.g. province and settlement type) and housing / basic services (e.g. electrification, type of dwelling, access to drinking water, and home ownership). These are estimated by Ordinary Least Squares rather than by non-linear probit or logit models because the dependent variable is continuous.

Table 50 presents the results from the Ordinary Least Squares estimations for living in a household depending on the changes of household monthly consumption from the 2010 IES. The sample included all households that fully report on their digital basket.[32] In the baseline model (Model 1), the continuous variable identifying the size of the digital basket was the only explanatory variable and therefore has not been controlled for other household level characteristics.

[32] As mentioned in the Methodology , the number of households (about 426/25328) that show missing data for the digital basket in the IES 2010 is very small. These households have been dropped from the sample.

Table 50: Ordinary Least Squares estimations predicting Natural Logarithm Household Monthly Expenditure, 2010

Dependent: log of monthly hh expenditure		Model 1	Model 2	Model 3	Model 4
ICTs in household					
Total ICT assets (additive index)		0,358***	0,243***	0,226***	0,210***
Demographics					
Gender of hh head	Male		0,106***	0,082***	0,098***
Population group household head	White		0,768***	0,726***	0,724***
	Indian		0,564***	0,512***	0,501***
	Coloured		0,277***	0,230***	0,214***
Maximum complete education by hh member	Primary		0,099**	0,094**	0,103**
	Secondary		0,393***	0,345***	0,342***
	Tertiary		0,942***	0,881***	0,878***
Household size	Number of members		0,052***	0,063***	0,056***
Locality					
Province	Western Cape			0,072***	0,087***
	Eastern Cape			0,047**	0,065***
	Northern Cape			-0,036	-0,049*
	Free State			-0,004	-0,013
	KwaZulu-Natal			0,063***	0,075***
	North West			0,097***	0,099***
	Gauteng			0,221***	0,234***
	Mpumalanga			0,110***	0,101***
Settlement Type	Urban formal			0,273***	0,195***
	Traditional area			0,063***	0,020
	Rural formal			0,079**	0,048
Housing/basic services					
Electricity connection	Yes				0,026
Formal dwelling	Yes				0,216***
Drinking water access	Yes				0,146***
Home ownership	Yes				0,085***
R2		0,5630	0,6382	0,6546	0,6629
N		24902	24902	24902	24811
constant		6,795***	6,448***	6,262***	6,016***

Source: Own calculations from the 2010/11 Income and Expenditure Survey

Notes: The survey data have been weighted to represent population estimates using the population weights provided by Statistics South Africa.

Omitted variables: female household head, African/Black household head, no education completed, Limpopo, urban informal.

***p<0.01, **p<0.05, *p<0.1

The model shows the estimated coefficient (0,358)[33] for the digital basket that indicates the statistical significance in the larger household consumption output as the digital basket incrementally increases in size. In other words, for a one-unit increase in the digital basket in a household, one expects to see about a 35,8% increase in the natural logarithm of household monthly expenditure. The coefficient is positive and statistically significant at the 1% level (p=0.000). As for the constant, the estimation model predicts that individuals with zero ICT assets can expect to have household expenditures for the household of *6,795*. As the R-squared is 56,3%, this shows the variation that the household monthly expenditure can be explained by the digital basket.

In the second regression, Model 2 allows for the intercepts to differ by multiple predictor variables which are demographic in nature. This includes characteristics of the household head (e.g. gender of the household head and population group of the household head), as well as those related to the household (e.g. maximum completed education level by household member and household size). In holding these variables constant, there is a percentage decrease of the coefficient relative to Model 1, yet the positive coefficient confirms the findings that the larger the natural logarithm of the household monthly expenditure, the more likely it is to increase the size of the digital basket. In other words, for every addition unit increase in the digital basket, we expect to see a 24,3% increase in the natural logarithm of monthly household expenditure and statistically significant at the 1% level. The single largest correlate of monthly household expenditure in relation to the digital basket is the highest level of education completed by a household member. Households with at least one member with completed tertiary education (0,942) are far more likely to see increases in natural log of household monthly expenditures compared to those with no members in the household with education. As for gender of the household head, the natural log of monthly household expenditure will be 10,6% higher for the male-headed households than for the female-headed households. all estimations are statistically significant at the 1% level. In looking at population group of household

[33] In order to know what happens to the outcome variable y itself for a one-unit increase in x1, one can interpret the exponentiated regression coefficients, exp(B), since exponentiation is the inverse of logarithm function. (https://stats.idre.ucla.edu/other/mult-pkg/faq/general/faqhow-do-i-interpret-a-regression-model-when-some-variables-are-log-transformed/)

head, households with White headship show a greater likelihood (0,768) to increases in the natural log of monthly household expenditure compared to an African/Black-headed household. Again, it is statistically significant at the 1% level. The household size shows the smallest level of correlate, with each additional household member, one expects to see about a 5,2% increase in the natural log of household monthly expenditures. The variables of this second regression demonstrate some key demographic variables which explain the likelihood of increased natural log of monthly expenditures faced by households.

In the third regression, the estimations allow for the intercepts to differ by two dimensions: a) demographic information and b) locality of households. Model 3 includes all four demographic indicators used in Model 2 as well as the addition of two locality indicators: province and place of residence. In this regression, these additions in controlling for the locality indicators show that the main coefficient remains positive and statistically significant. The coefficient in Model 3 only slightly dropped (0,226) compared to Model 2. With each additional unit within the digital basket, there is a 22,6% increase in the natural logarithm of household monthly expenditures, with demographic and locality dimensions being held constant. Should a household member have completed tertiary education, there is a positive and statistically significant (0,881) to natural log of household monthly expenditure compared to those households with zero members completing any education. The population group of household head again presented strong correlates, specifically White-headed households being more likely to show increases in the natural log of household monthly expenditures than compared to African/Black-headed households. As for province, households residing in Gauteng are more likely (0,221) to have increases in natural log of monthly expenditures compared to those from Limpopo (reference province). Households within the urban formal settlement type have greater likelihood (0,273) to see increases in natural log of monthly expenditures compared to those from the urban informal. The coefficients of gender of household head, and population group of household head are all negative and statistically significant. The household size coefficient remains positive and statistically significant. As for locality, only certain provinces' coefficients are positive and statistically significant (KwaZulu-Natal, Gauteng and Mpumalanga) compared to reference province, Limpopo. The Free State province coefficient is negative and statistically significant.

In the last regression (Model 4), the estimations allow for the intercepts to differ based on the demographic information, locality of household and other welfare services attributes. This multiple regression includes all four demographic indicators and the two locality indicators used in Model 3 as well as four welfare indicators: electrification, dwelling type, access to drinking water, and home ownership. In analysing these additions by controlling for these welfare indicators, the main coefficient drops slightly relative to Model 3, but the main coefficient remains positive (0,210) and statistically significant at the 1% level (p = 0.000). In other words, with each additional unit of within the digital basket, there is a 21,0% increase in the natural logarithm of household monthly expenditures, with the demographic, locality, and welfare dimensions held constant. Similar to Model 3, this regression observes those with tertiary education completion by a household member compared to households with zero completed education, by which there are positive and statistically significant (0,879) to the natural log of household monthly expenditure, the greatest correlate relationship in this model. In controlling for other welfare services, the households residing in formal dwelling are likely to have a log of monthly expenditures which is 21,6% higher than those in non-formal dwellings. Those households with accessible drinking water would also see a 14,6% higher log of monthly expenditure compared to those without access. Finally those with household ownership would see a 8,5% greater log of monthly expenditure versus those without household ownership. All these other welfare relationships are positive and are statistically significant at the 1% level.

Overall, the major factor in the improvement of the natural logarithm of expenditures is the highest completed education level of one of the household members. In other words, households that include at least one member in household who has completed tertiary education are significantly less likely to experience poverty (after controlling for other explanatory variables). The higher level of education relationship shows the importance of investing in further education as a poverty reduction imperative. In particular, this correlate contributes towards recommendations of improvement of school education as well as digital literacy in order for acquired ICTs to be utilised for improving one's livelihood.

From the multivariate analysis presented, one key finding is that, even when holding constant a range of characteristics, each additional unit increase in the digital basket retain a significant positive association to the natural logarithm of household expenditure, a proxy to poverty reduction. I further ran a logit estimation on the odds of living in a poor household (using the lower bound poverty line at 2011 prices). The results, in the Table 51 below, reveal that the odds of being poor are lower (estimated coefficient is -0,063 without controlling for other household characteristics) for each additional unit to the digital basket (and the coefficient is both negative and significant). The results are again supportive of the OLS estimation models presented previously. Model 2 of this logit estimation includes intercepts on household demographics and it again present the odds of being poor to be lower for each additional unit to the digital basket (the coefficient, -0,061, is negative and significant). Model 3 that includes both the demographic intercepts and locality intercepts again present the odds of being poor to be lower for each additional unit to the digital basket (the coefficient, -0,053 is negative and significant). Finally, Model 4, which includes all intercepts into the regression (demographic, locality and household/basic services), the odds of being poor is again presented to be lower for each additional unit to the digital basket, all of which are negative and significant.

The reverse regression was also modelled (in Annex E, Table 62), whereby the digital basket is a function of the natural logarithm of monthly household expenditure. In each of the estimates provided by the four models, the coefficient remains positive and significant. In Model 3, when controlling for demographic and locality indicators, there are some differences on the household size, province (such as the Western Cape and Gauteng having negative signs) and informal settlement type having a positive sign compared to the original regression. These reverse regression models shows: 1) the reverse association as we expected; and 2) that the goodness of fit of the models for explaining the basket is less that the goodness of fit of the model for explaining household expenditure as we had hoped. This means that despite reverse causality, some part of the variation in household monthly expenditure is caused by the digital basket.

Table 51: Logit Estimations Predicting Odds of Poverty Status, 2010

Dependent: poverty status		Model 1	Model 2	Model 3	Model 4
ICTs in household					
Total ICT assets (additive index)		-0,063***	-0,061***	-0,053***	-0,048***
Demographics					
Gender of hh head	Male		-0,070***	-0,058***	-0,060***
Population group household head	White		0,041***	0,066***	0,065***
	Indian		-0,077***	-0,046 ***	-0,038***
	Coloured		-0,085***	-0,033***	-0,025***
Maximum complete education by hh member	Primary		0,083**	0,088***	0,087***
	Secondary		0,002	0,029	0,037**
	Tertiary		-0,001	0,029	0,035*
Household size	Number of members		0,076***	0,071***	0,070***
Locality					
Province	Western Cape			-0,071***	-0,072***
	Eastern Cape			-0,000	-0,010
	Northern Cape			0,017	0,020
	Free State			-0,021	-0,018
	KwaZulu-Natal			-0,035***	-0,040***
	North West			-0,041***	-0,040***
	Gauteng			-0,079***	-0,080***
	Mpumalanga			-0,044***	-0,037***
Settlement Type	Urban formal			-0,044***	-0,046***
	Traditional area			0,022	0,033**
	Rural formal			0,006	0,041**
Housing/basic services					
Connection to Main Electricity	Yes				-0,032***
Formal dwelling	Yes				-0,070***
Access to drinking water	Yes				-0,073***
Home ownership	Yes				0,028***
R2		0,1087	0,3015	0,3233	0,3322
N		24902	24902	24902	24811
constant		0,499***	0,238***	0,279***	0,347***

Source: Own calculations from the 2010/11 Income and Expenditure Survey
Notes: The survey data have been weighted to represent population estimates using the population weights provided by Statistics South Africa.
Omitted variables: female household head, African/Black household head, no education completed, Limpopo, urban informal
***p<0.01, **p<0.05, *p<0.1

An exploratory factor analysis was also conducted which tries to reduce the data and provide further validity of the constructed index. A similar analysis was conducted by Ragnedda *et al.* (2019) using a representative online survey of 868 UK citizens. First, in testing for correlations, the data presents the ten ICTs as correlated, therefore there are relationships between items. In running the Barlett's test, the p-value=0,000, meaning that the result is significant and indicates that there is sufficient intercorrelations to conduct the factor analysis. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy or the KMO is 0,856. As this value is relatively large (as in, over 0,50), this indicates an overall measure of overlap or shared variance between pairs of variables. Items are related, but have unique information to the factors. The data analysis as presented in Table 52 and in running the principal components analysis, there are two eigenvalues with values of 1 or more: the first factor explains 38,1% of the variability of the 10 items and the next factor explains 11,5%, Using the Kaiser (1960) criterion, I retain the first two factors due to their eigen values being 1 or above, as it explains the most variance in terms of the ten ICT items and was appropriate for the factorial solution.

Table 52: Factor loadings of the Digital Basket items

	Factor 1	**Factor 2**
	'accumulated group'	'basic ICTs group'
Internet	0,8062	
Landline telephone	0,7805	
DSTV	0,7288	
Computer	0,65	
Camera	0,6125	
Television		0,7919
DVD player		0,7718
Stereo		0,5038
Mobile phone		0,4951
Radio		0,4232
% variance explained by each factor	38,07	11,48

Source: Own calculations from the 2010/11 Income and Expenditure Survey
Notes: The survey data have been weighted to represent population estimates using the population weights provided by Statistics South Africa.
Kaiser-Meyer-Olkin (KMO) test= 0,856; Bartlett's test, p<0,000; factor loadings less than 0,40 are not shown.

Through this analysis, I provide two factor groups: Factor Group 1 appears to relate to ICTs that are retained by those households ably to retain relatively more expensive ICT assets over time and are able to specific accumulate ICTs that includes: internet (0,80), landline (0,78), satellite (DSTV) (0,73), computer (0,65) and camera (0,61) and thereby labelled 'accumulated group'. Factor Group 2 appears to relate to ICTs of greater accessibility for the majority, affordable ICT assets and they includes the following ICTs: television (0,79), DVD player (0,77), stereo (0,50), mobile phone (0,50) and radio (0,42). This group is labelled as the 'basic ICTs group' as the grouping of ICTs are typically those within a particular affordability range. Crombach Alpha is run for both groups and scores show good internal consistency reliability around 0,8 (Group 1 = 0,8022 and Group 2 = 0,7978).

The constructed digital basket index score were developed using the factor scores. I also run an OLS regression of a natural logarithm of monthly household expenditure as a function of this explanatory variable, the digital basket index score (continuous independent variable) (see Annex E, Table 63). In Model 1, the estimated coefficient (-0,918) for digital basket that indicates the statistical significance in the larger household consumption output as the digital basket score incrementally increases in size. The coefficient is negative and statistically significant at the 1% level (p=0,000). As the R-squared is 35,8%, this shows the variation that the household monthly expenditure can be explained by the digital basket index score. In the other three Models that hold particular intercepts as constant, the coefficients remains negative and statistically significant at the 1% level (p=0,000). The digital basket index score has an average of -0,0609 with the lowest score at -1,558 and highest at 0,2231.

Other studies have used cut-off points to differentiate households, in this case the digital baskets. In Table 53 below, I segmented the households into the digital basket quartiles and calculated the mean digital index score for each group. Amongst households classified as poor, the small and medium digital basket score appear to be above the national average whereas amongst the non-poor households, the large digital basket mean score is found closest to the national average.

Table 53: Mean digital index score by quartile

	N	No digital basket	Small digital basket	Medium digital basket	Large digital basket
National	24902	0,223	0,203	-0,425	-1,338
Poor	6574	0,223	0,215	0,134	-0,846
Non-Poor	18328	0,223	0,195	-0,083	-1,34

Source: Own calculations from the Income and Expenditure Survey 2010/11
Notes: The survey data have been weighted to represent population estimates using the population weights provided by Statistics South Africa.

7.11 Conclusion

In this chapter, I present my research findings of the digital baskets amongst South African households for the time periods between 2010 and 2015, as well as analyse the main research question of whether there is an association between ICTs and poverty reduction. Using multivariate analysis, the novel findings reveal that there is indeed evidence that the relationship of ICTs to poverty reduction is positive and statistically significant. In further qualifying these findings, a unique perspective is gained from the descriptive analysis on the demographics and choices of digital baskets amongst South African households in this five year period. From the findings, a majority of South African households are faced with profound material constraints concerning ICTs. When observing the average count of ICTs in a household's digital basket between 2010 and 2015, there is a clear decrease. The largest proportion of 2015 households held a three-asset digital basket, showing a drop of ownership from a four-asset digital basket of 2010. The smaller digital baskets are found to be growth areas, particularly the one-asset digital basket, which saw the largest growth from 2010 to 2015. In contrast, the larger digital baskets saw declines over the five years, but, those with large digital baskets are relatively small. These digital basket trends could be a consequence of the wider income decreases and a reflection of increased poverty headcounts during the same period. The growing costs of basic commodities can affect discretionary spending, lowering the demand to purchase ICTs and thereby expand the digital basket. The uptake of a smaller digital basket can also come from the technology supply side. Advanced digital devices are converging onto one platform, such as higher end television sets or smart phones, and therefore displace some redundant analog ICTs. This situation is suggested based on the absence of the DVD player within popular digital baskets by 2015 (although the DVD player formed part of the most popular digital basket composition in 2010).

From 2010 to 2015, there was also a slight reduction of zero-asset digital baskets and an increase of the one-asset digital basket, suggesting that households previously with no ICT assets are transitioning to the one-asset digital basket. In other words, those the previously unconnected are now digitally included, and it is mainly through the first time ownership of a mobile phone. In 2015, the single mobile phone was the digital basket composition in the largest proportion of households. The findings also show that a barrier to mobile ownership, high ICT device cost, is being addressed. Of the households with only one mobile phone as their digital basket, the majority of those households had reported their phone value to be between R1 to R400. The result of the low cost mobile phone has thereby allowed households to digitally participate in society. The analysis provides evidence of digital inclusion, in one sense, as many households become first time owners of technology. At the same time, the digital inclusion being based only through owning one device as a digital basket limits the population in taking advantage of the full potential of interconnected ICTs.

Digital basket ownership also varies based on household characteristics, whereby small digital basket ownership appears to harmonise with characteristics that historically follow low-income households. For example, female-headed households had the larger proportion of small digital baskets compared to male-headed households. However, over time, there is a shift of male-headed households from large and medium digital baskets to smaller digital baskets by 2015 more than female-headed households, contributing to a convergence. Other household characteristics such as population group of household head, the highest level education completed by a household member and settlement types also reveal digital basket disparities in both 2010 and 2015, yet previously disadvantaged groups reflect some convergence towards the national average. Again, the convergence may be due to less disadvantaged groups shrinking down their digital baskets over the time period. What is also clear from the most common digital baskets is what is most absent, particularly concerning computers and internet connectivity. The wider group of South African households has low ownership of both, again disabling them from benefiting from the full benefits of ICTs, thereby stifling their opportunities to use such ICTs to improve their livelihood and wellbeing. Finally, in regards to the relationship between ICTs and poverty reduction, the OLS regression analysis reveal a positive and significant relationship. Specifically, with each additional unit of ICT within the digital basket, there is a 21,0% increase in the natural logarithm of household monthly expenditures, with the demographic, locality, and other welfare dimensions held constant. The logit estimation further complement this OLS analysis stating that the odds of being poor are lowered with each additional unit of digital basket.

8 CHAPTER EIGHT: CONCLUSION AND DISCUSSION

8.1 Introduction

> *"Do we want to move into the Fourth Industrial Revolution with leaving half of our population behind? How can we even start talking about all the benefits of the Fourth Industrial Revolution when they're only applicable to half of the population?" Izak Minnaar, South African National Editors Forum (SANEF) (quoted in Bratt (2019))*

The overarching goal of my doctoral research was to further advance the understanding around ICTs and poverty reduction, and specifically within South Africa. By exploring an alternative lens on poverty measures, I argued that broadening a household's assets, particularly new ICTs, can provide relevant insights to human development in contemporary times. Specifically, I undertook the process of examining the Stats SA datasets to analyse the existing ICTs indicators amongst individuals and households in the country. The analysis revealed that the digital basket typically found within a poor household in South Africa were small; yet, there is convergence or gains over time by such households towards the national average. Over the five year period (2010 to 2015), non-poor households were reducing the size of their digital baskets, which was also contributing to an overall reduction of the national average of digital baskets. The study further drew on an empirical association between the digital basket and poverty reduction and the results were found to be positive and significant. In this chapter, I will summarise these key research findings in-depth before outlining the main contributions of the research. The final section of this chapter will then focus on future research, outlining several potential lines of enquiry related to this study.

Research Inquiry and Questions Revisited

In this section, I offer a brief discussion about each of the study's research questions, summarising the aspects of this thesis and offering greater insights to the concept of ICTs, particularly in relation to poor households in South Africa.

8.2 ICTs as Assets

This study's first research question asked whether ICTs can be theoretically constituted as assets, specifically within the context of an enhanced sustainable livelihoods framework (SLF). In a theoretical review of ICTs, these particular goods and services were found to share synergistic characteristics making them distinct from other assets. Specifically, by reviewing ICTs used by households in 2015 (see Chapter 4), it became apparent that many of the physical digital devices rely on a range of non-tangible goods and services to work interchangeably and in order to be most effective. In addition, the proliferation of ICTs is a worldwide phenomenon, and South Africa is no exception to these dramatic changes. Thus, these findings illustrate that not only is there a growing evolution of ICT devices available to households, but the ICT assets needed to use these mainly physical devices must also include digital content, applications, skills and competences and social networks. The interconnected nature of ICTs, as well as the ongoing innovative advancements, illustrate the need to expand the definition of household assets, and include ICTs as its own category, which can be termed the digital basket.

As its own asset category, this thesis also revisited a taxonomy to help group the different types of household ICTs. In Chapter 4, I unpacked an expansive list of ICTs which were available in 2015 and many of which were not conceived ten to 15 years ago. This inventory list is a unique contribution to ICT research, as it supports the argument that ICTs need to be a distinct group of assets. Another contribution made by this study, also in Chapter 4, is disaggregating the household ICT items into groups, specifically four ICT groups, which revisits Warschauer's (2003) ICT taxonomy: 1) physical ICTs, 2) digital content, 3) human resources for ICTs, and 4) social ICT resources for networking. By comparing Warschauer's original list from 2003 to the 2015 list, it becomes apparent that there is an increase in the diversity and evolution of household ICT goods and services in each grouping. Thus, current day ICTs go beyond physical assets and now include non-tangible goods such as human capacity and social networks. In addition, technological convergence over this 12 year period also illustrates a transition from previously analog devices and goods (e.g. radio, books, and so on) to digital forms, all of which can be bundled with other digital devices. Oftentimes, this emergent cross-over blurs the lines of the technological object as well as its ownership rights. The digital basket itself can include unique products, competences, and social connections that are symbiotic and, thus, work together in order to improve a person's quality of life. A possible limitation of this constant influx of converging and new ICTs is the ability to monitor change of household ownership of similar ICTs over time. Nevertheless, these contemporary changes support the need to augment the SLF's current categories of assets by including a unique ICT grouping referred to as the digital basket.

8.3 The Digital Basket

This study's second research question sought to determine what group or sub-groups of ICTs could be identified at a household level to provide a sixth capital dimension, the digital basket? This question's main objective was to apply this study's proposed concept of the digital basket to the South African context. In order to answer this question, I first needed to identify what surveys had suitable ICT indicators to constitute as assets for a digital basket. To do this, I reviewed the ICT indicators in South Africa, which illustrated that the most appropriate ICT indicators to analyse for this study were ICT ownership data from Stats SA. The process I undertook to determine this appropriateness was discussed in the study's methodology chapter (Chapter 5). Specifically, it demonstrates how ten ICT variables were deemed appropriate for the applied analysis and to specifically compose the digital basket between 2010 and 2015. The ICT assets were namely: 1) radio, 2) stereo, 3) television, 4) DVD player, 5) computer, 6) camera, 7) mobile phone, 8) landline telephone, 9) DSTV, and 10) connection to the internet.

Each of these ten individual ICTs were explored in-depth and provided insight into South African's household adoption of ICTs at a nationally representative level. South Africans were clearly shown to own a full range of ICTs, some of which is unevenly distributed, and the ownership of each individual ICT has changed over the ten year period, 2005 to 2015. On the one hand, by 2015, there were some ICTs with near ubiquity levels of ownership for South African households, such as televisions and mobile phones. In other words, almost all of the nation's population now owns mobile phones, and a convergence was found over time, demonstrating that previous mobile phone ownership gap between low income to upper income groups is rapidly narrowing. The same convergence was found with television ownership. Television peripherals such as satellite services (e.g. DSTV) and DVD player ownership also show rapid growth, with 40 to 50% of the population owning these respective goods by 2015. While there is relatively high growth in the uptake of computer ownership and connection to the internet, it was a relatively smaller percentage of ownership compared to, say, mobile phone or television ownership. Computer ownership and internet connection by previously disadvantaged population groups remain divergent compared to the non-poor class, resulting in these assets remaining out of reach when compared to the rest of the population.

While this thesis utilised ten ICT assets to assess South Africa's digital basket, this work also noted the extensive review process to arrive to this point, which can be acknowledged as a unique contribution. Currently, there are few tools to help households monitor their digital basket portfolio. Yet, there is demand (certainly in legal terms) to improve this information because of ICTs' increasing value in contemporary times (Everplans, nd; Uniform Law Commission, 2015). In South Africa, Stats SA have issued a few surveys, namely the General Household Survey, the Income and Expenditure Survey, and the Living Conditions Survey that collect information on a handful of ICT ownership. Research ICT Africa also collects ICT ownership data over time. The international 1999 Classification of Individual Consumption according to purpose (COICOP) was also reviewed for its household consumption indicators, but the list is outdated and although I reviewed the draft 2018 version of COICOP in this thesis, the latest version had yet to be released and applied. All of these survey tools had lacked appropriate indicators that matched Warschauer's 2003 taxonomy, namely the inclusion of digital content, human capital for ICTs and social capital for ICTs. In this case, there was an opportunity to apply the digital basket for analysis that was derived from ten ICT assets. This analysis is a starting point to unpack the contemporary digital basket in a household. This analysis acknowledges the limitations of the current survey tools and data to monitor the growing diversity of ICT assets. While the development of such indicators are ongoing, as are the opportunities to measure its value, there will remain an under-representation of ICTs owned and valued by households.

8.4 Applying the Enhanced Sustainable Livelihoods Framework

This study's third research question focused on the context of the digital basket, specifically seeking to understand the internal and external factors that can influence ownership, particularly amongst the most poor. The digital basket of a South African household is affected by the larger structural contexts, and through the SLF, chapter six illustrated in detail this complexity of South African society. Specifically, many South Africans can be exposed to long term vulnerabilities, despite the country being categorised as medium income. South Africa has fared relatively well in some development outcomes (such as health and living standards), however, vulnerabilities stem from high levels of income poverty (with recent figures of poverty headcount at 40,0% at 2015 prices). Yet, at the same time, South Africa has relatively advanced telecommunication infrastructure and an abundance of digital devices and services available in urban areas. As for under resourced areas of South Africa, large network operators are hesitant to extend their telecommunication infrastructure to reach sparsely inhabited rural areas (Song, 2019a) and there are clear connectivity and affordability gaps in rural areas (Rey-Moreno *et al.*, 2016). This digital divide by infrastructure provision is a worrying gap that can be exacerbated due to the high levels of vulnerabilities in the country.

Innovation and price have seen a wider selection of ICT equipment at the hands of households, ensuring choice in communication platforms. The entry of affordable computing devices are helping to expand a household's digital basket. Yet, this study has found low levels of adoption of computers and internet by the poor, which could be attributed to internet price issues. The Competition Commission recently ruled that broadband costs in South Africa are exorbitantly high (Competition Commission of South Africa, 2019), affecting the poor's ability to adopt ICTs. Therefore, ICT policies need to be developed in the country to continue to foster competition on broadband data and decrease prices to make these services affordable for everyone. From the social side, the widespread access to ICT services are helping many gain employment digitally, as well as are changing the landscape of community-based centres to include internet access.

Through this review of South Africa's internal and external factors, it is clear that a household's digital basket is affected by factors of the overall economic climate, the fragility of household poverty, and the policies of competition and regulation for ICTs. For the poor to truly benefit from using ICTs to improve their well-being, external aspects, such as the country's socio-economic and development strategy, would need to be complemented with the country's ICT policy. For instance, redistributed resources, such as social welfare grants, health care and improved educational facilities, could be implemented hand-in-hand with telecommunication infrastructure and regulation of lower connectivity prices in rural and remote villages. This application of the SLF at a national level is a contribution of this thesis, as it provides a holistic and nuanced understanding about the relationship between ICTs and poverty reduction in the South African context.

8.5 The Relationship between ICTs and Poverty Reduction in South Africa

This study's final question sought to understand the relationship between levels of ICT ownership and poverty reduction in the South African context, specifically questioning if there was an association between ICTs and poverty reduction. While some studies have applied asset indices around poverty (e.g. Lund & Cois, 2018), previous research using an ICT composite index against poverty indicators is limited. Thus, with asset broadening as a poverty reduction strategy, this study sought to address the paucity of research connecting ICTs to poverty reduction in the South African context. As illustrated in-depth in Chapter 7, the levels of ICTs can be measured using the digital basket approach. By using this approach, as this study's findings illustrate, on average, South Africans retain a small digital basket over time. More specifically, a typical household in 2010 had an average of 3,96 ICT assets, which, by 2015, had declined by 0,31 percentage points. The most common asset count was a four-asset digital basket held by approximately 20% of South African households in 2010. This asset count decreased to a smaller three-asset digital basket by 2015. Amongst the poor households, nearly two-thirds own small digital baskets between one to three ICT assets, which is far below the national average. When examining the composition of digital baskets in-depth, a singular mobile phone was found to be the popular digital basket in 2015. During the same period, zero-asset digital baskets had slightly declined. Those who were previously unconnected are now digitally included through a single mobile phone ownership. This same one-asset digital basket household, however, remains out of the realm of taking full advantage of the synergistic nature of complementary ICTs when they can only afford one mobile phone and not be able to expand their digital basket.

On the other side of the spectrum, a proportion of households possessing large digital baskets had overall declines by 2015 when compared to 2010. The demographic pattern of large digital basket ownership appears to mimic the characteristics of non-poor households, mainly those who are male-headed households, have one household member with tertiary education, reside in an urban area, and are at the top quintile of the income distribution. This result signalled a few concerns: 1) that the ability to gather a portfolio of digital “wealth” would likely influence those who were historically on the wealthy end of spectrum in income distribution; and 2) the decrease of large digital baskets demonstrates that households were indeed experiencing the income crunch, which had resulted in a reduction of discretionary spending and digital basket ownership. There may well be some technological advances between 2010 to 2015 with households finding better value with less ICTs, such as high quality smartphones and digital television sets.

The ownership of a wide variety of ICTs complements the idea that the multiplicity of assets within household allows for a wide diversity of digital activities, some of which may help individuals draw together income or livelihoods, both directly and indirectly, and thereby lower the incidences of poverty. Yet, major concerns are raised in this thesis that the most poor remain unable to take advantage of such possibilities, due to their zero- or one-asset digital basket portfolio. Thus, this thesis sought to test the association of ICTs and poverty. Through all models analysed, estimations revealed that with each additional unit included in the digital basket, the natural logarithm of monthly household expenditures was positive and significant. In other words, with each additional unit of the digital basket, the odds lowered the chances of living in a poor household. One characteristic which highly influenced the model was the completion of tertiary education by a household member. Thus, these results illustrate that ICT ownership in the South African context has a positive relationship to poverty reduction.

These models again fall within the context of larger holistic framework of the enhanced sustainable livelihoods framework, where the advancement of South

African digital infrastructural landscape and policy as well as high levels of poverty and inequality are all considered. Should the high vulnerabilities that currently exist in the country continue to persist and the ICT system fail to meet the needs of the poor, it can only be assumed that there will be limitations to this positive relationship between ICT ownership and poverty reduction in the future.

8.6 Contribution of this Research

This thesis makes several contributions to research on information and communication technologies for development, and, specifically within the field of development studies. Firstly, it contributes to the theoretical discussions about asset broadening as an alternative approach to poverty reduction, specifically considering ICTs as valued assets that can be referred to as a digital basket. The digital basket concept was expanded by applying the Warschauer (2003) taxonomy of ICTs. Secondly, this study made a contribution to these fields by comparing the Warschauer (2003) taxonomy of household ICTs to a 2015 updated list, which provided further articulation of certain technological trends—namely the evolving ICT assets portfolio held by households. Thirdly, within the SLF, this study makes a contribution to these fields by suggesting the concept of the digital basket to augment the former pentagon of asset resources and thereby extended it to include a sixth capital. This concept, the digital basket, as demonstrated in this thesis, can enable deeper exploration of ICTs within a household setting. Finally, using South Africa as a case study, this thesis illustrated how this theoretical concept and enhanced sustainable livelihoods framework could be applied to advance current understandings of ICT ownership and its relationship to poverty. It did this by conducting an in-depth national level analysis of South Africa's ICT systems. Second, by conducting a multivariate analysis using the digital basket to poverty reduction, it illustrated how household ownership of ICT has a positive and significant relationship to poverty reduction in South Africa. Thus, in summary, this study has provided a novel approach that can be applied to contribute to the current debate on ICTs and poverty. In the following sections, I outline the limitations of this study and how these limitations can potentially be addressed in future studies.

8.7 Limitation of the Research

While this study's findings have contributed to current research on the ICTs in the field of development studies, I also recognise and have mentioned throughout the thesis that this study has several limitations. One methodological limitation is the current choice ICT variables that are used in existing surveys and therefore what list of ICTs can be used for the digital basket. A review of surveys was conducted and critiqued in detail above as well as in Chapter 5. For example, I acknowledged the limits of physical ICTs as well as the absence of ICT indicators under the category of human capital for ICTs (e.g. digital skills and literacy) and social capital for ICTs. In a future that involves the emergence of digital work, understanding the human capital factor is a necessity. Creating indicators to monitor the changes of ICT competences is an imperative in order to meet the new demand of digital work (World Bank, 2019).

Also part of the under-counted ICT asset indicators is the process of calculating the un-monetised value of new ICTs that are created by the household or individual themselves. The ability for households to take their intangibles, such as digitalised photos, videos or other creative artifacts and transform them to make new sets of ICTs, and, in some cases, increase their income stream is unprecedented. Thus, these types of uncollected data could underestimate the true value of ICTs held by a household.

There was also the emergent limitation about the classification of newer ICTs that possess a multitude of functionality. For instance, some durable ICT goods are difficult to compare over time, and present a possible limitation for the future of tracking ICT indicators amongst households. Firstly, some technologies have become more distinct in their classification. For example, the computer is now being disaggregated to certain types such as a tablet, laptop and desktop computer. In other cases, some surveys are beginning to distinguish the difference between a smart phone, a feature phone, and a basic mobile phone. Secondly, through the means of convergence, domestic technologies can be found with a range of qualities that were previously found as separate individual ICTs. For example, one mobile smart phone can dial calls, but it can also include a radio (e.g. via Spotify application), and television (e.g. via Netflix application), as well as host numerous software applications owned by the user. The change of qualities, for example, within a mobile phone can be undetected and changes to a digital basket size may not expand accordingly because some ICT qualities that address multiple ICTs can all be found within one mobile phone. The ongoing digital evolution of “smart home” devices may blur the lines of digital versus analog goods and new ICT items can make any ICT inventory list outdated.

The extent of this ICT expansion and qualitative evolution is unpredictable and is relatively unique to ICTs; therefore, it will draw challenges in analysing changes of the same ICT over time. Identifying these salient limitations on measurement can contribute to future discussions about ICT classification, and highlights the importance in systematically capturing the domestic ICT innovations as they evolve year after year. Despite the limitation to the ICT ownership variables currently available, the opportunity remains to analyse the available ICT assets, allowing for cross-section comparison or trend reporting over time and provides an appropriate starting point for applying the digital basket.

8.8 Further Research and Recommendations

This study has provided a starting point for research on digital baskets that can be expanded and extended in several productive directions. First, in relation to the quantitative data contained in the IES and LCS survey, further analysis can be done on specific segments of the population, such as the digital baskets' composition and count for rural and urban households as well as female- and male-headed households. Further investigation of this sub-sample could reveal important and nuanced insights about the relationship between ICTs and poverty. Future research can also explore the quantitative research of digital baskets in association with other development outcomes such as employment. Testing this association may yield advanced insights and evidence around ICTs and its interaction with South Africans.

Another area of future research is to potentially expand the digital basket list applied in this study by including other ICT assets, such as human resources for ICTs, digital content, or social ICTs. However, this expansion could also draw on other available national level datasets that have implemented some of the recommended indicators set out by the ITU. This type of application of the digital basket would further expand its conceptualisation. Further, in relation to household ICTs, future technological products will continue to be designed and conceived. For example, the concept of the Internet of Things (IoT) illustrates the future of digital integration within household ICTs. Manufacturers are investing heavily on embedding microchips within various household goods that are designed to collect and analyse human behaviour and ultimate make the product more intuitive by design (Bloom, 2019). Thus, it could be useful to monitor the changing ICTs at the household level as a reflection of society shifts.

Further research could be done conducted to understand the value or the asset of personal digital data. The ability to better articulate its value would provide a way forward as to how it could be included in a household's digital basket. Personal data can be processed through machine learning and artificial intelligence that can produce important metadata for, say, decision making purposes. In this sense, such data can be of high value to a company or government. Yet the value derived from digital identities is not explicit, nor has it been well understood; therefore, further research could help to clarify this asset as well as identify elements regarding how a person could potentially be exploited for this asset. Worryingly, the opacity around personal property rights and value of personal digital data is becoming problematic, as third parties access and use this data without transparency and users' consent. While outside of the scope of this study, the larger debate about digital data used for surveillance, particularly of vulnerable persons and communities, is also worrying for democracies and the right to human dignity (Latonero, 2019). Such issues require further thought with regards to the legal implications of assets, particularly those raised around fiduciary access. Such implications include privacy, data breaches or fraud, and property rights. Privacy includes the procedures necessary to provide access to one's own personal information as well as clarity to how user-generated data is currently used, distributed, and how consent is provided. Digital theft is another emerging trend when certain digital platforms are compromised and personal digital identities can be used fraudulently to access information and bank accounts. Such liabilities can impact the effective use of a household's digital basket, and may particularly have some negative implications due to increased ICT ownership. Overall, the digital basket inventory list could continuously be updated as a reflection of these prolific changes in and understanding of household ICT products. Once there is maturity in understanding the product or service, they could be considered for measure in an applied digital basket analysis.

On the other end of the spectrum, further research on what interventions or mechanisms can target and support poor households in broadening their assets will also be beneficial, as such work will help these households facilitate the expansion of their digital baskets. Encouragingly, this study's findings have illustrated that only a minority of households within the South African context are extremely digitally excluded and own no ICTs. In some cases, issues of affordability and structural issues within society keep these households from ever being connected. In these market failure cases, public facilities and targeted initiatives could help even out the playing field and facilitate their ability to digitally participate. In addition, public libraries and community centres remain imperative venues to assist in providing free computer and internet access to those cannot afford these ICTs. Intermediaries can assist the 'less digitally savvy' to continue to smooth out technically difficult tasks, like creating online profiles or digital identities, for the end user. Further research that monitor such targeted interventions and their contributions to expanding a household's digital basket could yield improved understanding of these issues.

Finally, in the South African context, digital services for accessing public resources cannot be the sole method of access given that this thesis' findings illustrate that there is a proportion of South African households that have no ICT assets, may only have one mobile phone, and there is no systematic knowledge currently gathered of households' digital skills and abilities. Based on this finding, it becomes evident that off-line platforms must remain in place for all, such as paper-based forms for job applications or for medical assistance, to ensure the poor or those with no digital means have equitable entry to work or hospital services. The digital eco-system remains flawed for those with low socio-economic status, as well as those with disabilities, older persons, or asylum seekers, as they are the many who are precluded from society's participation in the digital age. Further investigations into the nuanced balance of online and offline mechanisms for the poor and other targeted populations to access public resources will also help improve our understanding of the overall asset portfolio of the poor.

Specifically for South Africa, some of the existing ICTs are obtainable for the poor because of their retention of analog characteristics. However, these older television and its respective peripherals need to transition as government rolls out the digital migration of television broadcasting. For example, households would need to convert to new digital equipment (in this case, a set-top box or decoder). While government has plans to subsidise decoders for those earning less than R3 200 a month (Republic of South Africa, 2015), the affordability factor may still deter or exclude many from adopting and gaining this new ICT asset. Monitoring the changes that come with digital migration will be important to understand the changes of broadening a household's digital basket and whether digital exclusion is further extended to the most poor.

8.9 Final Conclusion

This thesis was conceptualised based on a personal observation that South Africans were rising in the tide of owning ICTs, specifically mobile phones, yet it was perplexing to see this fast adoption happening during a period of rising levels of poverty and unemployment. Thus, to further understand this observation, I designed a study to explore the digital basket in order to determine the extreme complexities of South Africa's contemporary society. It has highlighted that past apartheid racial and economic divisions are far from being resolved by investigating the relationships between ICTs and the multi-dimensions of poverty in South Africa. Yet through multivariate analysis, the research findings share evidence that the relationship of ICTs to poverty reduction is positive and statistically significant. Through the descriptions above, there are clear openings for the most poor to be further digitally included, albeit with the possession of a small digital basket. There is also the elite few who possess a full digital basket, however over the 2010 and 2015 time period, there were shrinking digital baskets for the wealthier or the historically advantaged.

In reviewing the existing literature, and through this applied research, I suggest a rethink of ICTs within poverty research, in which researchers further explore the development outcomes that can be enhanced from meaningful ICT use. To do this, I suggest reshaping research into poverty to include conceptualisation of ICTs as an unique asset or capital. Using the Sustainable Livelihoods Framework to study the national context of ICTs, this thesis illustrated new ways in which researchers can make sense of ICTs—through a human development lens. Finally, as some of the prices of ICTs become relatively affordable for the poor, providing internet and supplying ICTs is not enough to improve the lives of the most vulnerable. Deliberate measures are needed to support lower income households in broadening their digital basket, such as support for digital skills, local language content, and social integration. It will be through this emerging concept that recent developments around poverty measurement will improve the world's understanding of human deprivation in the global South and ultimately bring contemporary realities to the eradication of extreme poverty as set within the United Nations' Sustainable Development Goals.

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ANNEX A: ICT indicators

Table 54: Selected Indicators on ICTs by Household and Individuals

Indicator number	Description of indicator
HH1	Proportion of households with a radio
HH2	Proportion of households with a TV
HH3	Proportion of households with telephone
HH4	Proportion of households with a computer
HH5	Proportion of individuals using a computer
HH6	Proportion of household with Internet
HH7	Proportion of individuals using the Internet
HH8	Proportion of individuals using the Internet, by location
HH9	Proportion of individuals using the Internet, by type of activity
HH10	Proportion of individuals using a mobile cellular telephone
HH11	Proportion of households with Internet, by type of service
HH12	Proportion of individuals using the Internet, by frequency
HH13	Proportion of households with multichannel television, by type
HH14	Barriers to household Internet access
HH15	Individuals with ICT skills, by type of skills
HH16	Household expenditure on ICT
HH17	Proportion of individuals using the Internet, by type of portable device and network used to access the Internet
HH18	Proportion of individuals who own a mobile phone
HH19	Proportion of individuals not using the Internet, by type of reason

Source: Adapted from Partnership on Measuring ICT for Development (2016)

ANNEX B: Additional Information on the Variables for Multivariate Analysis

Table 55: IES 2010 Reference Variables and the Derived Variables

IES Question #	Question	Indicator	For use in regression analysis	Original variable choices from IES 2010
Demographic Characteristics				
1.2	Derived from Q1.2 if the respondent selects the gender of head of household	Gender of household head	1. Male, 0. Female	1. Male, 2. Female
1.3	Derived from Q1.3 of respondents select population group of household head	Race of household head	1. African/Black, 2. Coloured, 3. Indian/Asian, 4. White	1. African/Black, 2. Coloured, 3. Indian/Asian, 4. White
2.1	The highest level of education successfully completed	Derive a variable: Highest level of education by a household member	1. No education completed, 2.Primary, 3. Secondary, 4. Tertiary	1. Primary includes: 00. Grade 0, 01, Grade 1, 02. Grade 2, 03. Grade 3., 04. Grade 4, 05. Grade 5, 06. Grade 6, 07. Grade 7
				2. Secondary includes: 08. Grade 8, 09 Grade 9, 10. Grade 10, 11. Grade 11, 12., Attended but not complete grade 12, 13. Grade 12, 14. Grade 12 with uni exeption, 15. Certificate with less than Grade 12, 16. Diploma with less than Grade 12, 18. Diploma with Grade 12
				3. Tertiary includes: 19. Bachelors degree 3 years, 20. Bachelors degree 4. years+, 21. Postgrad diploma, 22. Honours degree, 23. Higher degree (Masters).
				0. None includes: 24. No schooling. 25. out of scope (<5 years), 26. Other, 27. Don't know. 99 unspecified
				*Note. Above are individual responses, then derive a variable on the highest education level of one member within a household
derived	Household size	Household size	Continuous variable	This represents the total number of persons per household, range from 1 - 21 (continued)

IES Question #	Question	Indicator	For use in regression analysis	Original variable choices from IES 2010
Locality Characteristics				
derived	South African provinces	Province	1.Limpopo, 2. Eastern Cape, 3. Northern Cape, 4. Free State, 5. KwaZulu-Natal, 6. North West, 7. Gauteng, 8. Mpumalanga, 9 Western Cape	1. Western Cape, 2. Eastern Cape, 3. Northern Cape, 4. Free State, 5. KwaZulu-Natal, 6. North West, 7. Gauteng, 8. Mpumalanga, 9 Limpopo
derived	Type of settlement where the dwelling unit is situated	Settlement Type	1. Urban informal, 2. Urban formal, 3. Traditional area, 4. Rural formal	1. Urban formal, 2. Urban informal, 3. Traditional area, 4. Rural formal
Other welfare dimensions				
4.1	Indicate the type of main dwelling and other dwelling that the household occupies on this piece of land	Formal Dwelling	1. Yes, 0. No	1. Yes includes: 01. Dwelling/house or brick/concrete block structure, 02. Traditional dwelling/hut, 03. Flat or apartment in a block of flats, 04. Cluster house in security complex, 05. Townhouse, 06. Dwelling/house in backyard
				2. No includes: 07. Informal dwelling/shack in backyard, 08. Informal dwelling not in backyard. Og. Informal settlement or farm, 09 Room on a property like granny flat, 10. Caravan/Tent, 11. Other
4.5	What is this household's main source of or access to water for drinking and for other use?	Access to drinking water on-site	1. Yes, 0. No	1. Yes includes: 01. Piped (tap) water in dwelling, 02. Piped (tap) water on-site, 03. Borehole on-site, 04. Rain-water tank on-site.
				2. No includes: 05. Neighbour's tap, 06. Public Tap, 07. Water-carrier/tanker, 08. Borehole off-site, (continued)

IES Question #	Question	Indicator	For use in regression analysis	Original variable choices from IES 2010
				09. Flowing water/stream, 10. Stagnant water/dam, 11. Well, 12. Spring. 13. Other
				Note. Some non-response
4.9	Does this household have a connection to the main electricity supply?	Connection to main electricity supply	1. Yes, 0. No	1. Yes, 2. No
5.2	Is the main dwelling…	Home Ownership	1.Yes , 0. No.	1. Own includes: 1. Owned and fully paid off, 2. Owned but not yet fully paid off, financed by mortgage bond, 3. Owned, but not yet fully paid off, financed by another type of loan
				2. Rent includes: 4. Rented as part of employment contract, 5. Rented not as part of employment contract,
				3. Occupied for free includes: 6. Occupied rent-free as part of employment contract, 7. Occupied rent-free not part of employment contract, 8. Occupies as a boarder/lodger. 9. Other
				Note. Some non-response

Source: Income and Expenditure Survey 2010, adapted by author

ANNEX C: National Poverty Lines, South Africa

Table 56: Inflation-Adjusted National Poverty Lines, South Africa, 2006-2018

Year	Food Poverty Line (FPL)	Lower-bound Poverty Line (LBPL)	Upper-bound Poverty Line (UBPL)
2006	219	370	575
2007	237	396	613
2008	274	447	682
2009	318	456	709
2010	320	466	733
2011	335	501	779
2012	366	541	834
2013	386	572	883
2014	417	613	942
2015 (April)	441	647	992
2016 (April)	498	714	1077
2017 (April)	531	758	1138
2018 (April)	547	785	1183

Source: Adapted from Statistics South Africa (2018b)
Notes: Per person per month in Rands

ANNEX D: Additional Descriptive Analysis for Digital Basket

Table 57: 2010 South Africa Descriptive Statistics

% of n	2010 South African population Percentage (%) n=25 328	se
Household Size		
1	17,7	0,3021
2-4	49,2	0,3996
5-10 members	32,1	0,3664
More than 11	1,0	0,0779
Highest Level of Education Completed by Household Members		
Primary	10,0	0,2253
Secondary	79,5	0,3364
Tertiary	8,8	0,2711
None	1,7	0,0871
Formal Dwelling		
Yes	87,2	0,2918
No	12,7	0,2918
Access to Drinking Water On-site		
Yes	75,3	0,3351
No	24,7	0,3351
Adequate Toilet Facilities		
Yes	93,7	0,1926
No	6,3	0,1926
Connection: Main Electricity Supply		
Yes	87,3	0,2825
No	12,7	0,2825
Home Ownership		
Own	73,5	0,3691
Rent	20,1	0,3346
Occupy for Free	6,3	0,2155

Source: Own calculations from the Income and Expenditure Survey 2010/11 and Living Conditions Survey 2014/15

Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in the adjacent column.

Table 58: Selected Compositions of the Digital Basket, 2010

# of ICTs in Digital Basket	ICT Asset Combination (selected)	Sample hhs	Number of est. hh (millions)	% of hh
0 ICTs	no ICTs	843	0,35	2,7% (0,1175)
1 ICT	1 cellphone	1764	0,93	7,1% (0,2039)
	1 radio	452	0,19	1,5% (0,0847)
	1 TV	201	0,08	0,6% (0,0482)
2 ICTs	1 radio, 1 cellphone	1672	0,89	6,9% (0,2027)
	1 TV, 1 cellphone	1276	0,63	4,9% (0,1683)
	1 radio, 1 TV	236	0,09	0,7% (0,0569)
3 ICTs	1 TV, 1 DVD, 1 cellphone	2380	1,22	9,4% (0,2269)
	1 radio, 1 TV, 1 cellphone	1617	0,79	6,1% (0,1840)
	1 stereo, 1 TV, 1 cellphone	364	0,16	1,2% (0,0742)
4 ICTs	1 radio, 1 TV, 1 DVD player, 1 cellphone	2796	1,46	11,3% (0,2507)
	1 stereo, 1 TV, 1 DVD, 1 cellphone	1047	0,51	4,0% (0,1498)
	1 TV, 1 DVD player, 1 cellphone, 1 DSTV	385	0,18	1,4% (0,0908)
5 ICTs	1 radio, 1 stereo, 1 TV, 1 DVD, 1 cellphone	941	0,47	3,6% (0,1460)
	1 radio, 1 TV, 1 DVD, 1 cellphone, 1 DSTV	564	0,28	2,1% (0,1196)
	1 stereo, 1 TV, 1 DVD, 1 cellphone, 1 DSTV	285	0,15	1,1% (0,0898)
6 ICTs	1 radio, 1 stereo, 1 TV, 1 DVD, 1 cellphone, 1 DSTV	319	0,14	1,1% (0,0717)
	1 radio, 1 TV, 1 DVD, 1 cellphone, 1 landline, 1 DSTV	149	0,08	0,6% (0,0595)
	1 radio, 1 stereo, 1 TV, 1 DVD, 1 cellphone, 1 landline,	115	0,05	0,4% (0,0424)
7 ICTs	1 radio, 1 stereo, 1 TV, 1 DVD, 1 computer, 1 cellphone, 1 DSTV	128	0,06	0,5% (0,0556)
	1 radio, 1 TV, 1 DVD, 1 computer, 1 camera, 1 cellphone, 1 DSTV	95	0,05	0,4% (0,0446)
	1 radio, 1 stereo, 1 TV, 1 DVD, 1 cellphone, 1 landline, 1 DSTV	91	0,05	0,4% (0,0564)
8 ICTs	1 radio, 1 stereo, 1 TV, 1 DVD, 1 computer, 1 camera, 1 cellphone, 1 DSTV	151	0,09	0,7% (0,0750)
	1 radio, 1 stereo, 1 TV, 1 DVD, 1 computer, 1 cellphone, 1 landline, 1 DSTV	84	0,05	0,4% (0,0508)
	1 radio, 1 TV, 1 DVD, 1 computer, 1 camera, 1 cellphone, 1 landline, 1 DSTV	62	0,04	0,3% (0,0474)
9 ICTs	1 radio, 1 TV, 1 DVD, 1 computer, 1 camera, 1 cellphone, 1 landline, 1 DSTV, 1 internet	136	0,11	0,8% (0,0944)
	1 radio, 1 stereo, 1 TV, 1 DVD, 1 computer, 1 camera, 1 cellphone, 1 landline, 1 DSTV	127	0,09	0,7% (0,0854)
	1 radio, 1 stereo, 1 TV, 1 DVD, 1 computer, 1 camera, 1 cellphone, 1 DSTV, 1 internet	98	0,07	0,5% (0,0670)
10 ICTs	1 radio, 1 stereo, 1 TV, 1 DVD, 1 computer, 1 camera, 1 cellphone, 1 landline, 1 DSTV, 1 internet	348	0,30	2,3% (0,1622)

Source: Own calculations using Income and Expenditures Survey 2010/2011

Notes: The data are weighted. Standard errors in parentheses.

Table 59: Selected Compositions of the Digital Basket, 2015

# of ICTs in Digital Basket	ICT Asset Combination (selected)	Sample hhs	Number of est. hh (millions)	% of hh
0 ICTs	no ICTs	598	0,36	2,3% (0,1143)
1 ICT	1 cellphone	2030	1,51	9,7% (0,2507)
	1 radio	227	0,14	0,9% (0,0734)
	1 TV	235	0,14	0,9% (0,0757)
2 ICTs	1 radio, 1 cellphone	959	0,64	4,1% (0,1620)
	1 TV, 1 cellphone	2081	1,43	8,8% (0,2339)
3 ICTs	1 TV, 1 DVD, 1 cellphone	1607	1,14	7,3% (0,2210)
	1 radio, 1 TV, 1 cellphone	1992	1,32	8,4% (0,2266)
	1 TV, 1 DSTV, 1 cellphone	595	0,38	2,4% (0.1263)
	1 stereo, 1 TV, 1 cellphone	487	0,28	1,8% (0,0939)
4 ICTs	1 radio, 1 TV, 1 DVD player, 1 cellphone	1260	0,88	5,7% (0.1959)
	1 stereo, 1 TV, 1 DVD, 1 cellphone	481	0,30	1,9% (0,1065)
	1 radio, 1 TV, 1 cellphone, 1 DSTV	502	0,31	2,0% (0,1133)
	1 TV, 1 DVD player, 1 cellphone, 1 DSTV	661	0,40	2,6% (0,1225)
5 ICTs	1 radio, 1 stereo, 1 TV, 1 DVD, 1 cellphone	214	0,14	0,9 (0,0819)
	1 radio, 1 TV, 1 DVD, 1 cellphone, 1 DSTV	628	0,40	2,5% (0,1278)
	1 stereo, 1 TV, 1 DVD, 1 cellphone, 1 DSTV	389	0,24	1,5% (0,0987)
6 ICTs	1 radio, 1 stereo, 1 TV, 1 DVD, 1 cellphone, 1 DSTV	227	0,15	1,0% (0,0844)
	1 radio, 1 TV, 1 DVD, 1 computer, 1 cellphone, 1 DSTV	240	0,18	1,1% (0,0947)
	1 stereo, 1 TV, 1 DVD, 1 computer, 1 cellphone, 1 DSTV	170	0,11	0,7% (0,0687)
7 ICTs	1 radio, 1 stereo, 1 TV, 1 DVD, 1 computer, 1 cellphone, 1 DSTV	126	0,09	0,6% (0,0557)
	1 radio, 1 TV, 1 DVD, 1 computer, 1 camera, 1 cellphone, 1 DSTV	63	0,06	0,4% (0,0567)
	1 radio, 1 TV, 1 DVD, 1 computer, 1 cellphone, 1 DSTV, I internet	63	0,06	0,4% (0.0591)
8 ICTs	1 radio, 1 stereo, 1 TV, 1 DVD, 1 computer, 1 cellphone, 1 DSTV, 1 internet	48	0,05	0,3% (0,0555)
	1 radio, 1 stereo, 1 TV, 1 DVD, 1 computer, 1 camera, 1 cellphone, 1 DSTV	51	0,05	0,3% (0,0534)
9 ICTs	1 stereo, 1 TV, 1 DVD, 1 computer, 1 camera, 1 cellphone, 1 landline, 1 DSTV, 1 internet	65	0,06	0,4% (0,0608)
	1 radio, 1 stereo, 1 TV, 1 DVD, 1 computer, 1 camera, 1 cellphone, 1 DSTV, 1 internet	61	0,06	0,4% (0,0590)
10 ICTs	1 radio, 1 stereo, 1 TV, 1 DVD, 1 computer, 1 camera, 1 cellphone, 1 landline, 1 DSTV, 1 internet	152	0,18	1,1% (0,1108)

Source: Own calculations using Living Conditions Survey 2014/2015

Notes: The data are weighted. Standard errors in parentheses.

Table 60: Households in South Africa by Digital Basket Type, 2010-2015

	2010			2015			
	Sample size	**Number of households (millions)**	**% of households**	**Sample size**	**Number of households (millions)**	**% of households**	**Relative Change 2010-2015**
No Digital Basket	843	0,36	2,70 (0,1147)	598	0,36	2,32 (0,1143)	-0,38%
Small Digital Basket	11 510	5,79	43,98 (0,3957)	11 739	7,97	50,95 (0,4312)	+6,97%*
Medium Digital Basket	9 844	5,15	39,12 (0,3911)	8 208	5,74	36,66 (0,4165)	-2,46%*
Large Digital Basket	2 705	1,87	14,20 (0,3250)	1 659	1,58	10,07 (0,2975)	-4,13%*
Total	24 902	13,16	100,00%	22 204	15,65	100,00%	

Source: Own calculations from the Income and Expenditure Survey 2010/11 and Living Conditions Survey 2014/15
* Denotes a significant change in the percentage of households estimate difference between 2010/11 and 2014/15 at the 95 percent level of confidence
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

Table 61: South African Digital Basket, by Income Decile, 2010

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**National**
No digital basket	9,3 (0,7)	7,9 (0,6)	3,6 (0,4)	2,6 (0,4)	1,5 (0,3)	1,3 (0,3)	0,8 (0,2)	0,1 (0,1)	0,2 (0,1)	0,1 (0,1)	2,7 (0,1)
Low digital basket	69,6 (1,1)	66,1 (1,1)	64,9 (1,1)	60,8 (1,2)	56,0 (1,2)	48,7 (1,3)	37,2 (1,2)	25,5 (1,1)	9,1 (0,7)	3,1 (0,5)	44,1 (0,4)
Medium digital basket	20,4 (1,0)	25,1 (1,0)	30,7 (1,1)	35,4 (1,2)	40,9 (1,2)	46,7 (1,3)	55,3 (1,3)	58,5 (1,3)	52,6 (1,4)	24,7 (1,3)	39,1 (0,4)
Large digital basket	0,7 (0,3)	0,8 (0,2)	0,8 (0,2)	1,2 (0,3)	1,5 (0,3)	3,4 (0,5)	6,8 (0,7)	15,9 (0,9)	38,1 (1,3)	72,1 (1,4)	14,1 (0,3)
Total:	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Source: Own calculations from the Income and Expenditure Survey 2010/11
Notes: The survey data are weighted to represent population estimates using the population weights provided by Statistics South Africa. Standard errors in parentheses.

ANNEX E: Additional regression analysis

Table 62: OLS estimations predicting the Digital Basket (Reverse regression) for South African households, 2010

Dependent: Total ICT assets (additive index)		Model 1	Model 2	Model 3	Model 4
Level of Poverty					
Log of Household monthly Expenditure		1,574***	1,160***	1,110***	0,996***
Demographics					
Gender of hh head	Male		0,169***	0,163***	0,221***
Population group household head	White		1,415***	1,395***	1,422***
	Indian		0,943***	0,859***	0,841***
	Coloured		0,452***	0,357***	0,352***
Max completed edu by hh member	Primary		0,024	0,026	0,053
	Secondary		0,527***	0,476***	0,452***
	Tertiary		1,340***	1,299***	1,300***
Household size	Number of members		-0,005	0,007	-0,013***
Locality					
Province	Western Cape			-0,082	0,016
	Eastern Cape			-0,390***	-0,219***
	Northern Cape			-0,478***	-0,442***
	Free State			-0,020	-0,000
	KwaZulu-Natal			-0,148***	0,031
	North West			-0,101**	-0,058
	Gauteng			-0,209***	-0,037
	Mpumalanga			-0,110**	-0,062
Settlement Type	Urban formal			0,357***	0,210***
	Traditional area			0,056	-0,058
	Rural formal			-0,090	0,042
Housing/basic services					
Electricity Connection	Yes				0,854***
Formal dwelling	Yes				0,081**
Drinking water access	Yes				0,115***
Home ownership	Yes				0,481***
R2		0,5630	0,6078	0,6139	0,6360
N		24902	24902	24902	24811
constant		-8,958***	-6,422***	-6,059***	-6,324***

Source: Own calculations from the Income and Expenditure Survey 2010/11

Notes: The survey data have been weighted to represent population estimates using the population weights provided by Statistics South Africa.

Omitted variables: female household head, African/Black household head, no education completed by hh member, Limpopo, urban informal

***p<0.01, **p<0.05, *p<0.1

Table 63: Principal Components Analysis for estimations predicting National Logarithm monthly household expenditures, 2010

Dependent: log of monthly hh expenditure		Model 1	Model 2	Model 3	Model 4
Level of Poverty					
PCA score of digital basket		-0,918***	-0,464***	-0,422***	-0,392***
Demographics					
Gender of hh head	Male		0,147***	0,111***	0,136***
Population group household head	White		1,149***	1,048***	0,984***
	Indian		0,892***	0,767***	0,699***
	Coloured		0,383***	0,299***	0,262***
Maximum complete education by hh member	Primary		0,157	0,145***	0,151***
	Secondary		0,654***	0,555***	0,508***
	Tertiary		1,374***	1,238***	1,158***
Household size	Number of members		0,070	0,083***	-0,067***
Locality					
Province	Western Cape			0,062**	0,100***
	Eastern Cape			-0,021	0,049**
	Northern Cape			-0,119***	-0,114***
	Free State			0,006	-0,001
	KwaZulu-Natal			0,060***	0,117***
	North West			0,104***	0,112***
	Gauteng			0,226***	0,275***
	Mpumalanga			0,124***	0,119***
Settlement Type	Urban formal			0,403***	0,255***
	Traditional area			0,082***	0,035
	Rural formal			0,070*	0,067*
Housing/basic services					
Electricity Connection	Yes				0,238***
Formal dwelling	Yes				0,255***
Drinking water access	Yes				0,197***
Home ownership	Yes				0,213***
R2		0,3581	0,5547	0,5869	0,6147
N		24902	24902	24902	24811
constant		8,099***	6,945***	6,679***	6,128***

Source: Own calculations from the Income and Expenditure Survey 2010/11
Notes: The survey data have been weighted to represent population estimates using the population weights provided by Statistics South Africa.
Omitted variables: female household head, African/Black household head, no education completed by any hh member, Limpopo, urban informal
***p<0.01, **p<0.05, *p<0.1

ANNEX F: Review of ICT expenditure items in South Africa

Table 64: Analysis of ICT expenditure items within LCS 2015 & IES 2010

	LCS 2015		IES 2010
#	**Description**		**Description**
	Expenditure for education and training		**Expenditure for education and training**
1	---Short courses less than 6 months (project management, computer classes, etc)	1	---Computer certification public schools
2	---Laptops, MP3 players, tablets for educational purposes	2	---Computer certification public schools - Grant
		3	---Computer certification private institutions
		4	---Computer certification private institutions - Grant
		5	---Other, specify (e.g. junior laptops, training and adult education) for public institutions
		6	---Other, specify (e.g. junior laptops, training and adult education) for private institutions
		7	---Other, specify Grant (e.g. junior laptops, training and adult education) for public institutions
		8	---Other, specify Grant (e.g. junior laptops, training and adult education) for private institutions
	Reading Material and Stationary		
	Reading material		
3	---Newspapers (including online subscription)		
4	---Magazines and periodicals (including online subscription)		
5	---Books/eBooks		
	Value of Musical instruments, audio visual equipment and accessories		**Value of Musical instruments, audio visual equipment and accessories**
	Audio visual equipment		**Audio visual equipment**
6	---Televisions sets, decoders (e.g. M-net, PVR, Explorer, etc) video recorders, Blu-ray and DVD player	9	---Television sets, decoders, video recorders/DVD players/recorders
7	---Aerials and satellite dishes	10	---Aerials and satellite dishes
8	---Television licenses	11	---Television licenses
9	---Subscription to satellite TV channels (e.g. DStv, TopTv, etc)	12	---Subscription to pay-TV channels
10	---Television rental	13	---Television rental
11	---Rent decoder, DVD, video equipment and tapes	14	---Rent for decoder, video equipment, DVDs and tapes (continued)

	LCS 2015		IES 2010
#	**Description**		**Description**
12	---Radios, tape recorders, compact disk players, sound system, MP3 players, iPods and similar equipment (including for cars)	15	---Radios (incl. motor car radios), tape recorders, compact disk players and similar equipment)
13	---Movies and music	16	---Diskettes, CDs, flash disks and other consumable goods
14	---Video games CDs/DVDs/Blu-ray/downloaded apps (include downloaded games: X-box, play-station, and Wii games)	17	---Magnetic tapes (excl. software and video games incl. pre-recorded and unrecorded music tapes)
		18	---Disks for photographic and cinematographic use
		19	---Compact disks/CDs (excl. software and video games; incl. pre-recorded and unrecorded disks)
		20	---DVDs (excl. software and video games, incl. pre-recorded and unrecorded DVDs)
		21	---VCDs (excl. software and video games; incl. pre-recorded and unrecorded VCDs)
		22	---Other musical instruments, sound equipment and accessories
15	---Repairs to sound equipment and accessories	23	---Repairs and service charges for musical instruments, sound equipment and accessories
	Recreation, entertainment and Sport		**Recreation, entertainment and Sport**
16	---Cameras, video cameras, projectors and flashes	24	---Cameras, video cameras, projectors and flashes
17	---Film development and photo prints	25	---Film development and photoprints
18	---Gaming consoles (including X-box, play-station, and Wii)	26	---Toys and games, video games (incl. software games)
19	---Repairs and service charges for recreation, entertainment equipment	27	---Repairs and maintenance services to recreation, entertainment and sports equipment
20	---Fees for lessons related to recreation, entertainment	28	---Fees for lessons connecting with recreation, entertainment and sport
	Computer and telecommunication equipment		**Computer and telecommunication equipment**
	Expenditure on computer and telecommunication equipment		**Expenditure on computer and telecommunication equipment**
21	---Personal desktop computers (excluding laptops)	29	---Personal desktop computers (excl. laptops)
22	---Laptops/notebooks	30	---Laptops/Notebooks/Tablets
23	---Tablets/mini tablets (e.g. iPad, galaxy tabs, etc.)		
24	---eReader	31	---Palm tops (continued)

	LCS 2015		IES 2010
#	**Description**		**Description**
25	---Calculators	32	---Calculators
	Computer parts, accessories and consumables		**Computer parts, accessories and consumables**
26	---Computer parts (e.g. motherboard, CPU, memory/RAM, graphics card, hard drives)	33	---Computer parts (e.g. motherboard, CPU, memory/RAM, graphics card, hard drives)
27	---Flash disks, SD cards and portable external hard drives	34	---Flash disks and portable external hard drives
28	---CDs/DVDs/Blu-ray discs (blanks)	35	---CDs/DVDs/Blu-rays
29	---Other consumables (e.g. toners, ink cartridges)	36	---Other consumables
30	---Software (e.g. Microsoft suite, downloaded applications for tablets/smart phones)	37	---Software (excl. games, play-stations, etc)
31	---Printer/scanners/copiers	38	---Printers/scanners/copiers
32	---Modems and routers	39	---Modems
	Communication equipment		**Communication equipment**
33	---Cellular phones (pre-paid hand set)	40	---Cellular phones
34	---Telephones and cordless telephones	41	---Telephones, cordless telephones, motor telephones
35	---Fax and telephone answering machines	42	---Fax machines and telephone answering machines for household purposes
36	---Cellular phone accessories (e.g. chargers, pouches, earphones, prepaid sim-cards, etc)		
37	---Insurance on cellular phones	43	---Pagers
38	---Two-way radios	44	---Two-way radios
39	---Repairs to computer and communication equipment (including printers/scanners/copiers, cellular phones, etc)	45	---Repairs of computers and communications equipment
		46	---Parts and upgrading of computer
	Communication for household purposes		**Communication for household purposes**
	Landline telephone fees		**Landline telephone fees**
40	---Telephone installation and rental: installation/connection to the network	47	---Connection to the network for a landline
41	---Telephone installation and rental: rental/contract	48	---Telephone installation
42	---Calls from household landline	49	---Rental landline
43	---Calls from public phones	50	---Call from public phones
44	---Private calls from place of work	51	---Private calls (continued)

	LCS 2015		IES 2010
#	**Description**		**Description**
45	---Value Added Tax (VAT). Only if account is available	52	---Value Added Tax (VAT). Only if telephone account is available
		53	---Value Added Tax (VAT) on calls. Only if telephone account is available
	Cellular phone fees		**Cellular phone fees**
46	---Rental/contract	54	---Rental cellphone
47	---Calls (including airtime)	55	---Calls (incl. phone cards)
48	---Value Added Tax (VAT). Only if account is available		
49	---Connection to the network (include initiation fees)	56	---Connection to the network for a cellphone
50	---Bundles (data, SMS, MMS, BIS)		
	Internet fees		**Internet fees**
51	---Subscription	57	---Internet subscription
52	---Mobile device, modem (e.g. 3G, Wi-Fi)		
53	---ADSL (including service provider fees)		
54	---Other (e.g. place of work, internet cafes)	58	---Other internet related costs
	Other		
55	---Other (e.g. telegrams, scanning, printing, copying, faxing, laminating, typing of CV, etc)		

Source: Income and Expenditure Survey 2010/11 and Living Conditions Survey 2014/15, adapted by author

ANNEX G –Analysis of COICOP & its respective ICT expenditure items

The proposed COICOP restructuring would take place mainly in two categories: Information and Communication (Division 08) and Recreation, Sport and Culture (09), given their interrelated consumption products. Of recent, the proposed change is to replace the COICOP 1999 Division 08 title from 'Communications' to the 2019 COICOP 'Information and Communication' and to move certain Division 09 ICT items to this newly titled Division 08 (United Nations, 2018)

Another major recommendation is to move from the 1999 four-digit system to a 2019 five-digit system. The following Division 8 information and communication sub-categories are suggested:

1) information and communication equipment (08.1),
2) software (excluding games) (08.2), and
3) information and communication services (08.3).

In comparison between the 1999 current template and 2018 draft version, there are new sub-classes around mobile equipment (e.g. smartphones, tablets, smartwatches, accessories, apps, other software, mobile communication services, Internet access provision and streaming services). Other 1999 categories have largely expanded to group-related goods together such as all repair and rental of ICTs are grouped together as are peripheral equipment. There are also separate groups for unrecorded recording media (08.1.5.0) and pre-recorded audio-visual media (09.5.2.0).

In addition, certain items are found to lean towards recreational purposes, yet they provide forms of communication. Selected Division 09 Recreation and Culture sub-categories that include ICTs such as:

- cameras (09.1.1.1),
- accessories for photographic and cinematographic equipment (09.1.1.2)
- video game computers, game consoles, game apps and software (09.2.1.1),
- hire and repair of photographic and cinematographic equipment and optical instruments (09.4.1.0),
- rental of game software and subscription to online software (09.4.3.1),
- audio-visual media (09.5.2.0),

- photographic services (09.6.3.0) and
- electronic versions or internet subscriptions of educational text books, other books, newspapers, magazines and periodicals (09.7).

Finally, in a full review of the proposed COICOP changes, several items fall outside of Division 08 and 09, which could be classified as ICTs and found at the end of the table. This includes:

- security/surveillance cameras (under 05.2.9 Other small electric household appliances) and
- education such as on-line tutoring (10.5.0.1 – Tutoring),
- language courses in classroom, on line, in form of software or audio tapes; and information and technology courses (e.g. learning how to use a specific software) (under 10.5.0 – Other education not defined by level).

Table 65: COICOP ICT expenditures, 1999-2018

2018	Description	Type of Resource	1999
08 INFORMATION AND COMMUNICATION			**08 COMMUNICATION / 09 RECREATION AND CULTURE**
08.1 Information and communication equipment			
08.1.1 Fixed telephone equipment	**08.1.1.0 Fixed telephone equipment** Includes: - telephones, radio-telephones, telefax machines, telephone-answering machines and telephone loudspeakers Excludes: - telefax and telephone-answering facilities provided by personal computers (08.1.3.1)	Physical	**08.2.0 - Telephone and telefax equipment** Includes: - purchases of telephones, radio-telephones, telefax machines, telephone-answering machines and telephone loudspeakers; - repair of telephone and telefax equipment Excludes: - telefax and telephone-answering facilities provided by personal computers (09.1.3) (continued)

2018	Description	Type of Resource	1999
08.1.2 Mobile telephone equipment	**08.1.2.0 Mobile telephone equipment** Includes: - mobile telephone handsets, including devices with several functions - smart phones	Physical	**Not exist**
08.1.3 Information processing equipment	**08.1.3.1 Computers, laptops and tablets** Includes: - desktop computers and laptops; - tablets; Includes also: - telefax and telephone-answering facilities provided by personal computers; Excludes: - computer software packages such as operating systems, applications, languages, etc. (08.2.0.0); - video game software, video game computers and consoles (09.2.1.1); - removable media containing books, dictionaries, encyclopaedias, foreign language trainers, multimedia presentations, etc. in the form of software (09.7.1);	Physical	**09.1.3 - Information processing equipment** Includes: - personal computers, visual display units, printers and miscellaneous accessories accompanying them - computer software packages such as operating systems, applications, languages, etc. - calculators, including pocket calculators - typewriters and word processors Also includes: - telefax and telephone-answering facilities provided by personal computers Excludes: - pre-recorded diskettes and CD-ROMs containing books, dictionaries, encyclopaedias, foreign language trainers, multimedia presentations, etc. in the form of software (09.1.4) - video game software (09.3.1) - video game computers that plug into a television set (09.3.1) - typewriter ribbons (09.5.4) - toner and ink cartridges (09.5.4) - slide rules (09.5.4) (continued)

2018	Description	Type of Resource	1999
08.1.3 Information processing equipment **(**cont'd)	**08.1.3.2 Peripheral equipment and its consumable components** Includes: -printers, scanners, monitors, projectors, augmented reality (AR) and virtual reality (VR) head mounts, modems, routers, network switches and the like, keyboards, mice, digitizers; - typewriters and word processors (device); - toner and ink cartridges, laser printer drums, typewriter ribbons; - calculators, including pocket calculators; -web camera;	Physical	**09.1.3 - Information processing equipment** Includes: - personal computers, visual display units, printers and miscellaneous accessories accompanying them - calculators, including pocket calculators - typewriters and word processors; **09.5.4 Stationery and drawing materials** Includes: - toner and ink cartridges;
08.1.4 Equipment for the reception, recording and reproduction of sound and vision	**08.1.4.0 Equipment for the reception, recording and reproduction of sound and vision** Includes: - television sets, video cassette players and recorders, digital video recorders, DVD players, Blu-ray players, Ultra HD Blue-ray players, streaming boxes, television aerials of all types; - radio receivers (radio sets, digital radio sets, internet radio sets, satellite radio sets, car radios, radio clocks, two-way radios, amateur radio receivers and transmitters); - portable and non-portable CD players; - portable and non-portable sound players; - stereo equipment and CD radio cassette recorder; - turntables, tuners, amplifiers, cassette decks, microphones and speakers, DJ equipment, karaoke systems;	Physical	**09.1.1 - Equipment for the reception, recording and reproduction of sound and picture** Includes: - television sets, video cassette players and recorders, television aerials of all types; - radio sets, car radios, radio clocks, two-way radios, amateur radio receivers and transmitters; - gramophones, tape players and recorders, cassette players and recorders, CD-players, personal stereos, stereo systems and their constituent units (turntables, tuners, amplifiers, speakers, etc.), microphones and earphones. Excludes: - video cameras, camcorders and sound-recording cameras (09.1.2) (continued)

2018	Description	Type of Resource	1999
08.1.4 Equipment for the reception, recording and reproduction of sound and vision (continued)	- audio and video systems for cars; - set-top boxes, satellite receivers, IPTV receivers, television converter boxes; - digital media players; -headphone, earplugs, and wireless/Bluetooth headsets;		
08.1.5 Unrecorded recording media	**08.1.5.0 Unrecorded recording media** Includes: - CDs (R and RW); - DVDs (R and RW); - Blu-ray discs (R and RE); - video cassettes; -audio tapes, cassettes, DAT; - external hard drives and solid state disks, NAS (network attached storage); - USB keys / flash drives - SD Cards, Compact Flash, etc. - magnetic data tapes; - other magnetic recording media; - other optical recording media; - other recording media (Phase-change recording media, holographic recording media, molecular recording media); Excludes: -recorded recording media (09.5.2 and 09.7.1)	Physical	**09.1.4 - Recording media** Includes: - records and CDs; - pre-recorded tapes, cassettes, video cassettes, diskettes and CD-ROMs for tape recorders, cassette recorders, video recorders and personal computers; - unrecorded tapes, cassettes, video cassettes, diskettes and CD-ROMs for tape recorders, cassette recorders, video recorders and personal computers; - unexposed films, cartridges and disks for photographic and cinematographic use Also includes: - pre-recorded tapes and CDs of novels, plays, poetry, etc.; - pre-recorded diskettes and CD-ROMs containing books, dictionaries, encyclopaedias, foreign language trainers, multimedia presentations, etc. in the form of software; - photographic supplies such as paper and flashbulbs; - unexposed film the price of which includes the cost of processing without separately identifying it; (continued)

2018	Description	Type of Resource	1999
08.1.5 Unrecorded recording media (cont'd)			Excludes: - batteries (05.5.2); - computer software packages such as operating systems, applications, languages, etc. (09.1.3); - video game software, video game cassettes and video game CD-ROMs (09.3.1); - development of films and printing of photographs (09.4.2);
08.1.9 Other information and communication equipment and accessories	**08.1.9.1 Other information and communication equipment** Includes: - baby monitors; -smartwatches; -fitness trackers and other wearable devices, such as smart glasses that do not work without a smartphone or tablet; -e-book readers;	Physical	Not exist
	08.1.9.2 Other information and communication accessories Includes: - chargers, batteries for information and communication equipment, cables, power banks, docking stations, covers, cases, cradles, mounts; -computer components: e.g. processors, internal hard drives, and solid-state drives, motherboards, memory, DVD drives, hard drives.	Physical	Not exist
08.2 Software (excluding games)			
08.2.0 Software	**08.2.0.0 Software** Includes: - computer software packages, such as operating systems, applications, programming languages, etc.	Digital/social	**Not exist** (continued)

2018	Description	Type of Resource	1999
08.2.0 Software (cont'd)	Includes also: -software subscriptions and use of online software; -apps Excludes: - video game software (09.2.1.1); -removeable media containing books, dictionaries, encyclopaedias, foreign language trainers, multimedia presentations, etc in the form of software (09.7.1.1).		
08.3 Information and communication services			
08.3.1 Fixed communication services	**08.3.1.0 Fixed communication services** Includes: - installation and subscription costs of personal telephone equipment; - telephone calls from a private line or from a public line (public telephone box, post office cabin, etc.); - local, regional, national and international calls; - telephone calls from hotels, cafés, restaurants and the like;	Social	**08.3.0 - Telephone and telefax services** Includes: - installation and subscription costs of personal telephone equipment; - telephone calls from a private line or from a public line (public telephone box, post office cabin, etc.); telephone calls from hotels, cafés, restaurants and the like; - telegraphy, telex and telefax services; - information transmission services; - hire of telephones, telefax machines, telephone-answering machines and telephone loudspeakers Also includes: - radio-telephony, radio-telegraphy and radiotelex services (continued)

2018	Description	Type of Resource	1999
08.3.2 Mobile communication services	**08.3.2.0 Mobile communication services** Includes: - local, regional, national and international calls, including voice and video calls; - messages, including voice, written (SMS) and image (MMS) messages, subscription fees for other messengers; - additional calling features, such as voice mail and call display, whether sold separately or bundled with the mobile local service plan; -voice and messaging mobile phone plans that also include limited data; Mobile phone voice, text, and data plans; -other mobile telephone services. Incudes also: -cost of telephone equipment if included in subscription costs; -mobile phones included in a package, i.e. prepaid or post-paid packages, generally tied to a specific operator for a certain period of time if not separately priced	Social	**Not exist**
08.3.3 Internet access provision services and net storage services	**08.3.3.0 Internet access provision services and net storage services** Includes: - Internet access services provided by operators of wired, wireless or satellite infrastructure; - cloud storage, file hosting and web hosting services - subscriptions for email services Includes also: - activation and installation fees and monthly rate	Physical	**Not exist** (continued)

2018	Description	Type of Resource	1999
08.3.4 Bundled telecommunication services	**08.3.4.0 Bundled telecommunication services** Includes: - telephony/Internet/television packages - any combination of telecommunication package	Social	**Not exist**
08.3.5 Repair and rental of information and communication equipment	**08.3.5.0 Repair and rental of information and communication equipment** Includes: - repair of all information and communication equipment - rental of telephones, telefax machines, telephone-answering machines and telephone loudspeakers - rental of wireless telephone equipment - rental of internet access provision equipment - rental of telegraphy, telex, telefax, radiotelephony, radiotelegraphy and radiotelex equipment	Physical	**08.2.0 - Telephone and telefax equipment** Includes: - repair of telephone and telefax equipment **09.1.5 - Repair of audio-visual, photographic and information processing equipment** Includes: - repair of audio-visual, photographic and information processing equipment Also includes: - total value of the service (that is, both the cost of labour and the cost of materials are covered) Excludes: - separate purchases of materials made by households with the intention of undertaking the repair themselves (09.1.1), (09.1.2) or (09.1.3) (continued)

2018	Description	Type of Resource	1999
08.3.9 Other information and communication services	**08.3.9.1 TV and radio licences, and fees** Includes: - TV and radio licenses - subscription to cable TV, satellite TV, IPTV, and Pay-TV	Physical	**09.4.2 - Cultural services** Services provided by: – hire of equipment and accessories for culture, such as television sets, video cassettes, etc.; – television and radio broadcasting, in particular licence fees for television equipment and subscriptions to television networks; – services of photographers such as film developing, print processing, enlarging, portrait photography, wedding photography, etc.
	08.3.9.2 Subscription to audio-visual content, streaming services and rentals of audio-visual content Includes: - streaming services (film and music); - rental, download or subscription of CDs, video tapes, DVDs, Blu-ray discs, software (excluding game software) -subscription to cable TV, satellite TV, IPTV, and Pay-TV; -online videorecorder services (web-based DVR services); -VOD services; -subscription to TV via decoder and rental of decoders. Excludes: - rental or subscription of video game software and online games (09.2.1.1) -audio-visual content purchased online for immediate downloading (09.5.2.0).	Digital	**Not exist** (continued)

2018	Description	Type of Resource	1999
	08.3.9.9 Other information and communication services Includes: - telegraphy, telex and telefax services -radiotelephony, radiotelegraphy and radiotelex services; - VOIP (Voice over Internet Protocol) provision (nomadic use); -rental/lease fees for a decoder; -software installation services	Digital/Physical (decoder rental, software installation)	**08.3.0 - Telephone and telefax services** Includes: - telegraphy, telex and telefax services; - information transmission services;
09 RECREATION AND CULTURE			
09.1 Recreation durables			
09.1.1 Photographic and cinematographic equipment and optical instruments	**09.1.1.1 Cameras** Includes: - still cameras, movie cameras and sound-recording cameras, film and slide projectors, enlargers and film processing equipment - video cameras, including camcorders, action cameras Includes also: -separate material purchased by households with the intention of undertaking the repairs themselves Excludes: -dash cameras (07.2.1.3); -web cameras (08.1.3.2)	Physical	**09.1.2 - Photographic and cinematographic equipment and optical instruments** Includes: - still cameras, movie cameras and sound-recording cameras, video cameras and camcorders, film and slide projectors, enlargers and film processing equipment, accessories (screens, viewers, lenses, flash attachments, filters, exposure meters, etc.);
	09.1.1.2 Accessories for photographic and cinematographic equipment Includes: -screens, viewers, lenses (including zoom lenses), lenses, flash attachments, filters, exposure meters, etc;	Physical	**Not exist** (continued)

2018	Description	Type of Resource	1999
	-photographic developer and photographic paper Includes also: -separate material purchased by households with the intention of undertaking the repairs themselves -photographic and cinematographic films; -camera specific batteries and chargers.		
09.2 Other recreational items and equipment			
09.2.1 Games, toys and hobbies	**09.2.1.1 Video game computers, game consoles game apps and software** Includes: -video game computers; -video game consoles; - gamepads, joysticks, racing wheels and other accessories for video gaming - electronic games - video game software (for game consoles, computers, tablets, smartphones, download and on any media, including CD-ROMs, cartridges, DVDs, Blu-rays, flash drives, etc.) Excludes: - video-game subscriptions and rentals (09.4.3.1).	Physical (equipment)/ Digital (software)	**09.3.1 - Games, toys and hobbies** Also includes: - video game software; - video game computers that plug into a television set; - video game cassettes and video game CD-ROMs; (continued)

2018	Description	Type of Resource	1999
09.4 Recreational Services			
09.4.1 Rental and repair of photographic and cinematographic equipment and optical instruments	**09.4.1.0 Rental and repair of photographic and cinematographic equipment and optical instruments** Includes: - rental of photographic and cinematographic equipment and optical instruments - repair of photographic and cinematographic equipment and optical instruments. Excludes: separate purchases of materials made by households with the intention of undertaking the repair themselves (09.1.1.2)	Physical	**Not exist**
09.4.3 Hire and repair of games, toys and hobbies	**09.4.3.1 Rental of game software and subscription to online games** Includes: - rental of game software (games on CDs, DVDs, Blu-ray discs, etc); -subscription of game software and apps -subscription to play online games (or streaming).	Social	**Not exist**
	09.4.3.2 Rental and repair of games, toys and hobbies Includes: - rental and repair of video game consoles and other equipment to play games	Physical	**Not exist** (continued)

2018	Description	Type of Resource	1999
09.5 Cultural goods			
09.5.2 Audio-visual media	**09.5.2.0 Audio-visual media** Includes: - recorded tapes, CD-ROMs, DVDs, Blu-rays, gramophone records, flash drives, for reproduction of sound and picture material. - downloads of music and films Excludes: - Software (other than video game software) (08.2.2.0) - video games and game apps (09.2.1.1) - recorded tapes and CDs, DVDs, Blu-ray, flash-drives of educational books (09.7.1) - recorded tapes and CDs, DVDs, Blu-ray, flash-drives of books, novels, plays, poetry, dictionaries, encyclopaedias, etc (09.7.1).	Digital	**09.1.4 - Recording media** Includes: - records and CDs; - pre-recorded tapes, cassettes, video cassettes, diskettes and CD-ROMs for tape recorders, cassette recorders, video recorders and personal computers; Also includes: - pre-recorded tapes and CDs of novels, plays, poetry, etc.; - pre-recorded diskettes and CD-ROMs containing books, dictionaries, encyclopaedias, foreign language trainers, multimedia presentations, etc. in the form of software;
09.6 Culture services			
09.6.3 Cultural services	**09.6.3.0 Photographic services** Includes: - services of photographers such as film developing, print processing, enlarging, portrait photography, event photography and video (e.g. for weddings), etc. Also includes: -photographic services provided by non-specialised shops (e.g. supermarkets, consumer electronic stores etc.) and purchased by Internet	Digital	(continued)

2018	Description	Type of Resource	1999
09.7 Newspapers, Books and Stationary			
09.7.1 Books	**09.7.1.1 Educational or text books** Includes: - formal education text books (school/academic manuals etc) - recorded tapes and CDs, DVDs, Blu-ray, flash-drives of educational books. - download of educational books - removable media containing books, dictionaries, encyclopaedias, foreign language trainers, in the form of software Includes also -all electronic forms of educational books (e-books and audio-books)	Digital	
	09.7.1.9 Other books Includes: - fiction and non-fiction books, - children's books, scrapbooks and albums for children, colouring books for children - dictionaries - art books - travel guides - recorded tapes and CDs, DVDs, Blu-ray, flash-drives of books, novels, plays, poetry, etc. - download of non-educational books Includes also: - all electronic forms of books (e-books and audio-books); scrapbooks and albums for children Excludes: - stamp albums (09.2.1.2).	Digital	**09.5.1 - Books** Includes: - books, including atlases, dictionaries, encyclopaedias, textbooks, guidebooks and musical scores Also includes: - scrapbooks and albums for children - bookbinding Excludes: - pre-recorded tapes and CDs of novels, plays, poetry, etc. (09.1.4) - pre-recorded diskettes and CD-ROMs containing books, dictionaries, encyclopaedias, foreign language trainers, etc. in the form of software (09.1.4) - stamp albums (09.3.1) (continued)

2018	Description	Type of Resource	1999
09.7.2 Newspapers and periodicals	**09.7.2.1 Newspapers** Includes: - newspaper bought in kiosks - subscription for newspapers (home delivery) - Internet subscription for newspapers Includes also: -all electronic forms of newspapers	Digital	**09.5.2 - Newspapers and periodicals** Includes: - newspapers, magazines and other periodicals *[not exist: Internet subscription for newspaper]*
	09.7.2.2 Magazines and periodicals Includes: - lifestyle magazines - children magazines - hobbies, leisure magazines - business, political magazines - TV magazines - subscription for magazines and periodicals (home delivery) - Internet subscription for magazines and periodicals Includes also: -all electronic forms of magazines and periodicals.	Digital	*[not exist: Internet subscription for magazines and periodicals]*
OTHER DIVISIONS			
05 FURNISHINGS, HOUSEHOLD EQUIPMENT AND ROUTINE HOUSEHOLD MAINTENANCE			
	05.3.2.9 Other small electric household appliances Includes: -surveillance cameras	Physical	Not exist
	0.6.1.3.2 Assistive products for hearing and communication Includes: -digital hearing aids	Physical	Not exist (continued)

2018	Description	Type of Resource	1999
	0.7.1.3.0 e-bikes, pedelecs	Physical	Not exist
	0.7.2.1.3 Accessories for personal transport equipment Includes: -GPS (satellite positioning equipment) -dash cameras	Physical	GPS not exist
	0.7.2.3 Maintenance & repair of installation of car cameras	Physical	Not exist
	0.7.2.4 charges for hire electronic tags	Physical	Not exist
07.3.3 Passenger transport by air	**07.3.3.1 Passenger transport by air, domestic** Includes also: -domestic air passenger transport by drones and multicopters.		
	0.7.4.1.2 Parcels delivery services of goods purchased online	Social	Not exist
10 EDUCATION			
10.5.0 - Education not defined by level	***10.5.0.1 -Tutoring*** Includes: -online tutoring **Other education not defined by level** Includes: -language courses in classroom, online, in form of software or audio tapes; -information technology courses (e.g. learning how to use a specific software).	Human	Not exist

Sources: COICOP 1999 & COICOP 2019, adapted by author