AOSIS

The future of international trade and development

Volume 2

DIGITAL DEVELOPMENTS AND EMPLOYMENT

UNDERSTANDING TRENDS IN AFRICA

Ali Parry, Wilma Viviers, Emmanuel Orkoh
& Susara J Jansen van Rensburg

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Published by AOSIS Books, an imprint of AOSIS Scholarly Books, a division of AOSIS.

AOSIS Publishing
15 Oxford Street, Durbanville, 7550, Cape Town, South Africa
Postnet Suite 110, Private Bag X19, Durbanville, 7551, Cape Town, South Africa
Tel: +27 21 975 2602
Website: https://www.aosis.co.za

Cover image: This cover design was created by Natascha Olivier/Coco Design with the use of a photograph by Gerd Altmann {3664100} obtained from Pixabay.com, titled 'Network, Earth, Blockchain image', available from https://pixabay.com/photos/network-earth-blockchain-globe-3664100/, copyright-free under the Pixabay licensing terms.

Published in 2024
Impression: 1

ISBN: 978-1-77995-317-9 (print)
ISBN: 978-1-77995-318-6 (epub)
ISBN: 978-1-77995-319-3 (pdf)

DOI: https://doi.org/10.4102/aosis.2024.BK471
How to cite this work: Parry, A, Viviers, W, Orkoh, E & Jansen van Rensburg, SJ 2024, *Digital developments and employment: Understanding trends in Africa,* The future of international trade and development, vol. 2, AOSIS Books, Cape Town.

The future of international trade and development
ISSN: 2789-7125
Series Editor: Wilma Viviers

Printed and bound in South Africa.

Listed in OAPEN (http://www.oapen.org), DOAB (http://www.doabooks.org/) and indexed by Google Scholar.

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Peer-review declaration

The publisher (AOSIS) endorses the South African 'National Scholarly Book Publishers Forum Best Practice for Peer-Review of Scholarly Books'. The book proposal form was evaluated by our Social Sciences, Humanities, Education and Business Management editorial board. The manuscript underwent an evaluation to compare the level of originality with other published works and was subjected to rigorous two-step peer review before publication by two technical expert reviewers who did not include the authors and were independent of the authors, with the identities of the reviewers not revealed to the authors. The reviewers were independent of the publisher and authors. The publisher shared feedback on the similarity report and the reviewers' inputs with the manuscript's authors to improve the manuscript. Where the reviewers recommended revision and improvements, the authors responded adequately to such recommendations. The reviewers commented positively on the scholarly merits of the manuscript and recommended that the book be published.

Research justification

The main focus of this book is to determine the effects of digital developments on inclusive growth, and specifically employment, in Africa. The reason for the chosen focus of the manuscript is that there is a broad consensus in the literature that job creation is a crucial element in growing an economy and that the digital era could be an important driver in this regard, especially in the African context where there are high levels of unemployment. However, while the digital era has the potential to expand and/or accelerate employment on the continent, it also poses risks. It is therefore important to find out what these opportunities and risks are so that they can be translated into well-informed policies and strategies.

This research is innovative and contributes to the economics discipline as there is no well-established, empirically determined relationship between digital developments and employment in Africa, which can make policymaking difficult. The book addresses this research gap, giving due cognisance to the different levels of development of African countries. Another original feature of the study was its empirical research methodology. Firstly, for the regression analysis, the study used two digital trade variables (for services and goods, respectively) in recognition of the influence of Africa-focused and international trade on domestic employment. Secondly, it disaggregated the employment-related results according to sector (i.e. agriculture, industry and services sector employment) and gender (i.e. female and male employment). Thirdly, it presented the results across country income groups (low-income countries, lower middle-income countries and upper middle-income countries), according to the World Bank's classification system, to reveal how the results and evident trends might differ from one group to the next.

The contribution of this study lies in the formulation of expected results, which were drawn from existing literature, and the comparison of these with the actual results from the regression analysis. The results showed that the effects of digital developments on employment in Africa are highly contextual. For example, the industry and services sectors in Africa are more digitally prepared than the agricultural sector. The resilience of industry and services sector employment in the face of advancing digitalisation is somewhat surprising and warrants further investigation to determine how support to these sectors can be optimised. The fact that agricultural sector employment is lagging behind the other two is not surprising but is very concerning – particularly as agriculture holds the key to food security on the continent and could play a leading role in an agro-processing industrialisation drive.

The empirical study used a quantitative research methodology to examine the relationships between certain dependent (employment) variables and certain independent (digital development) variables. A longitudinal method was selected, using panel data regression, which allowed the dataset to be observed multiple times over a 20-year period.

This book represents a reworked version (more than 50%) of the dissertation of one of the authors, titled 'Determining the links between digital developments and inclusive growth: Implications for Africa', submitted in fulfilment of the requirements for the degree Master of Commerce in International Trade, in the School of Economic Sciences, Faculty of Economic and Management Sciences at North-West University, South Africa, 2022, with Prof. W Viviers as promoter and Dr SJ Jansen van Rensburg and Dr E Orkoh as co-promoters. The material has been substantially reworked, and new sections have been added to provide a fuller context and a more balanced and well-rounded contribution to the literature.

The authors confirm that no part of the work has been plagiarised.

The target audience of the book is fellow scholars in the development economics discipline who have an interest in policy studies and in gaining a holistic appreciation of the nexus between digital developments and employment in Africa, based on qualitative and quantitative research.

Ali Parry, TRADE Research Entity, Faculty of Economic and Management Sciences, North-West University, Potchefstroom, South Africa; and Trade Matters (Pty) Ltd, Johannesburg, South Africa.

Contents

Abbreviations and acronyms, figures and tables appearing in the text and notes

Abbreviations and acronyms

3D	three-dimensional
3i	Inclusive Internet Index
4IR	Fourth Industrial Revolution; Industry 4.0
A4AI	Alliance for Affordable Internet
ADF	Augmented Dickey–Fuller
ADI	Affordability Drivers Index
AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
AI	artificial intelligence
AR	augmented reality
AU	African Union
BEA	Bureau of Economic Analysis
COVID-19	coronavirus disease 2019
CPI	consumer price index
DRC	Democratic Republic of the Congo
EU	European Union
FDI	foreign direct investment
FGLS	feasible generalized least squares
GCI	Global Cybersecurity Index
GDP	gross domestic product
GMM	generalized method of moments
GNI	gross national income
GVC	global value chain
HCI	Human Capital Index
HDI	Human Development Index
HIC	high-income country
ICT	information and communication technology
IDI	Inclusive Development Index
IGI	Inclusive Growth Index

IIAG	Ibrahim Index of African Governance
ILO	International Labour Organization
IMD	Institute for Management Development
IMF	International Monetary Fund
IoT	Internet of Things
ITU	International Telecommunication Union
LIC	low-income country
LMIC	lower middle-income country
MDI	Multidimensional Inclusiveness Index
NTB	non-tariff barrier
OECD	Organisation for Economic Co-operation and Development
OLS	ordinary least squares
R&D	research and development
REC	regional economic community
RVC	regional value chain
SADC	Southern African Development Community
SDGs	Sustainable Development Goals
SWIID	Standardized World Income Inequality Database
UAE	United Arab Emirates
UK	United Kingdom
UMIC	upper middle-income country
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
USA	United States of America
VR	virtual reality
WDI	World Development Indicators
WEF	World Economic Forum
WHO	World Health Organization
WTO	World Trade Organization

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Orkoh's research focuses mainly on the welfare and distributional impact of trade, health and labour market policies as well as digital developments in Africa and other developing countries. He is a member of the African Growth and Development Policy (AGRODEP) Modeling Consortium, the Berkeley Initiative for Transparency in the Social Sciences (BITSS), the Econometrics Society, the UNCTAD Virtual Institute and the Pan-African Scientific Research Council (PASRC).

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Viviers has received many research grants and a number of prizes, including a fellowship from the ITRISA for her contribution to extending the scope of international trade-focused education and research in South Africa; the 'Women in Research Award' from the South African Association of Women Graduates; five university teaching excellence awards; and the Department of Science and Technology's 'Distinguished Women in Science Award' first runner-up in the Social Science and Humanities category.

Viviers is actively involved in initiatives aimed at enhancing South Africa's trade competitiveness and performance. She has successfully supervised more than 35 master's and PhD students. In addition, she was instrumental in introducing the TRADE-DSM® (Decision Support Model), which is a market selection tool designed to efficiently identify high-potential export opportunities for companies and countries. To this end, Viviers has overseen its rollout in several countries. The TRADE-DSM® and its applications are extensively covered in numerous publications. In recent years, she and her research team have been focusing on the digital economy and big data analytics and how these can be leveraged to improve export decision-making and countries' and industries' growth and development prospects. She is a co-editor and co-author of the book, *Africa*'s *digital future: From theory to action* (AOSIS 2021).

Preface

Africa is a continent of great contrasts and contradictions. Covering a vast territory, it is home to almost 1.5 billion people – many of them young and energetic, with great hopes for the future. It has many of the most sought-after raw materials in the world and is therefore on many countries' radar screens. The African Continental Free Trade Area (AfCFTA), in turn, is poised to play an important role in unlocking Africa's pent-up regional trade and investment potential. The continent is also known for having experienced a 'mobile revolution' in recent years, evidenced by a surge in the use of mobile phones and digital applications.

Yet, Africa lags behind other regions in the world from an economic development perspective and is burdened with high levels of unemployment and poverty, which show no signs of abating. Many countries on the continent have struggled to capitalise on their youthful talent pool with a view to creating the kind of skilled and productive workforces that are needed for the 21st century. One of the main factors contributing to Africa's lagging development is economic inequality – in other words, insufficient numbers of people are engaged in meaningful economic activity that sustains them and their families, expands the economy and tax base, and lays a solid foundation for growth and continuous improvement at the national level. Economic inequality is not confined to Africa; it is evident to a greater or lesser extent all over the world, but it is particularly acute on the continent. With the digital era gaining momentum, Africa also has the most pronounced 'digital divide' of all world regions, which is not surprising as digitalisation and economic development tend to go hand in hand.

A key question that policymakers, business leaders and scholars are asking is whether Africa will be able to ride the waves of digital advances and benefit, both socially and economically, or whether it will slip further and further behind, adrift in a sea of relentless change where only the most competitive and capable players will prevail. The digital era evokes mixed views and emotions. To some, it provides unparalleled opportunities for enhancing productivity and expanding into new fields of endeavour – all with a view to making businesses more efficient and sustainable and lifestyles more enjoyable. To others, it poses a serious threat to people's jobs and well-being as machines can perform many traditional functions more quickly and at lower cost than humans and many other functions that

How to cite: Parry, A, Viviers, W, Orkoh, E & Jansen van Rensburg, SJ 2024, 'Preface', in *Digital developments and employment: Understanding trends in Africa*, The future of international trade and development, vol. 2, AOSIS Books, Cape Town, pp. xix–xxii. https://doi.org/10.4102/aosis.2024.BK471.00

are simply beyond the capabilities of humans. The advent of generative artificial intelligence (AI) has added another layer of complexity to the digitalisation–employment debate, with signs pointing to generative AI becoming a highly disruptive force for the foreseeable future – although which sectors will be most affected remains uncertain.

Clearly, economic inclusion/exclusion, digital developments and employment are intertwined and worthy of closer inspection, particularly in Africa, which faces challenges on all these fronts. Although there are many views and opinions on the effects of digital developments on employment, relatively few *quantitative* studies have been conducted on the relationship between the two. Of these, even fewer have focused on the employment effects of digital developments in *Africa*. One of the challenges associated with conducting quantitative studies in this domain is that appropriate indicators must be used to act as proxies for digital developments and employment, respectively. The term 'digital developments' has no universally accepted meaning and could range from simple innovations, such as mobile phone usage and internet connectivity, to sophisticated innovations, such as cloud computing and advanced AI. Likewise, 'employment' could relate to formal or informal employment, or employment according to gender, industry sector or age group.

Africa's legacy problems of poverty and low levels of (meaningful) employment and its tenuous position and prospects in the digital era were the inspiration behind *Digital developments and employment: Understanding trends in Africa*. Drawing on a quantitative study conducted for a master's degree, this book examines the effects of digital developments on various dimensions of employment (i.e. total, sectoral and gender-based employment) in Africa. This disaggregated approach goes a long way towards revealing important nuances across the different employment categories, without which the results risked being too bland for informed policymaking. The analysis goes one step further by presenting the results pertaining to three different country income groups (low-income countries [LICs], lower middle-income countries [LMICs] and upper middle-income countries [UMICs]) in acknowledgement of the fact that African countries are at different stages of economic and digital development and therefore need tailor-made (rather than one-size-fits-all) solutions. The distilling of results across sectors, genders and country income groups is in recognition of Africa's complex character and has not featured in other, related studies.

The outlines of the book's six chapters are as follows.

Chapter 1, 'Research context, objectives and approach', sets the scene for this book by providing the broad research context, the motivation for and scope of the study, its different elements, and the methodologies used in the qualitative and quantitative analyses.

Chapter 2, 'Insights and debates on inclusive growth and digital developments', draws on the views of a cross-section of scholars and institutions and provides a qualitative overview of inclusive growth strategies (designed to act as an antidote to economic exclusion and/or poverty) and digital developments, as well as the links between the two. The chapter explores the concept of inclusive growth from different angles, discussing the respective merits of pro-poor growth (focusing largely on redistribution/social welfare) and broad-based growth (focusing largely on economic inclusion/employment). It also compares different views on digital developments and whether they represent an inclusive or divisive force in the African context.

Chapter 3, 'Quantitative studies on inclusive growth and digital developments', provides an overview of various quantitative studies conducted globally on different dimensions of inclusive growth and digital developments, using a range of indicators for each. The chapter probes the types of measures that were used in the studies in question and how these might assist governments and other stakeholders in tracking the effectiveness of their inclusive growth and digital development strategies over a period of time, thereby providing a more informed base for policymaking. It also reveals certain critical research gaps and offers a point of departure for the empirical study discussed in Chapters 4 and 5.

Chapter 4, 'Methodology and data', discusses the empirical study (which took the form of a regression analysis) that the authors of this book conducted to address identified research gaps and to probe some of the complexities surrounding the effects of digital developments on employment in Africa, given the continent's heterogeneous character. The digital development indicators were digitally delivered services trade, ICT goods trade and number of internet users. What made the study methodology distinctive was that it incorporated different country income groups with a view to producing a more nuanced set of results. Moreover, Chapters 2 and 3 provided a valuable foundation for this chapter as it allowed the authors to speculate about the outcomes of the study, which would then be tested empirically.

Chapter 5, 'Results and analysis', presents and analyses the results of the regression analysis across the three different country income groups and determines whether they were in line with the authors' expectations or whether they held some surprises. The fact that African countries are often described in the literature as far from homogeneous was very much in evidence, with the study yielding both expected and unexpected results (particularly with respect to sectoral employment), which warrant further investigation.

Chapter 6, 'Digital developments and employment in Africa: The way forward', reflects on the study as a whole – both the qualitative perspectives and the quantitative studies shared in Chapters 2 and 3, as well as the empirical results outlined in Chapters 4 and 5. The chapter concludes that a greater digital orientation could have positive spinoffs for employment in Africa, but it needs to be carefully crafted and applied to countries' particular circumstances. Furthermore, no amount of progress on the digitalisation front will obviate the need for African countries to put the fundamental developmental building blocks in place (from sound and inclusive education to reliable electricity and affordable internet), without which they will be unable to move out of the past and into the present and future.

We hope this book will be an interesting read and will provide valuable food for thought for those who are concerned about Africa's well-being in the years ahead.

Chapter 1

Research context, objectives and approach

Introduction

In recent years, the authors of this book[1] have become increasingly interested in two pronounced global trends: rising economic inequality, particularly in the developing world, and the quickening pace of the digital era – also known as the Fourth Industrial Revolution (4IR) or Industry 4.0. These two phenomena have prompted many debates about the relationship between them – particularly whether the digital era has the power to narrow or, alternatively, widen socioeconomic divisions.

In its *World Social Report 2020*, the United Nations (UN) (2020a) reports that people in North America earn on average 16 times more than people

1. This book is based on Ali Parry's dissertation for her Master of Commerce degree (MCom), which was awarded to her by the North-West University in South Africa in November 2022. Ali was supported in her studies by Prof. Wilma Viviers (who acted as her supervisor) and Dr Susara Jansen van Rensburg and Dr Emmanuel Orkoh (who acted as co-supervisors). The material contained in the dissertation was substantially reworked for the purpose of this book. In addition, new sections were added to provide a fuller context to the book's overarching purpose and contribution.

How to cite: Parry, A, Viviers, W, Orkoh, E & Jansen van Rensburg, SJ 2024, 'Research context, objectives and approach', in *Digital developments and employment: Understanding trends in Africa*, The future of international trade and development, vol. 2, AOSIS Books, Cape Town, pp. 1–9. https://doi.org/10.4102/aosis.2024.BK471.01

in sub-Saharan Africa, while people in Europe earn 11 times more. Apart from these between-country differences, inequality *within* countries has in turn been on the rise since the 1990s, with increasing numbers of high-wealth individuals living alongside poor people in ever-expanding communities (UN 2020b). There is a general agreement that such stark economic inequality must be addressed; otherwise, it will retard countries' economic and social development and lead to greater instability in the world. In this regard, many countries in Africa and elsewhere have recognised the importance of following an 'inclusive growth' path, but there is no consensus on what inclusive growth means or how it can be achieved (Cerra 2022).

The concepts of inclusive growth and digital developments

Some regard inclusive growth as the process aimed at improving the livelihoods of the poor and other marginalised groups (African Development Bank [AfDB] 2013; Sassi 2023), largely through a process of redistribution. Others believe that inclusive growth should be broad-based, aimed at ensuring that more people can participate in (through employment), and benefit from, economic activities.

According to Ianchovichina (2012) and Ianchovichina and Lundstrom (2009), a pro-poor approach to inclusive growth is not a sustainable solution because an economy can become inclusive only if it *grows* and becomes *more productive*. Ianchovichina and Lundstrom (2009, p. 2), writing for the World Bank, view inclusive growth as 'both the pace and pattern of economic growth, which are considered interlinked'; they therefore need to be assessed together. Their definition suggests that rapid economic growth is necessary to reduce (absolute) poverty. They add that for inclusive growth to be sustainable in the longer term, it must straddle different economic sectors and include the bulk of a country's labour force. The Europe 2020 Strategy (Organisation for Economic Co-operation and Development [OECD] 2014), in turn, adopts a mixed approach, stating that inclusive growth involves:

> [...] empowering people through high levels of employment, investing in skills, fighting poverty and modernising labour markets, training and social protection systems so as to help people anticipate and manage change, and build a cohesive society. (p. 9)

Whether countries favour the pro-poor, a broad-based or a mixed approach, the absence of a clear definition of inclusive growth complicates policymaking because it is difficult to determine where support is most needed. Moreover, in the fast-moving and uncertain digital era (which has

similarly given rise to a wide range of definitions and interpretations), it has become increasingly difficult to adopt appropriate policy responses in the face of the enduring challenges of inequality and slow or non-inclusive growth. On a positive note, however, many are of the view that digital technologies – such as automation and robotics, artificial intelligence (AI), the Internet of Things (IoT) and cloud computing – can in fact go a long way towards alleviating poverty and unemployment and accelerating countries' development (Dedola et al. 2023; Qureshi & Woo 2022; World Trade Organization [WTO] 2018). This is because such innovations have the potential to create new commercial pathways and business models, pave the way for new or more productive jobs and tackle developmental deficits in more cost-efficient ways.

Banga and Te Velde (2018) explain that there are many practicalities associated with the adoption of digital technologies. At the very least, a country needs conducive policies and regulations, appropriate infrastructure, digital skills and a pervasive innovation culture. It is an unfortunate reality, though, that many countries (and industry sectors within those countries) lack the resources and skills to effectively leverage digital technologies, resulting in a 'digital divide' (Alliance for Affordable Internet [A4AI] 2022; Lythreatis, Singh & El-Kassar 2022). Internet connectivity, for example, is fundamental to effective digitalisation. Yet, while 90% of Europeans use the internet, only one-third of Africans do (World Economic Forum [WEF] 2022).

Like economic inequality, a digital divide will widen if not addressed at the policy level. However, countries differ in terms of their developmental needs and priorities as well as their economic and technological capacity, which means that tailored digital solutions are required (Digital Regulation Platform 2023). Many questions surround the issue of how much digitalisation is advisable or possible in developing countries, given their many fiscal, infrastructure and capacity constraints (Unwin 2018). As a result, the term 'digital developments' means different things to different people, depending on their socioeconomic context and circumstances. To some, it refers simply to online connectivity via the internet; to others, it refers to sophisticated (often AI-driven) applications supported by various digital tools and platforms (Madanaguli et al. 2023).

The links between inclusive growth and digital developments

Notwithstanding the fact that both inclusive growth and digital developments lack universally accepted definitions, there appear to be synergies between the two concepts. Inclusive growth is directed at

narrowing the gap between marginalised and more privileged members of society, while digital developments are aimed at extending the benefits of digitalisation throughout society, thus reducing the digital divide and unlocking many potential economic opportunities for greater numbers of people (African Union [AU] 2020).

To properly understand the relationship (whether positive or negative) between inclusive growth and digital developments, the effects of the latter on the former need to be determined empirically. The literature discusses various strategies aimed at creating more inclusive societies in the digital era – ranging from overhauling traditional education methods with the help of online tools (OECD 2023) to driving higher levels of financial inclusion through digital means (WEF 2023b). Likewise, a number of quantitative studies have been conducted using various indicators as proxies for inclusive growth and digital developments, respectively (Banga & Te Velde 2018; Cirera & Sabetti 2016; International Telecommunication Union [ITU] 2023; United Nations Conference on Trade and Development [UNCTAD] 2023). For example, inclusive growth indicators have included the gross domestic product (GDP) per capita growth rate, wage levels, poverty levels, trade and investment flows, and employment levels, while digital development indicators have included mobile phone users, internet users, information and communication technology (ICT) infrastructure, cybersecurity laws and digital trade flows.

While acknowledging that strategies to address questionable education standards and inadequate financial inclusion (among other problems) have merit, the authors of this book are of the view that *employment* holds the key to inclusive growth in Africa (Hosono 2022). Some people see the digital era as an exciting source of new job opportunities (WEF 2023a), yet others believe that the adoption of (especially foreign) digital technologies, instead of creating new jobs, has a job displacement effect, thereby exacerbating inequality, unemployment and poverty on the African continent (Friederici, Ojanperä & Graham 2017). The concepts of inclusive growth and digital developments, both in general and in Africa, are fleshed out more fully in Chapters 2 and 3.

Given the diversity of views and perspectives on inclusive growth and digital developments, the authors of this book arrived at their own synthesised working definitions of the two concepts, which draw on the literature reviewed in Chapters 2 and 3 and provide the foundation for the empirical study discussed in Chapters 4 and 5:

- Inclusive growth refers to the process of increasing the size of the economy and accelerating its pace of growth by creating more – and more productive and sustainable – employment, especially for marginalised or vulnerable groups of people.

- Digital developments refer to the various activities associated with the adoption and/or expanded application of both fundamental and 'frontier' digital technologies to create more efficient, capable and inclusive societies.

Rationale for the study

As the digital era gains momentum, a key question is: will African countries be able to benefit from digital advances, or are they likely to slip further behind in the technological race? There is no quick or easy answer to this question. Africa covers a vast territory and is very heterogeneous in its political ideologies, economic circumstances, trade performance, geographies, logistics capabilities, and growth and development aspirations. Africa also has the most pronounced 'digital divide' of all the regions in the world.

Relatively few quantitative studies have been conducted on the effects of digital developments on *employment* specifically, while an even smaller number have focused on the employment effects of digital developments in *Africa*. Examples of the latter include De Berquin and Mbongo (2019), Hjort and Poulsen (2019), Orkoh, Viviers and Jansen van Rensburg (2021) and Viviers, Parry and Jansen van Rensburg (2019). While these studies provide some basis for exploring the digital developments–employment nexus in Africa, they do not consider the different stages of development of African countries, which would influence their employment and digital landscapes and priorities. This points to a significant research gap. Africa is home to low-income, lower middle-income, upper middle-income and high-income countries, according to the World Bank's classification (Ianchovichina & Lundstrom 2009) (see Table A1 in the Appendices). Therefore, inclusive growth strategies (with employment at the core) need to be informed by and tailored to countries' development status. Another discernible research gap is that the sector-level and gender-based employment effects of digital developments in Africa have been given relatively little attention, which means that many potential nuances in the employment effects have been overlooked.

As there is no well-established, empirically determined relationship between digital developments and employment in Africa, policymakers on the continent are not well informed about the digital developments–employment dynamics in their countries and how these may be optimised. This book therefore addresses the aforementioned research gaps, giving due cognisance to the different levels of development (evidenced by income group) of African countries (UNCTAD 2021) in presenting the findings and drawing broad conclusions.

Objectives and scope of the study

The overall research objective of the study was to: Determine the effects of digital developments on inclusive growth, with specific reference to employment in Africa.

The specific research objectives were to:

1. Identify the main themes and perspectives emanating from the global discourse on inclusive growth and digital developments, including the effects of digital developments on inclusive growth in Africa.
2. Determine the effects of digital developments on total employment in Africa.
3. Examine how these effects differ according to sector and gender across different country income groups.

The literature contains wide-ranging views and perspectives on the meaning of inclusive growth and the indicators used to measure it. However, the study outlined in this book focused specifically on the *employment* dimension in an *African* context for the following reasons:

- Most African countries are burdened with high levels of unemployment and informal or vulnerable employment, which lacks scalability. Such problems must be addressed in new and creative ways. The digital era appears to have the potential to ameliorate the situation by expanding and/or accelerating (particularly formal) employment, although the opposite effect cannot be ruled out. If digital developments pose risks to employment on the continent in the short and long term, it is important to find out what these risks are so that appropriate policies and strategies can be implemented. These aspects were systematically explored in this study.
- According to the literature, there is a broad consensus that job creation is a crucial element in growing an economy and that the digital era could be an important driver in this regard. This study therefore built on an already-established layer of interest in the employment effects of digital developments.

The decision to focus on the employment dimension of inclusive growth does not suggest that the youth, disabled people, rural inhabitants or other marginalised groups are not important when it comes to deliberations about inequality and inclusive growth. Indeed, the study's focus on the employment effects of digital developments took these potentially marginalised groups into consideration – although not in a direct sense. These groups could be given more in-depth attention in future studies.

Literature study

Given the relatively complex nature of the issues under investigation, the findings from the literature study straddle two chapters. Chapter 2 provides a cross-section of views (of a qualitative nature) on the concepts of inclusive growth and digital developments, respectively, and explores evident synergies and tensions between them, with specific reference to Africa. Moreover, the chapter gives special attention to employment as a leading indicator of inclusive growth. Chapter 3, in turn, examines various quantitative studies (both regional and Africa-specific) on inclusive growth and digital developments, respectively, including the measured effects of the latter on the former. Furthermore, the chapter draws particular attention to studies with an employment angle.

Empirical (quantitative) study methodology

Chapters 2 and 3 provide the conceptual foundation for the empirical study discussed in Chapters 4 and 5.

Research design

The empirical study used an exploratory research design that allowed the research topic to be investigated from various (including new) angles. The research design essentially provided the roadmap (setting out the steps involved in collecting, analysing, interpreting and presenting the data) that linked the research objectives to the final empirical research results (Boru 2018).

Research method

The study used a quantitative research method to examine the relationships between certain dependent variables (pertaining to employment) and certain independent variables (pertaining to digital developments). In addition, several control variables impacting the dependent variables were included in the models. The value of a quantitative research method is that, by using statistical techniques to analyse collected data, it produces measurable and reliable results from which various deductions can be made (Boru 2018; De Vos et al. 2011; Kumar 2014).

From the various types of quantitative research methods available, the study used a longitudinal method, using panel data regression. This allowed

the dataset to be observed multiple times over a period of time (i.e. 20 years). The reason for using a longitudinal method was to establish the links between the dependent and independent variables and the evident dynamics between them over the period in question. Panel data were preferred over cross-sectional or pure time-series data because there was less risk of collinearity between the independent variables (which could have skewed the results) (Kumar 2014).

Data and data sources

The study used panel data on 33 African countries for the period 2000–2019, with the World Bank's country classifications according to income group, that is, low-income countries (LICs), lower middle-income countries (LMICs) and upper middle-income countries (UMICs) (Ade 2018). The panel data were all publicly available, secondary data. The sample comprised those countries for which there were available data for the chosen variables. The data sources for the study mainly comprised the World Development Indicators (WDI) database from the World Bank, the UNCTADSTAT database from UNCTAD and the Africa Infrastructure Development Index database from the AfDB.

One of the key factors driving digital developments in Africa is countries' involvement in and openness to digital trade, which facilitates technology transfer and access to innovative goods and services while also encouraging the creation of innovation networks and partnerships. As a result, two of the three digital development variables selected for the study were digitally delivered services trade and ICT goods trade. The third digital development variable was the number of internet users, which is logical because internet connectivity is a cornerstone of the digital era and, thus, digital trade (see ch. 4). Three employment variables were selected for the study to provide thorough insights into the employment effects of digital developments in Africa. These were total employment, sector-level employment and gender-based employment.

How the study contributes to the advancement of knowledge in the digital era

In addition to addressing the identified research gaps, the contribution of this study can be found in the originality of its empirical research methodology. Firstly, for the regression analysis, the study used two digital trade variables (for services and goods, respectively) in recognition of the influence of Africa-focused and international trade on domestic employment

(see Orkoh et al. 2021; Viviers et al. 2019). Secondly, it disaggregated the employment-related results according to sector (i.e. agriculture, industry and services sector employment) and gender (i.e. female and male employment). Thirdly, it presented the results across the country income groups (LICs, LMICs and UMICs) to reveal how the results and evident trends may differ from one group to the next. This was in recognition of the fact that the employment effects of digital developments are not homogeneous, as African countries are at different stages of development.

Chapter 2

Insights and debates on inclusive growth and digital developments

Introduction

The concepts of inclusive growth and digital developments have been the subject of considerable debate and have given rise to a variety of perspectives on what they mean, how they manifest and why they have become so important. Although the natural affinity between inclusive growth and digital developments may not seem all that obvious, some scholars are of the view that these two concepts have complementary goals.

Inclusive growth is often spoken about in policy circles, typically within the context of the widespread acknowledgement that the world is becoming increasingly divided – economically, socially and technologically. Yet, there are wide-ranging and contrasting views about inclusive growth and how it can be achieved. Developing a deep understanding of what inclusive growth is and what its drivers are is an important step towards bringing it about.

This chapter provides an overview of inclusive growth and digital developments, drawing from a wide range of views and perspectives

How to cite: Parry, A, Viviers, W, Orkoh, E & Jansen van Rensburg, SJ 2024, 'Research context, objectives and approach', in *Digital developments and employment: Understanding trends in Africa*, The future of international trade and development, vol. 2, AOSIS Books, Cape Town, pp. 11–44. https://doi.org/10.4102/aosis.2024.BK471.02

provided in the global literature. It starts by examining the phenomenon of inequality and why it is a policy and human imperative to bring about greater inclusiveness in society. It then explores various definitions of inclusive growth and assesses the prospects of Africa achieving more rapid and inclusive growth in the years ahead. The chapter then focuses on digital developments and their various dimensions, discussing the ways in which digital technologies are impacting domestic economic activities and international trade. It also weighs up the perceived advantages and disadvantages of the digital era, with specific reference to Africa. The chapter concludes with some views on the evident links between inclusive growth and digital developments, highlighting both synergies and tensions between the two concepts.

The scourge of inequality throughout the world

No discussion on inclusive growth would be complete without some reflections on the phenomenon of inequality. Inequality is the result of many factors, from different education and skill levels and uneven spatial development patterns to entrenched, socially or politically driven stereotypes and biases. Inequality also takes different forms, such as gender-based, ethnic and economic inequality (Li 2012). Not discounting the prevalence and often severe consequences of gender-based and ethnic inequality, it is economic inequality – evidenced by the (often yawning) gap between the rich and the poor – that is of particular and indeed growing concern in the world (Qureshi 2023). Despite the attention it receives, particularly among policymakers, inequality in an economic sense shows little sign of abating (Monga, Abebe & Andinet 2019).

Inequality in the world has been driven or exacerbated by a range of factors: rising geopolitical tensions between major powers, a surge in international migration, accelerating climate change and (in recent years) the coronavirus disease 2019 (COVID-19) pandemic. All these factors, one could argue, are by-products of globalisation (WTO 2021). For example, the war in Ukraine is playing out in the tragic destruction of a once-vibrant economy, mass migration and a growing humanitarian crisis (Qureshi 2023). It has also led to escalating global energy and food prices, which have affected countries as far afield as South Africa. Climate change, in turn, is causing serious damage to both the physical environment and the built infrastructure in many parts of the world, with millions of people being displaced and/or losing their homes and livelihoods. While COVID-19, as a health condition, has largely retreated into the background, it was economically devastating for millions of people, especially in African countries which could not implement effective recovery strategies. When it

was cutting a swathe through the world, COVID-19 caused extreme poverty levels to rise dramatically (World Health Organization [WHO] 2021).

Before COVID-19, which interrupted many countries' economic momentum, there were indications that inequality *between* countries was narrowing (boosted to some extent by strong growth in China and India), although it was still of major concern (Cerra 2022; Qureshi 2023). However, the advent of COVID-19 precipitated both health and economic crises globally, often overturning years of progress in narrowing the gap between the richer and poorer countries (Adarov 2022). Also concerning is the fact that inequality *within* countries has been on the rise in recent years, even though globalisation and technological progress have presented seemingly endless new economic opportunities (Lakner & Milanovic 2015; Qureshi 2023).

In our interconnected world, where so much information is free and fast-flowing, people are acutely aware of the uneven distribution of wealth and privilege, not only between richer and poorer countries but also in the cities and communities of individual countries. For example, many large corporations benefited handsomely from COVID-19 because it induced record-high prices for food, energy and pharmaceuticals. While hundreds of new billionaires were created practically overnight, many millions of people were robbed of their livelihoods and found themselves with barely enough to sustain themselves and their families on a daily basis (Oxfam International 2022). Such a dichotomy does not go unnoticed and is the source of much societal dissent and instability.

The need for a solution to extreme economic inequality

Oxfam International (2022) proposes that one of the solutions to growing inequality in the world is to tax the rich heavily, via windfall taxes and permanent wealth taxes, thereby discouraging the accumulation of extreme wealth and the exercising of monopoly power. Although such a proposal has many detractors, one can conclude that widespread and deep inequality is a manifestation of deficient societal norms, economic models and policy choices (Van Niekerk 2017; World Bank 2023). New approaches are therefore required.

Klaus Schwab, the founder of the WEF and originator of the term 'Fourth Industrial Revolution' (or '4IR') – also known as Industry 4.0 – highlights the complexity of the inequality phenomenon (WEF 2020):

> The social and economic consequences of inequality are profound and far-reaching: a growing sense of unfairness, precarity, perceived loss of identity and dignity, weakening social fabric, eroding trust in institutions, disenchantment with political processes, and an erosion of the social contract. The response

> by business and government must include a concerted effort to create new pathways to socioeconomic mobility, ensuring everyone has fair opportunities for success. (p. 4)

Growing unhappiness and often overt anger over perceived inequality can be seen the world over (WEF 2020) and are putting countries under pressure to ensure that their growth and development strategies are centred on greater inclusiveness (Draper et al. 2019). When societies are divided, the world becomes increasingly fragmented, which can result in counterproductive nationalism, myopic policymaking and economic decline (Goldin 2021). In its *World Trade Report 2021*, the WTO urges countries to develop economic resilience, so that they can withstand the many crises gripping the world today (geopolitical, economic, health and climate), which will continue to do so with increasing force. 'Building economic resilience requires an understanding of economic challenges and opportunities, as well as the ability to anticipate, evaluate and manage risks' (WTO 2021, p. 64). A key component of economic resilience, according to the WTO, is inclusiveness (WTO 2021).

The leaders of many countries acknowledge that traditional economic growth models are outdated and require modernisation (Draper et al. 2019; G20 Leaders 2016). Derviş and Chandy (2016) are of the view that economic success is a reflection of the extent to which economic growth is inclusive. Bringing about an inclusive society is different from bringing about an equal society, with the latter being an unrealistic and undesirable goal. Although it is reasonable to suggest that everyone is entitled to equal respect as a human being and should, within reason, enjoy equal economic *opportunities*, equality in the sense that resources and economic welfare are allocated equally across the population is a problematic concept.

Li (2012) contends that a certain amount of inequality (or 'stratification') is both normal and desirable in a society because it encourages some people to perform certain types of work that others would deem 'undesirable'. It may also incentivise people to work hard and, propelled by a competitive spirit, to improve their economic status and prospects. If, however, everyone enjoyed the same rewards from their labour – regardless of their capabilities or work ethic – there would be an unhealthy imbalance in society. Indeed, widespread poverty would be the result (Li 2012). The Greek philosopher Aristotle (384–322 BC) reportedly claimed: 'The worst form of inequality is to make unequal things equal' (Kruger & Yadavali 2016, p. 3), suggesting that societies are not uniform when it comes to socioeconomic strata; nor should they be.

While Li (2012) acknowledges that a certain amount of inequality in a society is normal, *excessive* inequality should not be tolerated. In other words, the gap between rich and poor should not be extreme, even if the rich have acquired their wealth in legitimate ways and are making a

noteworthy contribution to society. Huge disparities in wealth, Li (2012) claims, are detrimental to social harmony and well-being.

Inclusive growth as a socioeconomic imperative

High levels of poverty and unemployment in a country are an indication that large numbers of people are excluded from or are operating on the periphery of the economy, unable to access meaningful work (or any work at all) or to benefit from broad economic activity. This usually suggests an extremely unequal society (World Bank 2023). It is often in this context that an 'inclusive growth' strategy is advocated, which is designed to bring marginalised or excluded people into the economic mainstream – as beneficiaries or participants, or both. Vulnerable or neglected groups, such as the unemployed, the poor, women, youth and rural inhabitants, are often singled out as requiring special attention as they have traditionally been overlooked at the formal policy level (Ryder 2019).

Inclusive growth is a key theme of the United Nations Development Programme (UNDP) Sustainable Development Goals (SDGs), with SDG 8, for example, calling for 'sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all' (UN n.d.). In Africa, the AU's Agenda 2063, an ambitious plan to reinvigorate the continent at many levels, envisages: 'A prosperous Africa based on inclusive growth and sustainable development' (AU n.d.). Linked to this vision are many high-level goals, ranging from the eradication of poverty and the creation of technology- and job-rich urban hubs, to the adoption of new strategies for human capital development and the creation of an innovative culture. However, it is not clear who is supposed to drive such an ambitious transformation project or what measures are to be used to track progress along the way.

Inclusive growth – Different views and opinions

Despite frequent calls from government officials, businesspeople, academics and members of civil society for more inclusive growth, the term lacks a universally accepted definition (Klasen 2010; Van Niekerk 2017; WEF 2023).

The link between economic growth and inclusive growth

There is a strong link between economic growth and inclusive growth, but the two terms should not be confused. Economic growth refers to an

increase in the value of (economic) goods and services which are produced through economic activity over a period of time (Roser 2021). It therefore lends itself to clear, unambiguous measurement and is typically expressed as GDP. Meanwhile, GDP per capita refers to economic growth per head of the population. When measured over successive periods, GDP per capita reveals whether people are becoming wealthier or poorer (Roser 2021). Inclusive growth, in contrast, does not lend itself to a standard measurement technique (Draper et al. 2019; Van Niekerk 2017). Consequently, it often ends up being simply a vague quest. In the absence of a generally accepted definition, policies and initiatives aimed at driving inclusive growth in a country could well be misdirected, with ill-fitting milestones to register progress.

A limitation of the economic growth measure is that it conceals inequality in a country, which means that the prevalence and causes of the underperformance or exclusion of certain groups of people are often overlooked (Ryder 2019). Economic growth does not necessarily promote inclusiveness, the latter having a longer-term time horizon (Ianchovichina & Lundstrom 2009); nor does it reveal whether specific economic sectors appear sustainable or what factors could reinforce or threaten their sustainability[2] (Cerra 2022). Furthermore, there is no clear link between economic growth and increased employment. In fact, 'jobless growth' is a frequent phenomenon in many (especially African) countries (Van Niekerk 2020).

Notwithstanding these limitations, economic growth is generally regarded as a prerequisite for inclusive growth because if more people are to benefit from collective economic activity, then the economic activity must increase (Draper et al. 2019; Hausmann et al. 2023; Ianchovichina 2012).

Pro-poor growth versus broad-based growth

Many concur that inclusive growth is associated with a drive towards improved economic well-being. Yet, there are differences of opinion as to whether growth strategies and interventions should be directed mainly at assisting disadvantaged or vulnerable groups or whether they should be more broad-based (Hausmann et al. 2023).

A few years ago, the chief economist at the UNDP, Thangavel Palanivel, said that inclusive growth is concerned with ensuring that the needs of poor people are served and that such growth should manifest in the sectors

2. Sustainability broadly refers to the ability to use resources (natural, physical, economic, human) wisely so that they will continue to deliver value in the short and longer terms (FutureLearn 2021).

in which they typically work (such as agriculture), in the areas in which they typically live (such as low-income areas) and in the prices of the goods and services that they typically purchase (such as food, clothing and fuel) (Suliver n.d.). The AfDB (2013) sees inclusive growth (evidenced in greater economic, social, political and geographical inclusion) as a means of reducing poverty. These pro-poor sentiments are not surprising, considering that the poor are among the most vulnerable members of society – especially from the perspectives of education, health and employment (Benner & Pastor 2016).

Ranieri and Ramos (2013) draw a distinction between pro-poor growth and inclusive (broad-based) growth. They say that the former is geared towards improving the circumstances of those living below the poverty line, while the latter is geared towards ensuring that everyone is able to benefit from, and participate in, the economic growth process, but that the most seriously disadvantaged should receive special attention. However, this should not be at the expense of maintaining a stable macroeconomic environment, fiscal discipline, efficient and accessible public services, and an effective trade regime – all of which are hallmarks of a modern, growing economy (Ranieri & Ramos 2013). Another point of difference is that broad-based growth covers other sources of disadvantage besides low (or no) income, such as gender, ethnicity or geographical location. In Africa, for example, women and the youth are weakly integrated into the formal labour market, which hampers broad-based growth (International Labour Organization [ILO] 2023; United Nations Educational, Scientific and Cultural Organization [UNESCO] 2022; Van Niekerk 2020).

Ranieri and Ramos (2013) assert that the notions of the whole population benefiting from inclusive growth and the most disadvantaged benefiting proportionately more are definitely compatible. Ramos, Ranieri and Lammes (2013) explain that when poor people's incomes rise more quickly than those of more affluent people, the result is a decline in both poverty *and* inequality. Klasen (2010, p. 9) agrees, saying that inclusive growth should be regarded as 'disadvantage-reducing growth'. In other words, no one should be excluded, but the poor should experience a more pronounced improvement in their well-being relative to other, less-disadvantaged groups. The OECD (n.d.), in turn, sees inclusive growth as 'economic growth that is distributed fairly across society and creates opportunities for all'.

Ianchovichina (2012) agrees that inclusive growth entails exposing under-served or vulnerable groups to more economic opportunities and benefits, which helps to level the economic playing field and create a more stable and sustainable socioeconomic climate. Furthermore, Hausmann et al. (2023), Ianchovichina and Lundstrom (2009), Kjøller-Hansen and Sperling (2020) and Lederman (2013) assert that growth is likely to

accelerate if labour is used in more productive ways, such as by enhancing the skills and capacity of those performing low-productivity work. They stress that inclusive growth strategies and interventions should not focus only on the poor. Other economic segments also need attention, including well-established companies and smaller, entrepreneurial concerns which, by employing staff, help to build a country's productive capacity.

Ianchovichina (2012) offers the following succinct (but insightful) definition of inclusive growth:

> In short, inclusive growth is about raising the pace of growth and enlarging the size of the economy, while levelling the playing field for investment and increasing productive employment opportunities. (p. 158)

Ianchovichina (2012) adds that the pace of growth can be hastened and more jobs can be created through 'extensive growth', which is the product of expanded capacity. However, for there to be sustainable growth and productive employment, periods of 'intensive growth' are required, supported by efficiency-enhancing measures and innovation. Creating an environment that is conducive to employment (and especially productive employment) entails putting down the necessary building blocks to ensure the steady migration of labour from low-productivity, low-paying jobs to higher-productivity, better-paying jobs (Hausmann et al. 2023). In this regard, the capacity of workers on the supply side needs to be matched with employment opportunities on the demand side.

Building on the aforementioned, Cerra (2022) contends that inclusive growth requires certain criteria to be met: participation in economic life (especially through productive employment); access to education and health services; access to fair and competitive markets (both domestic and international); sharing of benefits across different socioeconomic groups; and responsible governance and accountability from public officials. Cerra (2022) adds that inclusive growth must be sustainable, which means that resources must not be irresponsibly depleted or harmed, to the detriment of the current and future generations. Moreover, according to Cerra (2022), inclusive growth can only be realised against a backdrop of macroeconomic stability.

The problem with redistribution

Ianchovichina (2012) emphasises that inclusive growth – particularly *sustainable* inclusive growth – cannot be realised if it is driven mainly by a policy of redistribution. This would be evident in tax revenues generated by productive sectors in the economy being allocated too generously to poorly performing or non-performing sectors in the form of subsidies or grants. For example, the South African government's longstanding

subsidisation of underperforming state-owned enterprises (such as South African Airways and Eskom) and the ever-expanding pool of social grant recipients are classic examples of this (Bernstein 2023; Fourie 2018).

In policy debates on inclusive growth, governments often fixate on the outward manifestation of poverty and ignore its causes. Bernstein (2017) acknowledges the unacceptably large number of poor people in the world – even in UMICs like South Africa. However, instead of spending excessive amounts of time and money on contrived poverty-reduction schemes (such as grants, subsidies and other redistributive mechanisms), much more attention should be given to igniting and growing economies and making them more productive. According to Bernstein (2017, 2023), redistributive programmes do little more than provide temporary relief; they do not fundamentally improve people's lives through better education and health standards or employment opportunities.

Harvard economist Ricardo Hausmann summed it up well when he said that South Africa compensates poor people for their exclusion instead of finding more effective ways to include them (Bernstein 2017). Fourie (2018) similarly contends that inclusive growth 'cannot be attained only by sharing the "fruits of growth" with poor people (through, for example, social grants and housing, education and health services)'. To him, an inclusive growth strategy should encourage poor people to actively participate (through some form of employment) in expanding the economy, which would see them producing outputs and earning a decent income (Fourie 2018).

If the intention is merely to share the fruits of growth with poor and marginalised people, it would suggest a redistributive, rather than a growth-oriented, mindset. A redistribution strategy may narrow the income gap in a country, prevent mass hunger and improve the official poverty statistics. Yet, any resultant improvement in the country's economic performance is likely to be superficial at best. It does not grow the 'economic pie', which is essential for attracting new investment, encouraging higher productivity and competitiveness, and creating more value-added (and better-paid) work (Hausmann et al. 2023; Kjøller-Hansen & Sperling 2020). Fourie (2014) therefore advocates the concept of employment-intensive growth. Likewise, Aoyagi and Ganelli (2015) stress that the focus of attention should not merely be on the poor but also on more affluent or well-established segments of society which could also be valuable sources of employment.

Van Niekerk (2020) equates inclusive growth with organic growth, where everyone should be able to use their skills and resources in unique ways and be appropriately rewarded for their efforts. He uses the analogy of a tree, saying that a tree has a strong core and multiple branches which expand as the tree grows; it does not gain its strength from only a few, select branches. Ramos et al. (2013) similarly stress the importance of

everyone participating in and benefiting from inclusive growth. Inclusive growth is both a process (for example, employment) and an outcome (for example, reduced poverty), which should be mutually reinforcing. Participating without deriving sufficient or any benefit, they claim, would make the growth process unjust, while benefiting without actively participating would amount to fruitless welfare.

In the 1930s, Gerald LK Smith, a clergyman in the United States of America (USA), is said to have provided the following economically persuasive argument in favour of growing an economy through a larger and more productive workforce, as opposed to simply redistributing resources to the needy (Miller 2019):

> You cannot legislate the poor into freedom by legislating the wealthy out of freedom. What one person receives without working for, another person must work for without receiving. The government cannot give to anybody anything that the government does not first take from somebody else. When half of the people get the idea that they do not have to work because the other half is going to take care of them, and when the other half gets the idea that it does no good to work because somebody else is going to get what they work for, that [...] is about the end of any nation. You cannot multiply wealth by dividing it. (n.p.)

Rodrik (2021) avers that there are two main approaches to growing an economy: one approach targets the poor directly through the provision of income support and preferential access to education, health services and credit (the 'social policy'); the other approach aims to create more economic opportunities and to boost productivity through macroeconomic, fiscal, trade and other policies and regulations (the 'growth policy'). These two approaches are complementary. Rodrik (2021) emphasises, however, that any viable growth strategy must have higher productivity as a target as this will enable low-skilled workers (who make up the bulk of the poor) to make the transition to higher-skilled and better-paying jobs. Boarini, Murtin and Schreyer (2015) agree, saying that productivity-induced growth has the potential to boost workers' wages. However, they make a distinction between employment growth and productivity-induced growth: the former gives rise to new jobs or sources of income, while the latter facilitates higher wages or better returns for the self-employed.

How governments can drive inclusive growth

Although business and civil society are key players in a country's growth strategies, one could argue that the pursuit of *inclusive* growth is largely the responsibility of the government using various policy tools, regulations and incentives. If left entirely to market forces, an economy and its growth trajectory are unlikely to be inclusive. Monopolies and other dominant

actors would typically emerge, making it difficult for smaller or less well-established entities to compete.

Moreover, unfettered growth could compromise a country's sustainability prospects and the population's general well-being if it heralded environmental degradation, excessive pollution and accelerating climate change (Institute for Economics & Peace [IEP] 2023; Van Niekerk 2017). Blanke (2016), Hausmann et al. (2023) and Van Niekerk (2020) aver that growth needs to be as 'green' as possible, with consideration given to *how* things are produced and the impact thereof on the natural environment and those who will inherit it in the future. Thus, governments need to exercise appropriate restraint when working towards achieving SDG 8's goal of 'sustained, inclusive and sustainable economic growth'.

Clearly, if poverty is to be significantly reduced, rapid growth is necessary. However, if growth is to become sustainable in the long run, it needs to straddle all economic sectors and benefit the bulk of a country's labour force (Whiting 2024). Achieving this is neither an easy nor a quick process. According to Ianchovichina (2012), growth strategies introduced by governments should largely be aimed at removing the constraints to growth, making the government an *enabler* or a *facilitator* – and not a driver – of growth.

Inclusive growth and the informal sector

Fourie (2018) expresses the concern that informal-sector[3] participants are often overlooked in inclusive growth discussions and interventions. Many researchers and commentators, he contends, dismiss informal-sector participants as lacking in entrepreneurial ambitions or capabilities, who eke out a survivalist-type existence with poor prospects of creating employment and contributing to poverty alleviation. The informal sector is often associated with low-skilled activities, such as street trading and casual labour, and is consequently given scant attention at the policymaking level. Yet, it is precisely informal workers and survivalists (who are poor and marginalised) who should be factored into the inclusive growth equation.

Across Africa, as many as 85.5% of workers operate informally, compared with 68.2% in Asia and the Pacific, 40.0% in the Americas and 25.1% in

3. According to the International Monetary Fund (IMF 2021), about 60% of the world's adult labour force work in the informal sector. The informal sector is a collective term for all the economic activities performed by individuals or businesses that are not formally registered and are therefore not subject to the regulations that formal businesses are, such as company registration requirements and financial reporting and/or tax obligations. Informal-sector workers often lack social protection and access to credit, and their jobs are generally more precarious than those of their formal-sector peers (OECD 2024).

Europe and Central Asia (ILO 2018). Among the key constraints to informal businesses' growth and efficiency are limited financial knowledge and skills, a lack of creditworthiness, an inability to expand into more lucrative markets and vulnerability to crime (Fourie 2018). Informal businesses also lack protection under the law and would therefore have no legal recourse if they found themselves the victims of exploitation or abuse (Blaauw 2017).

Fourie (2013) asserts that it will always be important to promote and facilitate the growth of the formal sector, especially as it provides the bulk of a country's taxes. Yet, in many countries, the formal sector's profitability and growth prospects have been constrained by economic challenges, including the recent COVID-19 pandemic. Given its potential to absorb available labour and act as a training ground for entrepreneurs, the informal sector should be given more prominence at the policymaking level (Fourie 2013; Van Niekerk 2017).

Rodrik (2016), however, is circumspect about the potential of the informal sector. He claims that while it offers an economic lifeline to many, informality generally does not encourage productive growth. The high levels of informality in Africa's manufacturing and services sectors, for example, help to explain why these sectors have been falling behind in the productivity rankings, even where the countries concerned are registering strong economic growth rates. Rodrik (2021) concedes that some informal businesses that house entrepreneurial talent could – with business advice, training and technological support – grow into formal, viable operations in niche areas. He stresses, though, that without focused (especially policy) attention, even the most promising informal firms are unlikely to transform themselves into productive, viable ones.

The arguments in favour of the formalisation of informal businesses appear compelling. Formally registered businesses pay tax, thereby making a positive contribution to the fiscus and economic growth statistics. They also need to comply with industry norms and standards, which would help them to optimise their businesses and attract a larger client base, while also entitling them to various forms of recourse in the event of exposure to unfair trading practices. Unfortunately, excessive red tape and the high cost of compliance often deter informal-sector workers from formalising their businesses. This deprives them of the benefits enjoyed by registered businesses, including having an effective 'voice' to speak on their behalf, such as a trade union leader or an industry representative. Furthermore, a lack of formality means that the government is unable to develop a proper understanding of the nature and scale of the informal sector, making policymaking difficult (Kiaga & Leung 2020).

Strategies for driving inclusive growth in Africa

Although it is resource-rich, Africa is the poorest continent, with about 40% of Africans classified as extremely poor[4] (Aikins & McLaughlan 2022). Sub-Saharan Africa, for example, has the dubious reputation of being home to more than half the so-called fragile countries in the world (Signé 2019). According to Chair and De Lannoy (2018), a lack of economic opportunities is one of the most significant concerns of young people globally. African youths account for 60% of the continent's jobless, with the worst-affected countries including Botswana, Republic of Congo, Senegal and South Africa (Ighobor 2019). In sub-Saharan Africa, young, economically active people are mainly found in the informal sector where they face difficult working conditions (ILO 2019). Clearly, employment should be at the centre of the inclusive growth conversation in Africa.

As previously noted, economic growth is a prerequisite for inclusive growth as it enables more people to participate in and benefit from economic activity in a country (the 'economic pie'). Although African countries have at times registered impressive economic growth rates, the causes of such growth tend not to be sustainable. For example, a strong growth rate is often attributable to uncontrollable external events (such as a global commodity price boom or an unexpected, sharp movement in the exchange rate) rather than deliberate structural changes implemented at the policy level (Hausmann et al. 2023; Rodrik 2016). Erratic (as opposed to steady and predictable) economic growth provides a weak foundation for inclusive growth as it does not create a resilient and balanced economy.

According to Rodrik (2016), if Africa wishes to achieve rapid and sustained economic growth well into the future, it could follow one of four possible routes. The first would be to revive and enhance its manufacturing capability to underpin an industrialisation drive. The second would be to drive agriculture-led growth by diversifying into non-traditional agricultural production. The third would be to focus on delivering high-value-added services. The fourth would be to rely on natural resources, with which many African countries are well endowed.

Regarding the manufacturing/industrialisation option, Rodrik (2016, p. 14) maintains that Africa is held back by its 'poor business climate', evidenced by high transport, logistics and energy costs, significant security concerns, onerous or opaque regulations, policy uncertainty and corruption, among other factors. Another limitation is that manufacturing in Africa is

4. The extremely poor live on less than US$2.15 per day (World Bank n.d.).

dominated by small, informal businesses that lack access to finance, modern technologies and sizeable markets, and are not very productive.

Even if African countries were to give serious attention to the aforementioned constraints, manufacturing-led industrialisation is being hampered, both in developed and developing countries (Bhorat et al. 2023). A tell-tale sign in this regard is the shrinking proportion of the labour force making up the manufacturing sector (Hausmann et al. 2023). Rodrik (2016, 2021) attributes this 'de-industrialisation' process to various factors, including shifts in global demand patterns and the disruptive effects of technological advances. For example, while globalisation has – with the growth of global value chains (GVCs) – prompted the relocation of much manufacturing activity from developed countries to developing countries, GVCs rely on imported inputs and therefore constitute a relatively weak channel for domestic employment creation, particularly among those with low-level skills (Rodrik 2021).

The agricultural sector is a major employer in Africa; yet, the prospects of diversifying into more value-added, non-traditional agriculture are, as with manufacturing, limited by Africa's 'poor business climate' and other factors, such as uncertain land rights and high capital costs, especially in the case of large-scale farming (Rodrik 2016, p. 15). The steady migration to urban areas is another deterrent to significant, long-term investment in agriculture.

Although Africa has registered significant growth in recent years in modern service sectors such as mobile telephony and mobile banking, Rodrik (2016) contends that, with a few exceptions, services have not acted as a vehicle for rapid growth on the continent. Many farmers have gravitated to the cities, abandoning their agricultural livelihoods in favour of jobs in various service sectors. However, this transition has not resulted in a marked increase in productivity. The main problem, he claims, is that growth-enhancing services, such as ICT, generally require high skill levels that assume a robust education system and a relatively sophisticated business sector that provides opportunities to learn on the job.

Services account for approximately 60% of Africa's GDP, but most of these are of an informal, low-value-added nature (such as construction and small-scale retailing), which does not drive economic diversification or employment growth (Fosu 2017; Monga et al. 2019). Thus, it is often easier for a farm worker, seeking a career change, to move from agriculture into manufacturing than into a value-added service sector as the required skills of the former are normally less complex at the entry level (Rodrik 2016).

Rodrik (2016) is not in favour of a natural resource-based growth strategy for Africa because few countries have in fact used their natural

resource endowments to rapidly grow their economies – at least not in modern times. Practically all countries that have seen rapid economic growth over the past few decades, he claims, have benefited from a manufacturing-led industrialisation drive. Among the problems associated with a natural resource-based growth strategy are the high capital costs involved and the relatively low labour absorption rate.

Clearly, Rodrik (2016) is less than sanguine about the prospects of Africa generating more rapid economic growth by leveraging its manufacturing, agricultural, services or natural resource capacities. Nevertheless, given Africa's many socioeconomic challenges, particularly its extremely high levels of poverty and unemployment (Van Niekerk 2020), transitioning away from its heavy commodity dependence towards more productive, innovative and value-added economic activities is essential. Hausmann et al. (2023), however, see potential in Africa leveraging its mineral wealth to supply in-demand inputs (such as platinum group metals) to the expanding renewable energy sector both on the continent and globally, while also potentially creating new employment opportunities.

Africa's industrialisation landscape

Jansen van Rensburg et al. (2021, p. 51) define industrialisation as 'a process of moving an economy from a low-productivity, factor-driven stage to a more efficient, innovation-driven stage'. Lin (2011) is of the view that rapid growth rates are the product of innovation and technological adoption and the transformation of agrarian societies into modern, industrialised ones. Naudé (2019) believes that industrialisation is the correct path for Africa to follow. However, he considers industrialisation to be a much broader concept than just manufacturing. In his view, there are three types of industrialisation, which can be mixed and matched according to countries' specific circumstances and levels of development. This is a useful approach as African economies are very heterogeneous.

The first type of industrialisation, according to Naudé (2019), involves building 'traditional', labour-intensive manufacturing capacity while also investing in new, complementary technologies that will gain traction and gradually help the more traditional systems to modernise. The second type involves developing service sectors (such as ICT, tourism, transport, financial services and agricultural services) to support or eventually replace manufacturing. The third type involves engaging in high value-added manufacturing, using digital technologies such as automation, AI, the IoT, big data analytics and cloud computing.

The advantage of adopting a tailor-made approach to industrialisation is that it caters to institutions and individuals at different points along the

knowledge and skills spectrum. This mitigates the risk of job losses with the take-up of increasingly sophisticated technologies and work methods. However, African countries need to proactively leverage new technologies because failure to do so will see them falling further and further behind other countries, which will impact the volume and value of their trade and investment and, consequently, their general development.

Historian-cum-futurist Yuval Harari (2020) goes further, stressing the need for a different mindset about industrialisation. As time passes, Harari contends, land, equipment and other physical assets will no longer be the key drivers of competitiveness; they will increasingly give way to information, data, and digital technologies and skills, which will be harnessed and managed through decentralised decision-making processes. Moreover, increasingly sophisticated forms of AI are poised to alter the world of work in ways that were inconceivable a few short years ago.

We are undoubtedly living in an era of rapid and increasingly unexpected technological change, with the digitalisation of information and rapid data flows having become key economic drivers in many parts of the world (UNCTAD 2021b). Yet, the need for more inclusive societies has never been more pronounced, particularly in Africa. Might technology offer solutions to the inclusive growth conundrum?

The nature and scope of digital developments[5]

The digital era or Industry 4.0 (for want of a better term to describe today's technological age) is not a new phenomenon, but it is constantly evolving, with its effects being felt in the workplace, in the educational and recreational spheres, and in the home environment. As was the case with previous industrial revolutions, Industry 4.0 is proving to be highly disruptive (Cerra 2022). In other words, the advent of advanced robotics, the IoT, 3D printing, blockchain and a myriad of sophisticated AI applications has upset the status quo, prompting mixed opinions about the value (or otherwise) of digitalisation, particularly in developing countries where the adoption of digital technologies lags behind that in developed countries.

AI deserves special mention at this point. It should be noted that AI is ubiquitous and is used in a surprising number of day-to-day applications. For example, email servers use algorithms to filter out spam mail; Google's AI tools advertise goods and services to internet users (with high levels of

5. The term 'digital developments' broadly refers to a range of activities associated with the adoption or increased use of digital tools and technologies. At the heart of digital developments is connectivity, which is dependent (at the most basic level) on a reliable power supply, internet access and appropriate digital devices (Tralac 2019).

precision in what is likely to appeal to them); smartphones use a host of AI applications to automate functions, from predictive text to voice-activated digital assistants; and ride-sharing apps like Uber use AI to coordinate passenger transport needs, driver availability and geographical route maps. AI even had a role to play in the development of COVID-19 vaccines (Broom 2021).

However, the recent release of generative AI systems, such as ChatGPT and Dall-E 2 (by OpenAI), Bing Chat (by Microsoft) and Bard (by Google), has taken AI to a whole new level – to the astonishment of people all over the world. Generative chatbots can draw on all the knowledge available on the internet and produce answers (in text, visual or audio form) to questions and commands at great speed (The Economist 2023). They also learn from previous experience (the true hallmark of AI) and are inexhaustible, unlike humans. This level of innovation has immense implications for a myriad of sectors – manufacturing, engineering, education, health care, transport, financial services, and many others. While generative AI systems could vastly improve productivity, they could also significantly deplete job opportunities – even among highly skilled workers whose cognitive capabilities may no longer be required (Baily, Brynjolfsson & Korinek 2023). Of great concern, too, is that AI can be abused, as 'thinking' machines can wreak havoc in all sorts of ways, if directed to do so. Many governments are mulling ways to regulate AI. It is therefore important to remain aware of key developments in the AI sphere (The Economist 2023).

Some countries have not really progressed beyond the previous industrial revolution (Industry 3.0) which was characterised by the adoption of the internet and other ICT applications for the purpose of digitalising production. Other countries have started to use robotics, AI and other applications in a tentative or piecemeal fashion, while some have embraced them wholeheartedly. Exactly where Industry 3.0 ends and Industry 4.0 begins is not clear, as the former provides an essential foundation for the latter. As a result, 'digital developments' can be regarded as both fundamental (basic) and more cutting-edge, with their prevalence and juxtaposition varying from one organisation, industry sector or country to the next.

Digital terminology

The digital era has given rise to many new terms which, though liberally used, often mean different things to different people. For example, one often hears or reads about the 'digital economy', 'digitalisation', 'digitisation', 'digital advances' and 'digital technologies' – with some used interchangeably.

Bhorat et al. (2023) view the digital economy as:

> [*A*]ny and all economic activities related to, reliant on, or enhanced by, the use of digital technologies. Digital technologies include, but may not be limited to, digital infrastructure, digital services and/or platforms, and digital media. (p. 5)

Parviainen et al. (2017, p. 64) see digitisation as 'the action or process of digitizing; the conversion of analogue data (in later use images, video, and text) into digital form' in the context of business or leisure activities and social engagements. Banga and Te Velde (2018, p. 2) refer to digitalisation as the 'digital transformation of an economy', induced by the application and interaction of different digital technologies. To these authors, digital technologies characterise the digital economy and manifest as robotics, cloud computing, IoT, 3D printing, AI, augmented reality (AR),[6] virtual reality (VR),[7] blockchain and big data analytics. All these digital technologies need physical ICT infrastructure (such as computers, broadband cables, sensors and satellites) and various ICT services to function (Banga & Te Velde 2018; UNCTAD 2019). Furthermore, digitalisation needs an enabling environment, with conducive policies and regulatory frameworks, digital skills (such as programming, web design and digital marketing) and a strong innovation culture (Banga & Te Velde 2018).

Data go to the core of the digital economy and can be retrieved from 'sensors and tracking systems, security cameras, point-of-sale transactions and innumerable other sources – even social media activity, such as app purchases, status updates and "likes"' (Parry et al. 2021, p. 288). However, raw data have no innate value; they need to be aggregated and processed into useful digital information (UNCTAD 2021b). Indeed, the ability to use and commercialise data is a key competitive advantage in many sectors and has spawned the development of both traditional and digital goods and services.[8] Of course, the internet is the cornerstone of any digital process, connecting the world in innumerable ways. Even impoverished or marginalised communities experience the power of the internet at a basic level via their smartphones and other mobile devices (Economist Impact 2022).

6. Augmented reality can be regarded as an altered or embellished representation of an object or location, which is viewed on a smartphone, computer, tablet or other digital device. Augmented reality is often used to encourage greater operational efficiency as it enables workers (prompted by various digital cues) to perform tasks with greater precision.

7. Virtual reality refers to a more extreme departure from day-to-day reality and is experienced by using specialised equipment (such as a VR headset). Virtual reality enables people to enter and interact with a fabricated, 3D environment – be it a tranquil mountain path or a noisy city street.

8. Digital goods are (tangible) goods that are ordered online through e-commerce platforms and then physically delivered (e.g. books or household goods from online retail stores, such as Amazon or Alibaba), or, alternatively, have digital features or components and may or may not be ordered online (e.g. a mobile phone or telecommunications equipment). Digital services are (intangible) services that are ordered and delivered entirely via the internet, such as an airline ticket, an online banking facility, a music download, or online financial or legal assistance. Although digital goods ordered through e-commerce platforms still require traditional logistics (packaging, packing and transport), the digital elements in the transaction (including online ordering, payment and tracking) can greatly streamline the buying and selling process (Barefoot et al. 2018). Not surprisingly, the production and consumption of digital goods and services require a certain minimum level of technological preparedness in terms of infrastructure and skills.

While digitalisation refers to a technological process, digital transformation is arguably a more holistic term, referring to the leveraging of digital technologies to enhance an organisation or sector in the interests of both employees and customers (Get Smarter 2022). Digital transformation thus involves both people-centric change and tech-driven change, although what constitutes an optimal balance between the two will largely depend on the prevailing circumstances (Get Smarter 2022).

How different sectors use digital technologies

All economic sectors, from agriculture to manufacturing and services, make use of digital technologies. The Friedrich Ebert Stiftung (2020) explains that digital technologies can be used in the agricultural sector to improve productivity and food security where production has traditionally relied on slow, manual systems. For example, automation can speed up production and increase output, while the use of various mobile apps (with AI capabilities) can help farmers analyse soil quality, track crop growth, monitor trends and opportunities in the market, and connect with other farmers to share information and concerns.

Artificial intelligence systems can be used in mining operations to monitor the movement of people and rocks underground for enhanced safety, while autonomous vehicles can be used (using IoT technology) to increase production and minimise the risk of accidents (Marwala 2020). The automotive sector is a technology giant that has used automation and robotics in its production processes for many years. As Industry 4.0 has accelerated, vehicle manufacturers have continued to adopt new, increasingly sophisticated technologies. The wholesale production of driverless cars (which will see on-board sensors scanning the surroundings and determining optimal routes from available data, without the need for human intervention) is not yet here, but the emerging technology has already attracted massive interest and investment in research and development (R&D).

In the energy sector, renewable forms of energy (solar, wind and hydro) offer more environmentally friendly and sustainable alternatives to fossil fuels (such as coal, oil and natural gas), which are contributing to the escalating climate crisis in the world today. The financial services sector has undergone dramatic change through the adoption of digital technologies. Many traditional banks, for example, have streamlined their operations to cut costs, trimming the number of physical branches and staff. This does not suggest that staff in the financial services sector are becoming obsolete. While many routine jobs have been automated, there is still a strong demand for people with financial knowledge who are also

tech-savvy to perform various types of work, including designing new, innovative financial products and services (Marwala 2020).

Digital developments have also given rise to the 'fintech' (short for 'financial technology') model which allows people to access a variety of financial services via smartphones and other digital devices, often at very competitive prices. In an African context, some new banks, such as South Africa's Bank Zero, have no physical presence at all and operate entirely in the digital space (Marwala 2020). The well-known M-Pesa mobile money platform has been extremely successful in countries such as Kenya, Ghana, Uganda, Tanzania and Mozambique where conventional banking has never gained significant traction (Jansen van Rensburg et al. 2021). According to the World Bank (2019), M-Pesa has created many new categories of jobs, including 'mobile payment agents', thus helping to compensate for job losses in the formal banking sector because of advancing digitalisation. Digital technologies are also widely used in fields such as transport, logistics, medicine, health care, education and tourism.

The aforementioned examples suggest that if organisations and/or specific industry sectors are proactive and adopt relevant digital technologies to act as effective companions to (and not simply replacements for) their human workforces, they will be able to steer their own digital transformation process and not be defeated by it.

Digitalisation and trade

Digitalisation is extremely important for both regional and international trade. All forms of cross-border trade are powered by the internet, from simple email communications to complex contractual, administrative and payment procedures. However, digital trade adds several layers of complexity to more traditional trade practices (OECD 2023; UNCTAD 2021b).

According to the OECD, WTO and International Monetary Fund (IMF) (2020, p. 11), digital trade is all trade that is 'digitally ordered and/or digitally delivered'. This resonates with the definitions of digital goods and digital services appearing earlier in this chapter. Digitally ordered trade is 'the international sale or purchase of a good or service, conducted over computer networks', while digitally delivered trade is 'international transactions [essentially services] that are delivered remotely in an electronic format' (OECD et al. 2020, p. 11). It is generally accepted that e-commerce is a part of digital trade.

Many developing countries have relatively small domestic markets, which makes regional and global trade necessary to achieve adequate scale, possibly by participating in regional value chains (RVCs) or GVCs

(Friedrich Ebert Stiftung 2020). In Africa's case, focusing on regional trade opportunities makes sense in view of trading partners' geographical proximity to one another. However, intra-Africa trade is very limited, at only about 18% (Tempest 2020). This is mainly because it is both costly and difficult. Not only do goods often attract high tariffs when they cross regional borders, but non-tariff barriers (NTBs) are very prevalent, such as poor physical infrastructure (notably roads and ports) and logistics (including storage facilities), underdeveloped transport corridors, onerous technical standards, inefficient or opaque border formalities, and corruption (Strydom & Viviers 2021).

Despite the enduring importance of imports and exports of non-digital goods and services, the digital era has made it easier for businesses to identify new markets and transact with buyers and sellers cost-effectively, using various digital platforms and tools. It has also spurred the development of more innovative goods and services, helping countries to diversify and add value to their economic pursuits (González & Jouanjean 2017). In Africa, greater digitalisation, both in the products and services produced and in trade procedures, could add value to countries' export offerings and help to bring down the notoriously high cost of trading on the continent. Logistics is an area that can benefit greatly from digitalisation, such as by using 'smart storage', digital scanning and cargo tracking, and drone deliveries (Ouma, Stenmanns & Verne 2019; Tempest 2020).

Gaining greater market access through the adoption of various digital technologies helps to stimulate more economic opportunities and activity and pave the way for more inclusive societies. Meanwhile, a reduction in costs makes companies and sectors more competitive at a regional or international level and more attractive to investors. However, even if African countries were to pursue more vigorous digitalisation drives, this would not lessen the need for them to address their physical infrastructure shortcomings and other cross-border trade impediments, including a lack of coherence between different countries' digital trade rules and uneven knowledge and capacity, especially at the official level (UNCTAD 2021b). This has important implications for the ability of the African Continental Free Trade Area (AfCFTA) to successfully free up trade across the continent through the removal of tariffs and NTBs and the harmonisation of rules and standards (Chivunga & Tempest 2021; Tempest 2020).

Although it is a key focus area for policymakers, digital trade can sometimes be difficult to measure. This adds to the challenge of formulating policies that balance the interests of all relevant stakeholders. Furthermore, the data that drive digital trade can easily fall into the wrong hands and be used unscrupulously or illegally. This heightens the need for national, regional and international cybersecurity laws and regulations as well as multi-party co-operation in ensuring data protection.

To many (developing) countries, digital (especially foreign) technologies pose a threat to local jobs and therefore need to be reined in or curtailed (Bacchetta et al. 2021). Other countries actively encourage the diffusion of new technologies as it helps to accelerate the pace of development. Hausmann (2013) remarked some years ago that almost all the rich countries in the world became wealthy because they effectively leveraged technological advances. He added, though, that it takes time for people to acquire knowledge and put it to productive use, which then becomes 'tacit knowledge' (Hausmann 2013). 'It is easier to move brains than it is to move tacit knowledge into brains', he said. He therefore strongly advocated that trade and investment policies should facilitate the efficient transfer of tacit knowledge, mainly through immigration. This, however, may not be a preferred option in countries faced with high levels of unemployment among their own citizens.

For a country to develop strong trade and digital trade capabilities, it first needs to get its 'domestic house in order', evidenced in policy coherence and certainty, strong and ethical institutions, efficient service delivery at the national and local levels, incentives and rewards for skills development, and progressive and outward-looking trade and investment regimes. It also needs to integrate its trade policies with its domestic (including industrialisation) policies so that they are mutually reinforcing.

Supporters and critics of digitalisation

It is not uncommon to hear that the digital era or Industry 4.0 is busy transforming whole societies and acting as a powerful growth and development lever (Bhorat et al. 2023; OECD 2023; Schwab 2016; WEF 2018; WTO 2018). Schwab (2016) has been a particularly vocal proponent of digitalisation, asserting that it is a key driver of social progress in a fast-changing world. For all its supporters, however, digitalisation has also attracted many critics who are not convinced that it has the power to breathe new life into economies and deliver widespread benefits.

Duncan (2019), Hardoon (2017), the Third World Network (2019) and Friederici et al. (2017) have questioned the usefulness of some of the latest technologies for developing countries (given their skills shortages and fiscal constraints) and have even suggested that such technologies mainly serve the interests of their designers and suppliers in advanced economies. Similarly, Unwin (2019) is of the view that many people and institutions are acting in their own self-interest, designing and marketing digital technologies, with much fanfare, to a gullible or uninformed public. Tackling inequality and extending more economic opportunities to marginalised people are, he claims, the furthest things from most innovators' minds.

Friederici et al. (2017, p. 1) claim that the 'grand visions' of the transformative power of the internet, for example, tend to be peddled by large development organisations (such as the World Bank) and 'big tech' companies with vested interests in driving such a narrative. Furthermore, such entities tend to make sweeping statements, which are not necessarily backed by sound empirical research (Friederici et al. 2017). Friederici et al. (2017) also claim that advocates of digitalisation in the advanced economies are disingenuous in persuading developing countries, and especially LICs, to open their markets to free international data flows. This is because it becomes difficult for recipient countries to establish their own domestic technology industries in the face of competition from foreign firms. Google, Amazon, X (formerly Twitter) and Meta (formerly Facebook) currently enjoy largely uncontrolled access to countries around the world in terms of data retrieval and dispersion, most of which collect no taxes from these tech giants, despite the latter's dominant presence in their local markets (Marwala 2020).

One of the reasons that tech firms such as Google, Amazon and Airbnb, among others, enjoy such liberal access to foreign markets is that, since 1998, there has been a moratorium on the imposition of customs duties on cross-border electronic transactions among WTO members. The moratorium was one of the issues discussed at the WTO's 12th Ministerial Conference in June 2022. Many developing countries (including South Africa) were pressing for the moratorium to be lifted so that they could capitalise on the additional customs revenue that would be generated from cross-border electronic transactions, while also acquiring greater policy space when it comes to digital matters. However, the OECD (among others) has long contended that the lifting of the moratorium would raise tariff levels, subject consumers to higher prices, destabilise digital trade and place a considerable burden on global trade generally, with enormous geopolitical repercussions (OECD 2023). At the WTO's 13th Ministerial Conference held in February 2024, WTO members agreed to a further, temporary extension of the moratorium until the WTO's 14th Ministerial Conference (European Commission 2024).

As vast amounts of data flow, often without restrictions, across digital platforms (both within countries and across borders), data privacy and protection have become very important but also highly contentious issues (Friedrich Ebert Stiftung 2020). Big tech companies are often accused of deviously mining private data from customers to use in their marketing and expansion drives, for example. More worrying is the fact that public- and private-sector organisations and individuals are becoming increasingly susceptible to hacking and other cybercrimes. Unlike the USA and the European Union (EU), few African countries have personal privacy laws or

data-protection laws, which could be invoked in the event of data breaches (Friedrich Ebert Stiftung 2020).

Digitalisation in Africa – Successes and shortcomings

Low levels of digital adoption are usually associated with significant developmental shortcomings and widespread poverty. It comes as no surprise, therefore, that Africa is the least digitally connected continent, with only 43% of the population enjoying internet access in 2023, compared with 67% in Asia, 77% in the Middle East, 80% in Latin America, 89% in Europe and 93% in North America (Internet World Stats 2023). This is despite hundreds of millions of dollars having been spent on sub-marine fibre-optic cables to boost internet connectivity on the African continent. Furthermore, women are 50% less likely to use the internet than men in Africa, which demonstrates the lack of educational and economic opportunities open to many women on the continent (Friedrich Ebert Stiftung 2020). Together with their comparatively low internet penetration rates, African countries must generally contend with slow download and upload speeds (Banga & Te Velde 2018).

It should be borne in mind that Africa's internet penetration rates differ dramatically from country to country. For example, as measured in 2023, some of the most digitally connected countries (i.e. internet users as a proportion of the total population) were Libya (94.8%), Kenya (84.1%), Algeria (83.8%), Mauritius (80.6%), Morocco (79.4%) and Seychelles (78.6%). Some of the least digitally connected countries were Central African Republic (11.2%), Sierra Leone (12.7%), Somalia (14.5%), Mozambique (20%), Burkina Faso (21%) and Equatorial Guinea (24.5%). Interestingly, South Africa's internet penetration rate was only 63.1%, below Tunisia (69.4%) and Nigeria (67.5%) and above Gabon (59.1%), Mali (58.8%), Eswatini (56.4%), Zimbabwe (55.2%), Zambia (51.3%) and Namibia (51.1%) (Internet World Stats 2023). Of course, these percentages are themselves averages, masking within-country variations, but they do give an indication of the relative effectiveness of governments' digitalisation efforts.

Recent years have seen the African continent attract substantial investment in digital technologies and the creation of hundreds of technology hubs. Africa also boasts some sizeable e-commerce marketplaces, such as MallforAfrica, Jumia and Takealot, which are homegrown and supported by impressive logistics operations (Tempest 2020). However, digital developments are mainly concentrated in a few countries (especially Egypt, Morocco, Nigeria, Ghana, Kenya and South Africa), which raises questions about the extent of digital adoption and

digital awareness across the continent (Ndemo & Weiss 2017). In addition, technology hubs often operate in relative isolation, whereas they should be the driving force behind integrated technology ecosystems linking business, government and academia (Juma 2019).

Africa is known for having experienced a 'mobile revolution', evidenced by a dramatic surge in mobile phone usage and exponential growth in the mobile money sector in particular. To many people, this is a clear example of 'technological leapfrogging', which broadly refers to the adoption of modern, often geography-defying technologies (such as mobile phones) in the place of more traditional and expensive technologies (such as landlines) (Swartz et al. 2023). In principle, this enables a sector to accelerate its development and recover some lost ground (Asongu & Boateng 2018; Azmeh & Foster 2018). However, about one-quarter of Africans live more than 50 km from a fibre-optic or cable broadband connection, making access to high-speed internet the exception rather than the rule for many on the continent. A lack of access to efficient and affordable digital networks seriously hampers productivity (Hausmann 2014).

Masters (2021) notes that Africa has a pronounced 'digital divide' which, according to Sanders and Scanlon (2021), refers to uneven access to data and digital technologies, including broadband internet access. Sanders and Scanlon (2021) add that digital exclusion amounts to economic and social exclusion. In this regard, Africa's digital divide reflects many entrenched socioeconomic shortcomings on the continent (Economist Impact 2022; UNCTAD 2021b). The AU Digital Transformation Strategy for Africa (2020–2030) notes that Africa's digital divide is the result of a host of factors, such as inadequate digital infrastructure and skills, limited access to finance, a dearth of education and training opportunities, limited co-operation and cohesion at the policy level, and poor network linkages between African countries (AU 2020). Although there is a great deal of knowledge in circulation, which can be tapped, many organisations in Africa have poor 'absorptive capacity', which refers to the ability to apply externally acquired knowledge and manage an operation effectively (Banga & Te Velde 2018). Compounding the problem is the fact that about half the population of sub-Saharan Africa has no access to electricity[9] (Statista n.d.).

The digital divide has another, less obvious dimension. Masters (2021) contends that African countries have not been able to play an active role in the formation of contemporary knowledge structures (especially through formal research), which are dominated by developed countries, such as the USA, Germany, Finland and Switzerland, and large emerging economies,

9. The use of electricity to drive mass production was the focal point of the Second Industrial Revolution or Industry 2.0, which roughly spanned the period 1870–1969.

such as China and India. Thus, African countries (along with many other developing countries) are largely consumers of knowledge and 'off-the-shelf' digital technologies, from power stations to fibre-optic broadband networks, which were conceived and produced elsewhere. Moreover, little thought appears to have been given as to whether or not such technologies and related rules and standards can be effectively leveraged to build local and regional capacity and competitive advantage.

True digital transformation relies on partnerships and ongoing engagement in the digital space, enabling countries to contribute meaningfully to international knowledge structures rather than simply be on the receiving end of transactional dealings (Derviş 2019; Masters 2021). In this regard, Africa's regional economic communities (RECs) and the AfCFTA have important roles to play. The 2001 Southern African Development Community (SADC) Declaration on Information and Communications Technology stressed the importance of a coherent approach to ICT development in the region and highlighted how the emergence of a digital divide would have serious economic and social consequences (SADC 2001). More than two decades later, the envisaged consequences of the digital divide are all too apparent in many parts of Africa. In the AU Digital Transformation Strategy for Africa (2020–2030), governments are reminded that they must play an overarching, enabling role and have responsive policy and regulatory frameworks in place (AU 2020). The AU Science, Technology and Innovation Strategy for Africa 2024, in turn, drives home the importance of an integrated approach to building research capabilities and networks and contributing to recognised knowledge structures. However, these strategies tend to be short on practical details, particularly on how to overcome longstanding impediments to development on the continent.

Removing the barriers preventing access to, and participation in, Industry 4.0 should be at the core of African countries' domestic economic policies. According to the World Bank (2019), this should entail making digital connectivity more accessible; investing in efficient ICT infrastructure; building skills and capacity; channelling finance into entrepreneurial initiatives; developing innovation and technology hubs; transforming the primary, secondary and tertiary education systems so that they are more Industry 4.0-responsive; expanding opportunities for mentoring; and convincing policymakers of the value of digitalisation and digital transformation.

Trade policy needs to follow suit when it comes to digital matters. In the digital era, 'traditional' trade policies are by no means redundant (Chen et al. 2019). However, additional dimensions must be considered, such as whether and how to regulate cross-border data flows, how to protect consumers' personal and intellectual property rights, how to comply with

digital product and service standards, and what measures should be taken to discourage unfair competition and stamp out cybercrime (International Telecommunication Union [ITU] 2021; Moyo 2019). These issues have added to the challenge of intraregional trade in Africa which has long been burdened with infrastructure and logistics problems, administrative bottlenecks at borders and a lack of regulatory coherence between countries. The AfCFTA has the potential to unlock much pent-up economic and trade potential on the continent, but only if the necessary foundations are in place.

Banga and Te Velde (2018) and Floyd (2022) assert that if African countries take active steps towards removing the impediments to digitalisation, they will reduce the costs of production and trade, boost exports and GVC and RVC activity, and create jobs. If they fail to do so, they will find themselves increasingly out of step with market demand and production standards globally, which could repel investors who have shown interest in establishing or maintaining an offshore presence on the African continent. This could accelerate job losses or prompt a pronounced shift from formal work to more informal, and thus vulnerable, work.

Despite the speed with which new digital technologies are being developed and rolled out, there is a window of opportunity for African countries, according to Banga and Te Velde (2018). They suggest that African countries should concentrate some of their industrialisation efforts (using traditional manufacturing methods) on those sectors that have so far been less susceptible to automation at the global level, including food and beverages, basic metals, and paper and paper products. This would help to narrow the developmental gap and facilitate a smoother transition to more digitalised production in due course.

Perceptions regarding the links between digital developments and inclusive growth

At this point in the narrative, two key questions should be asked. What are the links between digital developments and inclusive growth? What are the implications of such linkages for Africa, especially in view of its considerable development challenges? To answer these questions, one needs to probe the evident synergies and tensions between digital developments and inclusive growth, both of which can be derived from studies examining the relationship between various indicators of digital developments and inclusive growth, respectively. This is covered in Chapter 3 (which examines various quantitative studies on digital developments and inclusive growth) and Chapters 4 and 5 (which analyse, empirically, the employment effects of digital developments in a sample of African countries). However, some initial observations are made in the following paragraphs.

In discussions and debates about digitalisation, a key consideration is whether it is an *inclusive* or a *divisive* force – particularly in view of the high levels of inequality in the world today. This prompts a series of interrelated questions:

- Is the adoption of digital technologies helping to tackle longstanding socioeconomic problems or is it driving a deeper wedge between the 'haves' and the 'have-nots'?
- Is digital adoption creating new jobs across demographic groups and economic sectors or is it depriving people of current jobs as well as future employment prospects?
- Are digital developments and inclusive growth compatible concepts, with the potential to converge at the policy level, or are they ideologically distant from each other?

Many claim that digitalisation makes communication easier and cheaper (WhatsApp and Zoom are simple examples of cost-effective communication channels) and provides new pathways to economic opportunities for those who may otherwise find it difficult to find employment, or at least meaningful employment. These include women and young people who, in many societies, are among the most economically marginalised (Signé 2019; UNESCO 2022; WTO 2018). Even having access to online job advertisements via smartphones can make a difference to people's employment prospects and ultimate well-being.

Furthermore, the adoption of digital technologies and the resultant transformation in the work environment can help some businesses to expand their markets by producing more innovative products and thereby grow their operations (Naudé 2017; UNCTAD 2021a). Importantly, too, many education and training programmes are available online, making them an accessible and convenient companion to those who are keen to acquire a new skill or embark on a new career.

Digitalisation and changes in the workplace

Various scholars stress that digitalisation has the potential to improve productivity and drive down costs (Anderton, Reimers & Botelho 2023; Naudé 2017; Qureshi 2019; Signé 2019). This should boost the demand for labour in more productive, technology-enhanced sectors while also potentially creating new jobs in complementary sectors (UNCTAD 2021a). Admittedly, in the face of advancing automation, there has been a decline in medium-skilled jobs in developed countries, such as computer-assisted clerical work and, in the manufacturing sector, machine operating and assembly – the latter possibly also signalling a progressive shift towards services (UNCTAD 2021a). In contrast, the demand for medium-skilled jobs

(including those in manufacturing) has been rising in middle-income developing countries.

Strydom (2021) reports a similar trend in manufacturing in sub-Saharan Africa where the percentage of manufacturing jobs to total employment is comparatively low (at around 11%). Given such a low level of participation, there is little risk (at least for the foreseeable future) of job polarisation where medium-skilled workers are displaced by machines. Strydom (2021) adds that jobs requiring high-level (e.g. complex cognitive) skills and low-level (e.g. simple manual) skills, respectively, are less 'codifiable' (able to be performed by machines) and therefore less vulnerable to the effects of advancing digitalisation. Cognitive skills include critical thinking, communication, adaptability and problem-solving (Qureshi 2019). As time goes by, though, even highly skilled workers could be displaced by increasingly intelligent, AI-driven machines, warns Baldwin (2019) and Ordonez, Dunn and Noll (2023).

When viewed in a positive light, digitalisation (even a simple internet connection) has the power to give people access to practically unlimited amounts of information, thus acting as a unifying force (Friedrich Ebert Stiftung 2020). This helps to smooth over negative stereotypes relating to people's socioeconomic status, gender, race or disability because, in the digital realm, people's demographic identity is far less obvious.

However, various scholars emphasise that an increasing number of human-centred jobs in different sectors, from finance to logistics, are under threat from or have already fallen victim to automation, machine learning[10] (or AI) and other digital processes (Acemoğlu 2021; Acemoğlu & Restrepo 2019; Muro, Maxim & Whiton 2019). This can be economically and socially devastating if displaced workers are not redeployed to new positions (which may or may not be opening up as more traditional ones fall away) or are unable to take up new professions (Marwala 2020; Muro et al. 2019). Furthermore, replacing humans with machines can prompt a reduction in overall labour demand and wages, exacerbating inequality (Acemoğlu & Restrepo 2019; Cerra 2022). The ability of digitalisation to disrupt employment norms should therefore be anticipated and planned for, with upskilling and reskilling being important interventions (Qureshi 2023).

Acemoğlu (2021) is of the view that the human element in jobs should not be abandoned simply because a machine may be able to deliver results more quickly or cost-effectively. He asserts that an unhealthy preoccupation

10. Acemoğlu and Restrepo (2019, p. 2) define machine learning as 'the statistical techniques that enable computers and algorithms to learn, predict and perform tasks from large amounts of data without being explicitly programmed'.

with automation could deprive firms of a different type of productivity resulting from new work methods and technological applications that actually complement human performance (Acemoğlu 2021). Marwala (2020) agrees that humans will continue to have important roles to play as the business landscape changes, but they will increasingly be expected to display both technological know-how (which requires continual upgrading) and 'soft skills', including critical thinking, active listening, empathy, service orientation and other human skills that generally do not feature in the AI skill set (WEF 2023). This calls for a multidisciplinary approach to education, skills development and capacity building.

According to economist Richard Baldwin, AI need not be a threat to people's jobs – provided they know how to use it (Mok 2023, n.p.). 'AI won't take your job', asserts Baldwin. 'It's somebody using AI that will take your job'. He adds: 'AI is essentially wisdom in a can. It's giving more power to all workers, but especially those average workers'. Regarding OpenAI's ChatGPT, Baldwin is of the view: 'I think it will be uplifting for the middle class, but it will be extremely disruptive in the sense that every job will change'.

Interestingly, in its *Future of Jobs Report 2023*, the WEF (2023) states that the following jobs will see the strongest growth over the next five years: agricultural equipment operators, heavy truck and bus drivers, mechanics, machine repairers, and vocational teachers. Most of these jobs require manual dexterity, supplemented by problem-solving skills. In addition, it is anticipated that there will be a 30% increase in jobs for agricultural professionals. One reason for this is that the agricultural sector is less likely to be impacted by generative AI. However, another reason is the shortening of supply chains, with more and more small farmers supplying consumers directly rather than using intermediaries. Furthermore, in some countries, a strong focus on climate change mitigation and food security is creating new agricultural jobs (WEF 2023).

Digitalisation and inequality

In its *2021 Technology and Innovation Report*, UNCTAD (2021a) focuses specifically on the inequality problem in the world – both within countries and between developed and developing countries – and whether so-called frontier technologies, such as robotics, AI, big data analytics, IoT, blockchain and biotechnology, are likely to exacerbate inequality as time goes by or, in fact, narrow the economic and digital divides. UNCTAD (2023) asserts that frontier technologies (which rely on digitalisation and connectivity) can increase productivity and enhance people's well-being. For example, AI together with robotics can transform production systems, while 3D printing enables fast and relatively inexpensive low-volume manufacturing.

Few countries produce frontier technologies at present (the USA and China are the major players), although this will undoubtedly change in the future. While technological advances are maligned or feared in certain parts of the world, people should remember that it was through AI, biotechnology and other applied sciences that COVID-19 was first identified and testing for the virus began on a massive scale (UNCTAD 2021a).

Digital advances are also important for trade. In fact, trade performance is a key factor influencing the extent of inequality between countries. For example, the ability to produce innovative goods and services using foreign technologies and know-how helps to expand export markets, thereby preserving existing jobs and creating new (and more value-added) ones – provided the firms in question have the right skills and there is an accommodating policy environment (Lederman 2013). Lederman (2013) adds that countries with protectionist trade regimes produce fewer product innovations than countries with more liberal trade regimes. To some extent, this is because exposure to foreign expertise and competitive offerings, resulting from regional and global trade and investment, helps to boost productivity, innovation and value chain participation. About 80% of world trade now takes place in GVCs linked to corporations with a global presence (Derviş 2019).

Somewhat paradoxically, a distinction can be made between *product*-related innovations, which bolster export earnings and create new jobs, and *process*-related innovations, which could result in humans being replaced by more efficient machines (UNCTAD 2021a). Bell and Derviş (2019) are of the view that with the rapid appearance of new technologies, those who are well educated and have a diverse skill set have a better chance of finding or retaining employment than those with lower-level knowledge and skills. In this regard, firms that are not motivated to invest in accessible, affordable and productivity-enhancing technologies could find themselves losing ground to more digitally agile firms, which would negatively impact their local, regional and international competitiveness. Concentrated investment by a few leading firms tends to create monopolies, which hampers general technological diffusion throughout the population (Bell & Derviş 2019). This can dull the prospects of economic growth and inclusive growth.

Overcoming the digital divide

According to Viviers et al. (2019), the concepts of digital developments and inclusive growth are ideologically compatible. Yet, developing countries typically have very divided societies, with some segments able to adopt digital technologies more easily than others (A4AI 2022). UNCTAD (2021a) asserts that it is not digital technologies *per se* that are a potentially divisive

force; rather, it is a country's lack of digital readiness (in terms of ICT deployment, skills and access to finance, among other factors) that causes or widens divisions in society. The countries that are the 'most digitally ready' are generally developed countries, while the 'least digitally ready' are in sub-Saharan Africa.

Bell and Derviş (2019) stress that countries should leverage the gains from innovation to expand trade opportunities, to boost productivity through the provision of incentives, and to create a society in which income is distributed in equitable and sustainable ways. Qureshi (2019, p. 192) is cautiously optimistic about the power of technology to narrow divisions in the world, saying that 'globalisation and technology always produce winners and losers'. Yet, well-crafted policies – from macroeconomic policies to those relating to competition, trade, intellectual property rights and taxation – can help to introduce a better balance and pave the way for stronger and more inclusive growth. In addition to policies, though, there is a need for strong and accountable public and private institutions to ensure that policies are properly implemented (UNCTAD 2021a).

Regarding the influence of digital developments on inclusive growth, Gillwald (2019) asserts:

> There is nothing inherent in so-called 4IR technologies of artificial intelligence, blockchain or drones that will result in economic growth, job creation or empowerment of the marginalised. Evidence from the so-called third industrial revolution tells us we should not take for granted that technology will translate into wage or productivity growth – unless we develop a good set of complementary policies both as business and government. (n.p.)

Similarly, UNCTAD (2021a) opines:

> Technology is neither inherently good nor bad; it is a means to an end. Technology, frontier or otherwise, may support initiatives of all kinds, social, political, or environmental, but all technology needs to be used carefully if it is help rather than hinder. (p. 71)

In other words, digital technologies will not automatically unleash new economic opportunities or accelerate growth. They need to be skilfully *applied* to address specific problems or achieve specific goals. Therefore, inclusive growth (however it is defined) will remain a distant goal unless it has high-level support and there are deliberate interventions to achieve it. UNCTAD (2021a) adds that, to bridge the digital divide, countries need to optimise frontier technologies (calibrated to their level of digital readiness) with a view to spurring rapid growth in various areas and opening up new developmental pathways. At the same time, though, they need to master *existing* technologies with a view to diversifying their economies, upgrading traditional sectors such as agriculture and developing basic digital skills among neglected groups.

Another obvious imperative for developing countries, and Africa in particular, is ensuring that the population has access to 'the basics', including electricity and affordable and reliable internet connectivity. The A4AI (2022) goes so far as to say that all countries should adopt a system of universal internet access to ensure scalable digitalisation. Such digital transformation will rely on robust trade and investment and widespread diffusion of knowledge and know-how via technology hubs, education/skills programmes and on-the-job mentoring (Parry 2021).

Summary and conclusion

This chapter provided an overview of different perspectives on the concepts of inclusive growth and digital developments and whether they have overlapping or antagonistic goals.

Given the high levels of inequality in the world, especially in an economic sense, governments are under increasing pressure to adopt strategies that will forge more inclusive societies. 'Inclusive growth' is often spoken about; yet, the term lacks a universally accepted definition. Some see inclusive growth as a process (e.g. employment creation), while others see it as an outcome (e.g. a reduction in poverty). There are also divided views on whether inclusive growth strategies and interventions should target the poor or whether they should be more broad-based.

Despite these different perspectives, many scholars agree that inclusive growth is dependent on more rapid and more robust economic growth (which is required to fuel more economic opportunities), a more productive workforce (and not a society dependent on social welfare), and a proactive and supportive policy environment. Together, these factors help to pave the way for more jobs – especially better-paying jobs. Clearly, employment goes to the heart of inclusive growth, which is powerfully expressed in SDG 8's call for 'full and productive employment' and 'decent work for all'.

Africa has extremely high levels of unemployment and informal employment, which exacerbate inequality and poverty across the continent. It is therefore critical that Africa's inclusive growth strategies and interventions are directed at productive employment opportunities, especially among marginalised groups, and the creation of a culture of innovation and entrepreneurship. This will translate into stronger and more diverse regional and international trade performance, which will be a further driver of sustainable employment on the continent.

Those countries that have been slow to adopt a digital mindset and digital technologies risk being left behind from a developmental perspective. Many suggest that 'technological leapfrogging' could help countries or sectors to fast-track their growth and development by adopting new

(so-called frontier) technologies – such as various AI applications, IoT, cloud computing and big data analytics – in preference to more traditional alternatives. However, a leapfrogging strategy is at best selectively applied, and the 'basics' must already be in place, such as a reliable electricity supply, fit-for-purpose ICT infrastructure, affordable (and fast) internet connectivity, a conducive trade and investment environment, and a sound regulatory framework to control cross-border data flows and data privacy. These are often in short supply in African countries, culminating in a pronounced digital divide.

Much has been said and written about the benefits of digitalisation to economic sectors as diverse as agriculture, manufacturing and services. However, several scholars are critical of the aggressive tactics employed by 'big tech' organisations and their governments to persuade developing countries to adopt the latest in digital technologies. The scholars in question contend that many of these countries lack the money, skills and commercial sophistication to put such technologies to effective use. That does not mean that developing countries, particularly in Africa, should avoid digitalisation altogether; rather, they should align their technological choices with their development status and priorities. In this regard, it may be advisable to adopt a blend of digital technologies – some sophisticated and some more fundamental – to satisfy the specific needs of different sectors and communities. This approach will also help to shield some sectors from excessive or rapid job losses if they are vulnerable to the risk of human workers being displaced by automation, AI and other digital processes.

Clearly, parallels can be drawn between inclusive growth strategies and digital development strategies. The former are aimed at unlocking economic opportunities (thereby reducing inequality), while the latter are aimed at extending the benefits of digitalisation to as many people as possible (thereby narrowing the digital divide). Both strategies are heavily dependent on macroeconomic stability, education and skills, knowledge diffusion and technological transfer – especially through trade and foreign direct investment (FDI) – and both have significant implications for employment.

While inclusive growth narratives generally emphasise the importance of productivity, they are not forthcoming about how productivity improvements can be made. Digitalisation is all about speed and efficiency, which are at the heart of the productivity debate. However, care needs to be taken, within a policymaking context, to recognise and harness human talents and skills and to ensure that people (who are suitably empowered) become companions rather than slaves to increasingly sophisticated technologies. In other words, digitalisation should be an inclusive, rather than a divisive, force.

Chapter 3

Quantitative studies on inclusive growth and digital developments

Introduction

Chapter 2 provided a cross-section of perspectives on inclusive growth and digital developments, while also noting the perceived synergies and tensions between the two concepts. This chapter advances the discussion by providing an overview of various quantitative studies that have focused on specific dimensions of inclusive growth and digital developments. This chapter first explains the importance of using appropriate measurement techniques and then discusses a selection of studies that have used formal indicators to measure and track inclusive growth and digital developments, respectively, over time. Finally, this chapter examines certain studies that have drawn correlations between selected indicators of inclusive growth and digital developments with a view to showing the effects of the latter on the former.

How to cite: Parry, A, Viviers, W, Orkoh, E & Jansen van Rensburg, SJ 2024, 'Quantitative studies on inclusive growth and digital developments', in *Digital developments and employment: Understanding trends in Africa*, The future of international trade and development, vol. 2, AOSIS Books, Cape Town, pp. 45–62. https://doi.org/10.4102/aosis.2024.BK471.03

Measures of inclusive growth

Strictly speaking, growth (in whatever form) should be measurable. Economic growth, for example, refers to the value of goods and services produced, which is measured at specific intervals. This differs from economic development, which is a much broader concept and includes non-physical attributes, such as education, skills, health, innovation and social structures. It is more difficult to determine the direction and pace of a country's economic development than those of its economic growth, as several of the defining features of development are qualitative in nature and take time to manifest in some or other form. As a result, some countries may produce positive economic growth figures but are actually in developmental decline (Van Niekerk 2017). If *inclusive* growth can be achieved, however, economic diversification and development should be the natural by-products (Van Niekerk 2020).

Inclusive growth, as discussed in Chapter 2, lacks a precise definition. To complicate matters further, it has (at least according to some scholars) some inherent qualitative features, such as employability and productivity, which could manifest in several ways. Moreover, inclusive growth is not typically associated with a standard measurement period, as is the case with GDP or inflation, which are calculated and compared quarterly or annually. The concept of inclusive growth also raises questions about who should benefit from and contribute to growth initiatives, what steps should be taken to improve people's employment prospects and productivity, how much redistribution is advisable and, ultimately, who is responsible for ensuring that inclusive growth gains traction and becomes a sustainable process and/or outcome.

In quantitative studies on inclusive growth, one or more indicators have typically been used to represent (and thus act as proxies for) inclusive growth. Movements in and/or interrelationships between different indicators have then been studied over specific time periods. A selection of quantitative studies and indices are discussed in the ensuing sections. Together, they offer insights into how individual scholars and institutions have chosen to quantify inclusive growth, which has helped to inform the empirical work discussed in Chapters 4 and 5.

Previous quantitative studies measuring inclusive growth

Ramos et al. (2013) analysed changes in inclusive growth over a 10-year period in 43 developing countries from two angles: benefit sharing (specifically poverty and income inequality) and participation (specifically employment). Their study was premised on the fact that inclusive growth

is concerned with the *consequences* of economic growth – in other words, how much inclusiveness is achieved over a specified period. For the indicators, they used poverty data from the World Bank, income inequality data from the Standardized World Income Inequality Database (SWIID) and employment-to-population data from the ILO.

The results from the Ramos et al. (2013) study were mixed. There was a significant reduction in poverty in most of the countries over the period. However, poverty was still of major concern, particularly as most of the countries in the sample were classified as middle-income countries. There was also a reduction in income inequality, with sub-Saharan Africa faring quite well in this regard. However, South Africa showed a worrying increase in inequality over the period. Countries' employment-to-population ratios showed relatively little change, suggesting a lack of meaningful structural changes that would have created more employment opportunities. However, an improved employment-to-population ratio should be viewed with caution as it could be a sign that vulnerable or precarious employment is on the rise. Likewise, a lower employment-to-population ratio is not necessarily a bad thing (at least in the eyes of pro-poor growth advocates) as it could suggest that more people are benefiting from governments' social welfare programmes and therefore face less pressure to work.

In their study of five developing countries (three in Eastern Europe and two in Africa), Kjøller-Hansen and Sperling (2020) likewise set out to determine whether economic growth had been inclusive over the period in question. They focused specifically on productive employment as the key driver of the growth process, while acknowledging that an increase in employment may not be enough to address inequality and poverty. This is because people may be employed but remain poor. Existing work therefore needs to be made more productive while new jobs must also be of the productive variety.

The indicators used in the Kjøller-Hansen and Sperling (2020) study were employment-to-population ratio, wage growth relative to economic growth, low-wage growth relative to high-wage growth, shift in share of employment from low-wage to high-wage sectors and labour productivity growth in the wake of structural transformation. World Bank and UN data were used. As the countries selected for the study were economically diverse, it is not surprising that their performance against the five indicators differed quite markedly. For example, Burkina Faso, the poorest country in the group, showed pleasing growth in high-wage sectors, albeit off a low base. Romania, the most developed country in the group, saw a reduction in unemployment, higher wage growth relative to economic growth and higher labour productivity growth in the wake of structural transformation.

In their study, Kacem, Abid and Ghorbel-Zouari (2019) focused on a single African country, Tunisia, tracking its inclusive growth performance over the period 1980–2017. The purpose of the study was to guide future policymaking. The data were from the World Bank, and the chosen indicators were economic conditions (shown, for example, as GDP per capita growth rate and public debt-to-GDP ratio), inequality and poverty (shown, for example, as the Gini index), education (shown, for example, as years in schooling, literacy rate and tertiary registrations), health (shown, for example, as life expectancy at birth and child mortality rate) and governance (shown, for example, as public expenditure on health and education, and freedom from corruption).

The results from the Kacem et al. (2019) study revealed a deterioration in Tunisia's inclusive growth performance over the period in question, evidenced by rising unemployment (especially among the youth); heightened political and economic marginalisation in certain regions; and increasing educational disparities, institutional weaknesses and corruption. All these factors hampered the fair distribution of growth benefits across different socioeconomic groups. An especially worrying result was that women (even when well educated) were often excluded from the labour market.

Amponsah, Agbola and Mahmood (2023) studied the relationship between poverty, income inequality and inclusive growth in 35 sub-Saharan African countries over the period 1990–2018. The indicators used were poverty headcount (for poverty), net Gini (for income inequality) and GDP per person employed (for inclusive growth). The latter was a new measure designed to capture the participation and benefits of individuals engaged in economic activity. Amponsah et al. (2023) used data from the World Bank's WDI database, the SWIID and the UNDP Human Development database.

The results of the Amponsah et al. (2023) study showed that income inequality increases poverty and worsens the prospects of achieving inclusive growth. Furthermore, inclusive growth (largely the result of structural reforms) may help to reduce poverty and income inequality, but it depends on the type of inclusiveness being sought. For example, rural inclusive growth efforts are more effective in reducing poverty than urban inclusive growth efforts, whereas urban inclusive growth efforts are more effective in reducing income inequality than rural inclusive growth efforts.

Inclusive growth indices

In addition to individual studies, a number of scholars and institutions have developed indices to guide, track and report on countries' inclusive growth

strategies over time. It should be noted that some of the indicators used are quite qualitative in nature and are typically associated with long-term development, thus reinforcing the fact that there is no clear meeting of minds over the meaning and parameters of inclusive growth. A selection of indices that have been published in recent years are discussed in the following sections.

Human Capital Index

The World Bank's Human Capital Index (HCI) measures how much human capital a person born today is likely to acquire given the state of nutrition, health care and education in the country in which they reside (World Bank n.d.). Human capital, according to the World Bank, refers to people's accumulated knowledge, skills and state of health, which will make them more (or less) productive members of society. 'Investing in people through nutrition, healthcare, quality education, jobs and skills helps develop human capital, and this is key to ending extreme poverty and creating more inclusive societies' (World Bank n.d.).

The most recent index, the HCI 2020 (World Bank n.d.), exposed stark differences between the 174 countries surveyed. It was not surprising that HICs on the whole achieved the best scores. For example, Sweden (an HIC) boasted a strong schooling system and high literacy rate among school children as well as a generally healthy population. By contrast, Ethiopia (an LIC) was weighed down by a weak schooling system, a poor literacy rate among school children and a comparatively unhealthy population. South Africa did not perform well on the index, with its educational attainment levels well out of step with its UMIC status. China, another UMIC, far surpassed South Africa in terms of its educational outcomes. This reflected China's strategy of developing a strong human resource base to ensure the country's preparedness to tackle the challenges of a fast-changing world (Marwala 2020).

Ibrahim Index of African Governance

The Ibrahim Index of African Governance (IIAG) measures various governance-related aspects in African countries. Published by the Mo Ibrahim Foundation, the IIAG was recently revised to incorporate three new indicators: anti-corruption (shown, for example, in corruption in public and private institutions, and anti-corruption measures), inclusion and equality (shown, for example, in access to public services and political power) and sustainable environment (shown, for example, in sustainable management of land and forests, and land and water biodiversity) (Mo Ibrahim Foundation n.d.).

In the latest index, IIAG 2021 (Mo Ibrahim Foundation n.d.), Mauritius was in the top position while South Sudan was at the bottom. Although recent years have seen the appearance of new economic opportunities and more rapid human development in Africa, the potential thereof has been eroded to some extent by a deterioration in economic participation, security conditions and adherence to the rule of law.

Inclusive Growth Index

In 2022, UNCTAD launched its Inclusive Growth Index (IGI), which is supported by four pillars: economy, living conditions, equality and environment (UNCTAD 2022). Particular attention is given in the index to gender issues, employment, labour productivity, internet connectivity and financial inclusion. In the latest (2022) index, which used data from the UN, World Bank, ILO, WEF and IMF, the top performers were developed countries, with the top five being Luxembourg, Switzerland, Singapore, Norway and Sweden. The poorest performers were mainly African countries, attributable largely to the limited labour absorption capacity and extreme income inequality on the continent. The index rankings showed that countries needed to achieve a certain level of economic growth and prosperity for inclusive growth to take root and become self-perpetuating (UNCTADSTAT 2023).

Multidimensional Inclusiveness Index

Another index is the Multidimensional Inclusiveness Index (MDI), conceptualised by Dörffel and Schuhmann (2022). It was designed to be an improvement on the UNDP's Human Development Index (HDI) (UNDP n.d.), which uses the indicators of income, schooling and health, and the WEF's Inclusive Development Index (IDI), which uses the indicators of median household income, poverty rate, and income and wealth Gini indices (WEF 2018). The MDI, according to Dörffel and Schuhmann (2022), provides a better assessment of countries' attempts to achieve inclusiveness because it differentiates between developmental achievements (which centre on productivity) and equity (which suggests a more redistributive approach). The indicators used in the MDI include employment-to-population ratio, labour productivity, wealth Gini, gross and net savings rates, equality of health, equality of education, carbon intensity of GDP and natural resource depletion. Data are sourced from the World Bank, the SWIID, the WEF and the UNDP, among other institutions.

The most recent (2018) data showed that Western, developed countries occupied the top positions on the index, while many sub-Saharan African and Central Asian countries featured at the bottom (Dörffel &

Schuhmann 2022). South Africa was in 151st place out of 168 countries, below many other African countries, for example, Mauritius (61st), Morocco (89th), Ghana (103rd), Benin (129th), Burkina Faso (135th), Zambia (145th) and Botswana (148th). Most countries in the world have improved their rankings on the index (albeit at different speeds), suggesting that many people today enjoy a better standard of living than the previous generation. However, the distribution of welfare gains appears to have become more uneven.

Index of Economic Freedom

The Index of Economic Freedom, published by The Heritage Foundation, measures the extent to which a country's policies, regulations and institutions afford people the 'economic freedom' to work, consume, invest and control their own property (The Heritage Foundation 2023). The main principle underpinning the index is that economic freedom fuels greater prosperity (and thus less poverty and inequality) and healthier, greener and more sustainable societies. Various quantitative and qualitative indicators are used to gauge economic freedom: rule of law (shown, for example, in property rights, government integrity and judicial effectiveness), government size (shown, for example, in government spending, tax burden and fiscal health), regulatory efficiency (shown, for example, in business freedom, labour freedom and monetary freedom) and open markets (shown, for example, in trade openness, investment freedom and financial freedom) (The Heritage Foundation 2023).

The 2023 index revealed that the most economically free countries were advanced economies with democratic regimes, for example, Singapore, Switzerland, Ireland, Taiwan and New Zealand. The most repressed countries included North Korea, Cuba, Venezuela, Sudan, Zimbabwe, Eritrea, Burundi, Algeria and Bolivia. In Africa, only Mauritius was deemed mostly free, while a few countries fell into the moderately free category, for example, Botswana, Côte d'Ivoire and Tanzania. South Africa, Morocco, Ghana, Tunisia, Rwanda, Kenya, Namibia, Lesotho and Mozambique were all classified as mostly unfree (The Heritage Foundation 2023).

Measures of digital developments

In the digital development arena, scholars and institutions have similarly used various indicators to measure the nature, direction and speed of digital developments as well as (in some cases) how they have impacted phenomena such as economic growth, poverty, employment, trade and investment, and sustainable development. One of the major challenges associated with using digital development indicators is that the underlying technologies are constantly changing.

A selection of quantitative studies and indices, using various digital development indicators, are discussed in the following sections. Together with the findings from the quantitative studies and indices relating to inclusive growth (discussed earlier in this chapter), they constitute an important foundation for the empirical work discussed in Chapters 4 and 5.

Previous quantitative studies measuring digital developments

Reichstein, Härting and Neumaier (2018) sought to identify the key drivers of digitalisation in 200 European organisations. They tested the impact of six factors in achieving digitalisation effectiveness: efficiency, innovation, data security, mobile applications, new business models and human integration. The results showed that all these factors positively impacted organisations' digitalisation efforts, except for data security – which was surprising. One of the conclusions that Reichstein et al. (2018) reached was that digitalisation should not be seen merely as a series of inanimate digital processes; rather, it is part of a broader system of business optimisation where humans and machines complement one another.

Niyigena et al. (2020) examined the key drivers of ICT literacy and the factors contributing to the digital divide among 1,200 undergraduate students in East Africa over a one-year period. The results showed that the key factors influencing ICT literacy were whether students had urban or rural roots, whether they owned and were experienced in using a computer, and what their major subjects were. Interestingly, gender did not appear to play a role in the students' ICT literacy levels. Niyigena et al. (2020) concluded that mobile applications were being adopted in East Africa, but governments needed to invest more heavily in ICT infrastructure, as this would motivate more students to improve their ICT skills and use online educational resources.

Bhorat et al. (2023) measured the 'digitalisation gap' in 21 African countries over the period 2011–2017, with 21 G20 countries (excluding South Africa) acting as a comparison group. They based their empirical work on five dimensions of digitalisation (digital infrastructure, digital entrepreneurship, digital finance, digital public platforms and digital skills), each of which had a series of indicators, including mobile cellular subscriptions (per 100 people), use of the internet (% of population), ease of access to loans, account ownership at a financial institution, use of digital payment methods (% of population), secondary and tertiary schooling (% of population), and internet access at school (% of secondary school population). The indicators were synthesised into a single composite measure of a digitalisation gap. The results showed that in terms of some indicators (such as mobile phone

subscriptions and bank accounts), African countries have shown steady progress in catching up with the G20 countries. However, in terms of many other indicators (such as online transactions and the use of debit and credit cards), African countries have been lagging behind, with the most negative performance being evident in the digital skills arena.[11]

Digital development indices

As with inclusive growth, a number of indices have been constructed to monitor the pace and trajectory of digital developments in different countries and regions. A selection of published indices are discussed in the following sections.

Inclusive Internet Index

Economist Impact publishes an Inclusive Internet Index (3i), which tracks (using polled data) the extent to which countries are successfully leveraging the many benefits of the internet (Economist Impact 2022a). The indicators used to rank the 100 countries making up the index are internet availability (shown, for example, in breadth and quality of ICT infrastructure and available power supply), affordability (shown, for example, in cost of internet access relative to income), relevance (shown, for example, in relevance of content and local language content) and readiness (shown, for example, in capacity to use the internet based on skills, cultural acceptance and supportive policies).

The top-ranking countries in the 2022 Inclusive Internet Index were mainly developed countries (e.g. the USA, France, United Kingdom (UK) and Switzerland), although three Asian countries (Singapore, South Korea and Taiwan) were also in the top 10. China and Brazil were ranked 22nd and 23rd, respectively, while South Africa was in 49th place, ahead of, for example, India (50th), Egypt (57th), Kenya (58th), Nigeria (64th), Tunisia (66th) and Ghana (73rd). Almost all the remaining countries on the list, in descending order, were in Africa, with Mozambique (97th), Burkina Faso (98th), Liberia (99th) and the Democratic Republic of the Congo (DRC) (100th) at the bottom.

In its five-year report-back on the Inclusive Internet Index, Economist Impact (2022b) highlights that there is still a pronounced digital divide in the world, despite many (especially low-income) countries taking steps to improve their internet connectivity. What emerged from the analysis is that

11. For more information on how the indicators in the aforementioned indices were measured, readers should consult the relevant websites in the list of references for this chapter.

the digital divide is largely the result of a 'usage gap' (signalling people's inability or unwillingness to use the internet) as opposed to inadequate network coverage. This could point to expensive or poor-quality connections and/or poor digital literacy in low- and some middle-income countries. Another worrying finding was that the gender gap in mobile phone and internet usage has widened in some South Asian and sub-Saharan African countries (Economist Impact 2022b).

World Digital Competitiveness Ranking

The World Digital Competitiveness Ranking, which is published by the International Institute for Management Development (IMD) World Competitiveness Center, measures the readiness of more than 60 countries to leverage digital technologies to achieve greater competitiveness. Relying on both hard and soft data, the index uses three indicators: knowledge (resulting from inherent talent, education and skills), technology (supported by regulatory and other frameworks) and future readiness (reflected in business agility and ICT integration).

The 2023 rankings showed that the most digitally competitive countries were largely developed countries (such as the USA, Netherlands, Denmark and Switzerland), although Hong Kong, Taiwan, South Korea and Singapore were also in the top 10. China fared quite well (19th), with India (49th), Brazil (57th) and South Africa (58th) trailing well behind (IMD World Competitiveness Center 2023). South Africa's low ranking is of particular concern, which analysts have attributed to inadequate attention being paid to mathematics and science education and the government's lack of resolve to encourage an innovation culture. Although South Africa moved up two places from its 2022 ranking, it was in 47th position in 2017 when the index was first launched.

Frontier Technologies Readiness Index

The United Nations Conference on Trade and Development (2023) publishes a Frontier Technologies Readiness Index, which compares the capacities of more than 160 developed and developing countries to use, adopt and adapt frontier technologies, such as AI, IoT, blockchain, big data analytics and green hydrogen. The index uses five key technological 'building blocks': ICT deployment, skills, R&D, industrial activity and access to finance.

The results for 2023 showed that those countries displaying the greatest readiness were mainly in North America and Europe (with the USA in the top position), although three Asian nations made it to the top 10 – Singapore, South Korea and Hong Kong. Those countries displaying the least readiness were mainly in sub-Saharan Africa. China was ranked 35th, while Brazil and

India were ranked 40th and 46th, respectively. South Africa was 56th, just below Belarus and just above the Philippines. China's lower-than-expected position was attributed to urban–rural disparities in internet coverage and broadband speed (UNCTAD 2023). If firms in developing countries are to realise the economic gains from new technologies, they need to be empowered to do so. This means that they need not only scientific or technical skills but also a conducive business environment, supported by appropriate policies, regulations and infrastructure (UNCTAD 2023).

Digital Evolution Scorecard

In 2020, the Fletcher School at Tufts University in the USA, in partnership with Mastercard, published its Digital Evolution Scorecard, which analysed 90 economies' digitalisation status and momentum over time. The index used more than 150 indicators grouped into four categories: the quality of physical and ICT infrastructure (supply conditions), the ability of consumers to access and use digital technologies (demand conditions), the quality of policies, laws and regulations (institutional environment), and the availability of capital, talent and industry support (innovation and change). The economies were classified into four types: 'stand out', 'break out', 'stall out' and 'watch out' (Chakravorti, Bhalla & Chaturvedi 2020).

Stand-out economies (including Singapore, the USA, South Korea, Germany and the United Arab Emirates [UAE]) had made significant progress in their digitalisation drives and demonstrated great future potential. Break-out economies (including China, India, Kenya, Rwanda, Bangladesh and Vietnam) had limited digital infrastructure but were digitalising rapidly. Stall-out economies (including Denmark, Switzerland, Finland, Norway, Sweden, the UK and New Zealand) were digitally mature and therefore had comparatively less room for significant growth and advancement. Finally, watch-out economies (including Hungary, Brazil, Mexico, South Africa, Egypt, Namibia, Nigeria and Ethiopia) all demonstrated that their digitalisation efforts were being hampered in various ways. Watch-out economies would be well advised to learn from break-out economies on how to tackle infrastructure gaps, create a strong institutional environment and invest in human capital to narrow the digital divide (Chakravorti et al. 2020).

Affordability Drivers Index

The A4AI publishes an Affordability Drivers Index (ADI), which gauges the extent to which countries' policy, regulatory and supply-side environments help to reduce the cost of, and improve access to, broadband internet services. The index uses various indicators, such as licensing procedures, a national broadband plan, a universal access strategy, infrastructure sharing, a

spectrum allocation plan and gender targets. The A4AI (2022b) is a strong proponent of inclusive digital economies in which infrastructure and accessibility must work seamlessly together, supported by a strong policy environment. According to the A4AI, infrastructure (however sophisticated) is inadequate on its own; it needs to be part of a broader vision to deliver more affordable internet access to the population.

The latest (2021) ADI, which covered 72 low- and middle-income countries, revealed that developing countries are making ICT applications more affordable; yet, progress is often too slow to effectively bridge the digital divide (A4AI 2022a). Top-ranking countries on the ADI included Malaysia, Argentina and Thailand, while low-ranking countries included the DRC, Ethiopia, Afghanistan and Zimbabwe.

Global Cybersecurity Index

The Global Cybersecurity Index (GCI) is published by the ITU, a specialised UN agency. The index measures how well the 190 ITU member states are addressing cybersecurity threats by raising awareness and sharing insights among various stakeholder groups, benchmarking against best practices and conducting self-assessments (ITU 2021). The index uses 20 indicators grouped under five pillars: legal measures (shown, for example, in cybersecurity laws and regulations, and data-protection regulations), technical measures (shown, for example, in technical capabilities and active cyber incident response teams), organisational measures (shown, for example, in national cybersecurity agencies and strategies), capacity development measures (shown, for example, in awareness drives, cybersecurity training and capacity building) and co-operation measures (shown, for example, in cybersecurity public–private sector partnerships and multilateral cybersecurity agreements) (ITU 2021).

The latest (2020) index (ITU 2021) revealed a dramatic range of scores, with the USA, UK, Saudi Arabia and Russia being among the top performers, and Equatorial Guinea, Burundi, DRC, Lesotho and Namibia being among the worst performers. Argentina, South Africa and Botswana, for example, were ranked in the middle of the index. There were some outliers, with LICs such as Tanzania, Benin and Rwanda demonstrating a strong commitment to cybersecurity. In general, countries with high levels of internet connectivity were more likely to have data-protection and cybersecurity laws and regulations than those with low levels of internet connectivity.[12]

12. For more information on how the indicators in the aforementioned indices were measured, readers should consult the relevant websites in the list of references for this chapter.

Previous quantitative studies on the digital developments–inclusive growth relationship

Although individual scholars and institutions have often differed in their choices of indicators for quantitative studies on inclusive growth, most would agree that inclusive growth centres on creating the right conditions for greater economic activity and more active economic participation by marginalised members of society. Indicators denoting employment, productivity, human capital development and innovation are particularly important. Digital developments, in turn, are often regarded as useful growth levers, with important indicators including affordable and efficient internet access, ICT infrastructure, digital skills, digital trade and investment flows, a sound digital policy and regulatory environment, and co-operation in cybersecurity matters.

The need to create more productive and inclusive societies in Africa, using appropriate tools and technologies, has never been more urgent, especially as formal unemployment is at record levels. However, as discussed in Chapter 2, digital technologies are like a double-edged sword: they can either create or destroy jobs and either narrow or widen income gaps, depending on the context. Achieving the right policy environment is a critical factor in ensuring that digital technologies have a unifying and not a divisive effect. A selection of quantitative studies exploring the links between the concepts of inclusive growth and digital developments, using various indicators, are discussed in the following sections.

Regional studies

Cirera and Sabetti (2016), using World Bank data, analysed the effects of innovation on employment in developing countries in Africa, Asia, Eastern Europe and the Middle East over a three-year period. More precisely, they compared sales of products and services produced using new, innovative methods with sales of goods and services produced using 'old' production methods. Among the results was that even with the adoption of new technology, firms' demand for labour remained high if such innovation led to improved sales performance. However, the ongoing demand for labour was dependent on workers becoming more efficient as a result of using the new technology.

Banga and Te Velde (2018), using data from the UN and ILO, examined the impact of digitalisation on labour productivity in the manufacturing sector in selected LICs, LMICs and UMICs in sub-Saharan Africa and South Asia over the period 1991–2013. They used the number of internet users as

the digitalisation indicator, along with various control variables, such as imports as a share of GDP, inward FDI as a share of GDP and the HCI score. Among the results was that increased digitalisation positively impacted labour productivity, although this was less pronounced in sub-Saharan African countries. Banga and Te Velde (2018) attributed this to countries in the region being less well equipped to leverage the productivity-enhancing features of the new technologies. In this regard, Cirera and Sabetti (2016) assert that inadequate education and skills among workers can limit a firm's capacity to turn knowledge into innovative processes and outputs.

In their extensive study, Friederici et al. (2017) sourced 50 papers from a range of databases, with each paper providing empirical results on the effects of internet usage on economic growth across different geographical regions and social strata. Friederici et al. (2017) concluded that the evidence was 'inconclusive' as the papers revealed both positive and negative effects on economic growth. In some cases, a positive effect was dependent on certain conditions being met, such as the attainment of minimum infrastructure and internet user levels.

Africa-specific studies

Asongu (2015) investigated how mobile phone usage affected income distribution in 52 African countries and found that mobile penetration was particularly evident among the poor and helped to bring about greater income equality. Bankole, Osei-Bryston and Brown (2015) measured the effects of ICT infrastructure and complementary factors such as institutional quality and educational attainment levels on intra-Africa trade (exports and imports) in 28 African countries. They found that a strong ICT sector, along with various supporting factors, had a marked positive influence on trade between countries in the region.

Batuo (2015) conducted a study on 44 African countries over the period 1990–2010 and found that telecommunications infrastructure contributed significantly to economic development, while an increase in telecommunications investment generated higher rates of economic growth. This was broadly confirmed in a study by Donou-Adonsou, Lim and Mathey (2016) who conducted a study on 47 African countries over the period 1993–2012 and established that a 1 percentage point increase in internet and mobile phone usage resulted in economic growth rising by 0.12 and 0.13 percentage points, respectively.

Albiman and Sulong (2016) studied the long-term effects of ICT on economic growth in 45 countries in sub-Saharan Africa over the period 1990–2014, using digital development indicators such as numbers of fixed telephone, mobile phone and internet users. Mobile phone and internet

usage were found to stimulate economic growth, although a minimum penetration rate was necessary to induce such growth. Rangkakulnuwat and Dunyo (2018) examined the effects of internet usage on economic growth in 19 African countries over the period 2003–2014. The results showed that internet usage positively impacted economic growth when it was accompanied by the necessary capital investment and ICT infrastructure.

According to the results of a study by Njoh (2018), the use of ICT (evidenced in mobile and fixed phone-line usage, and broadband and wireless internet connectivity) was positively linked to economic development in Africa. The development component in the study was established using HDI data. David (2019) studied the effects of telecommunications on economic growth and development in 26 African countries over the period 2000–2015, using real GDP as the indicator for economic growth and the HDI as the indicator for economic development. The results showed that an expansion in telecommunications networks (evidenced by mobile phone lines, internet access and other variables) had a positive effect on economic growth and development.

Evans (2019) investigated the link between internet usage and economic well-being in 45 countries in sub-Saharan Africa over the period 1995–2015. The results showed two-way causality between internet usage and economic well-being, with economic well-being helping to promote stronger internet usage. Similarly, Haftu (2019) analysed the effects of mobile phone usage on per capita income in 40 sub-Saharan African countries over the period 2006–2015. The results showed that mobile phone usage led to a significant increase in GDP per capita (after controlling for a number of other variables), meaning that it helped to reduce poverty. Interestingly, in the Haftu (2019) study, the effects of the internet on GDP per capita were insignificant – possibly because of limited internet connections, low ICT skills and/or nascent technological developments in the region.

In a study examining the effects of internet usage on employment, Ebaidalla (2014) focused specifically on youth unemployment in 30 sub-Saharan African countries over the period 1995–2010. The results showed that mobile phone usage positively impacted youth employment, suggesting that the mobile boom in Africa had paid dividends. In a study on the effects of ICT on employment in 12 African countries, Khan et al. (2017) examined the correlation between mobile phone ownership, the extent of mobile phone usage and employment. Among the results was that, in most countries, ICT was likely to positively impact the employment prospects of older people, men and those residing in urban areas.

De Berquin and Mbongo (2019) studied the effects of ICT diffusion on the type and level of employment in 20 African countries over the

period 1995–2015. They found that ICT diffusion had a positive effect on employment in general, but on youth employment in particular. Hjort and Poulsen (2019), in turn, found that the laying of sub-marine fibre-optic cables along the African coast had a largely positive effect on employment in 12 African countries – even among the less educated – with very little, if any, job displacement among low-skilled workers and increased employment among higher-skilled workers.

Viviers et al. (2019) conducted a study on the relationship between digital advances and inclusive growth in 27 sub-Saharan African countries over the period 2006–2016, using data from the World Bank, UNCTAD, the OECD and the Bureau of Economic Analysis (BEA) (2018). They used three indicators for digital advances (digitally delivered services trade as a share of total services trade, ICT goods trade as a share of total goods trade and internet users as a share of total population) and six indicators for inclusive growth (employment-to-population ratio, sector-based employment [agriculture, industry, services], vulnerable employment, youth and gender-based employment, GDP per capita growth rate and life expectancy at birth). Among the results were that digital advances led to an increase in employment in the industry and services sectors, but a decrease in employment in the agricultural sector, in vulnerable employment and in the overall employment-to-population ratio.

Orkoh et al. (2021) explored the effects of digital trade on employment in 24 sub-Saharan African countries over the period 2005–2016, using data from UNCTAD and the World Bank. They used two digital indicators (digitally delivered services trade as a share of total services trade and ICT goods trade as a share of total goods trade) and four employment indicators (employment-to-population ratio, vulnerable employment, working poor and sector-based employment [agriculture, industry, services]), along with various control variables. Among the results were that an increase in ICT goods trade led to an increase in total employment and a decrease in vulnerable employment and working poverty, while an increase in digitally delivered services trade led to a decrease in total employment and an increase in vulnerable employment. In addition, an increase in both digitally delivered services trade and ICT goods trade led to a decrease in employment in the agricultural sector but an increase in employment in both the industry and services sectors.

Summary and conclusion

Measuring inclusive growth and digital developments as well as changes in their respective indicators over time allows governments and other interested parties to track the progress of specific strategies and interventions, to arrive at informed conclusions and to formulate or

adjust policies accordingly. However, as inclusive growth and digital developments lack universally accepted definitions (as discussed in ch. 2), the measurement of these two phenomena does not follow prescribed norms. This chapter provided an overview of various quantitative studies on inclusive growth and digital developments. Some studies examined the relationship between inclusive growth and digital developments, and how the latter influenced the former.

To analyse inclusive growth and digital developments empirically, scholars have chosen one or more indicators that, in their view, best represent (and thus act as proxies for) the phenomenon or phenomena in question. These have ranged from (for inclusive growth) GDP per capita growth rate, inequality measures, wage levels, poverty levels, years of schooling, health and well-being, employment levels, and trade and investment flows, to (for digital developments) affordable and fast internet access, ICT infrastructure, digital skills, digital policy environment and digital trade. Sustainability, both in an environmental and socioeconomic sense, has been an important consideration in many of the studies.

The inclusive growth and digital developments studies and indices covered in this chapter largely confirm the general views expressed about these phenomena: that developed countries have more inclusive economies and are more digitally ready than developing countries, and that African countries (with some exceptions) fall into the bottom half of most formal indices' rankings. African LICs generally occupy the very lowest positions. This brings into sharp relief the inclusiveness and digitalisation gaps that many African countries need to fill, particularly in the wake of the added devastation caused by COVID-19. It also suggests that there is an implicit relationship between countries' levels of inclusiveness and digital readiness, which warrants more in-depth empirical research.

The different studies show that digitalisation can help make certain sectors or society as a whole more efficient and inclusive. However, many scholars and institutions add the *caveat* that this can be achieved only if the fundamental macroeconomic building blocks are in place and policymaking is forward- and outward-looking. If they are not, then ongoing digital developments could exacerbate existing socioeconomic divisions (for example, by making more traditional jobs redundant and fuelling higher levels of unemployment or vulnerable employment) and worsen the prospects of developing countries catching up with their more developed counterparts. This is not to say that developing countries should simply try to copy the policy approaches and digital technologies adopted by developed countries. Rather, they should tailor their digitalisation efforts to their developmental status and capacity, immediate priorities and future aspirations.

It would appear that only the Viviers et al. (2019) and Orkoh et al. (2021) studies have examined the effects of digital developments on employment per sector (i.e. agriculture, industry and services) in Africa. It can therefore be concluded that there is a significant research gap in the literature – particularly given the importance that policymakers on the continent attach to each of these sectors, either as current or future employers, and the opportunities and threats that each faces as Industry 4.0 continues to gain momentum. Another evident research gap is the gender effect in the digitalisation–employment relationship in Africa.

Chapter 4 addresses these research gaps by determining, through a regression analysis, the effects of digital developments (using three indicators) on employment (also using three indicators) in a sample of countries in Africa. The empirical work outlined in the chapter builds on Viviers et al.'s (2019) study by focusing on employment indicators only and on Orkoh et al.'s (2021) study by introducing a gender dimension instead of vulnerable employment and working poor, while also adding the number of internet users as a third indicator of digital developments. Another point of distinction is that, unlike the studies by Viviers et al. (2019) and Orkoh et al. (2021), the empirical analysis described in Chapters 4 and 5 uses the World Bank's (2020) LIC, LMIC and UMIC classification of African countries in the presentation of the results. This is important as it makes provision for the fact that African countries are at different stages of development.

Chapter 4

Methodology and data

Introduction

Chapter 3 provided an overview of various quantitative studies, drawn from the global literature, on inclusive growth and digital developments, highlighting the indicators used to measure the different concepts and, in some cases, their interrelationships. This chapter discusses an empirical study that the authors of this book conducted to address certain identified research gaps in relation to the effects of digital developments on employment in Africa. This chapter outlines the research design and methodology, the data and data sources, and the estimation techniques used.

Research design and methodology

A study's research design is intended to map out the steps involved in collecting, analysing, interpreting and presenting the data. It starts with the broad research question or problem and ends with the empirical results (Boru 2018; De Vos et al. 2011). A study's research methodology, in turn, refers to the way in which data are collected and analysed using statistical techniques (Boru 2018; De Vos et al. 2011; Kumar 2014).

How to cite: Parry, A, Viviers, W, Orkoh, E & Jansen van Rensburg, SJ 2024, 'Methodology and data', in *Digital developments and employment: Understanding trends in Africa*, The future of international trade and development, vol. 2, AOSIS Books, Cape Town, pp. 63–75. https://doi.org/10.4102/aosis.2024.BK471.04

This study used an explanatory research design so that the research topic could be investigated from various (including new) perspectives. This study used a quantitative research methodology, supported by a regression analysis to examine the relationships between three dependent variables (relating to employment) and three independent variables (relating to digital developments). In addition, several control variables impacting the employment variables were included in the regression models.

More specifically, the study adopted the longitudinal research method, using panel data regression, which allowed the dataset to be observed multiple times in relation to the independent and dependent variables across 33 African countries over a 20-year period. The use of the longitudinal method made it possible to establish the links and dynamics between the independent and dependent variables over the period in question. Panel data were preferred over other types (e.g. cross-sectional or time-series data) because they allowed for the model parameters to be more accurately inferred, for the complexities underpinning human behaviour to be effectively captured, and for simplified computations and statistics to be inferred (Boru 2018; Hsiao 2007).

Instrumentation

While Chapter 3 referred to a wide range of indicators that earlier studies had used as proxies for the concepts of inclusive growth and digital developments, this chapter refers instead to 'variables', which is an appropriate term to use for regression analysis (although 'indicators' and 'variables' are often used interchangeably). Table 4.1 provides a summary of the variables used in the analysis, with related statistics.

The choice of variables was informed by theory and extant (empirical) literature (Popelo et al. 2021; Wu & Yang 2022; Xia & Pei 2021). With the exception of the entries for the HDI and water/electricity infrastructure development, which are presented as indices in Table 4.1, all other variables are presented as percentages.

Dependent variables

As highlighted in Chapters 2 and 3 in this book, employment is at the core of many conversations about and studies on inclusive growth (Bernstein 2017; Cerra 2022; Ramos et al. 2013; Rodrik 2021; Van Niekerk 2020), and it was the primary focus of the studies by Viviers et al. (2019) and Orkoh et al. (2021). The three dependent variables chosen for this study were related to different dimensions of employment: (1) total employment as a share (%) of total population; (2) sector-level employment (agriculture, industry and services) as a share (%) of total employment, respectively;

TABLE 4.1: Summary statistics of the variables used in the empirical study.

Description of variable	Variable	Observations	Mean
Dependent variables	Employment, 15 years+ (% of total population)	660	62.064
	Agricultural sector employment (% of total employment)	660	49.894
	Industry sector employment (% of total employment)	660	13.773
	Services sector employment (% of total employment)	660	36.334
	Female employment, 15 years+ (% of total female population)	660	53.966
	Male employment, 15 years+ (% of total male population)	660	70.487
Independent variables of interest	Digitally delivered services trade (% of total services trade)	660	34.801
	ICT goods trade (% of total goods trade)	660	4.891
	Number of internet users (% of total population)	660	11.080
Control variables	GDP per capita growth rate (annual %)	660	3.093
	FDI, net inflows (% of GDP)	660	3.259
	General government final consumption expenditure (% of GDP)	660	13.130
	Inflation rate, consumer price index (CPI) (annual %)	660	6.381
	Urban population (% of total population)	660	37.647
	Transparency, accountability, corruption in public sector rating	660	1.611
	HDI ranking (in the range 0–1)	660	0.408
	Water/electricity infrastructure development index (annual %)	660	65.551
Instrumental variable	ICT infrastructure	660	5.319

Source: Authors' computations based on data from UNCTAD (2020) and the World Bank (2020).
Key: ICT, information and communication technology; GDP, gross domestic product; FDI, foreign direct investment; HDI, Human Development Index.

and (3) gender-based employment as a share (%) of total female population and total male population, respectively.

Both a holistic measure of employment and disaggregated measures were deemed important for the study as together they would yield well-rounded results. The different employment measures pertained to formal employment, for which data were available for the countries concerned. Moreover, employment applied to people of working age who had engaged (for as little as a day or a week, or a longer period) either in paid employment or self-employment (ILO 2016).

It is evident from Table 4.1 that the average share (across the 20-year period) of the total population aged 15 years old and above who are employed is 62%, with a minimum of 37% and a maximum of 88%. From a sectoral perspective, the average share of agricultural sector employment

to total employment is the highest (50%), followed by that of services sector employment (36%) and industry sector employment (14%). This makes sense as agriculture is the backbone of a large number of African countries and contributes about 35% to the continent's GDP (Hodder & Migwalla 2023). Regarding gender, the average share of women aged 15 years old and above who are employed is 54%, with a minimum of 14% and a maximum of 86%. The respective rates for men are 71%, 43% and 91%. This is a reflection of male dominance in Africa's labour market, which has been historically shaped by sociocultural norms that make a distinction between men's and women's roles in production and access to productive resources.

Independent variables of interest

It was highlighted in Chapters 2 and 3 that studies have used a variety of indicators to denote digital developments, from mobile phone usage (Asongu 2015) to digital literacy (Banga & Te Velde 2018; Bhorat et al. 2023; Niyigena et al. 2020). In some studies, digital trade was regarded as an important indicator of digital developments. For example, González and Jouanjean (2017), Viviers et al. (2019) and Orkoh et al. (2021) used digitally delivered services trade and ICT goods trade as indicators, while Viviers et al. (2019) introduced an additional digital development variable in their study, that is, internet users. The three independent variables of interest in this study were related to different dimensions of digital developments: (1) digitally delivered services trade as a share (%) of total services trade; (2) ICT goods (or digital goods) trade as a share (%) of total goods trade; and (3) number of internet users as a share (%) of total population.

Following the work of Viviers et al. (2019) and Orkoh et al. (2021), the researchers in this study (and authors of this book) were of the view that digital trade (covering both digital services and digital goods) is key to Africa's development and inclusive growth prospects in the short and longer terms and should therefore be used as independent variables of interest in the study. For example, a country's digital trade performance would indicate its ease of access to imported digital technologies and know-how and its relative export competitiveness in digital and digitally enhanced goods and services. The researchers also decided that the number of internet users in a country should be the third independent variable of interest because internet connectivity is the cornerstone of the digital era and has become a practically indispensable tool in many types of work. Not only is the internet an endless source of information in its own right but it also serves as the driver of innumerable digital applications, both of a fundamental and more cutting-edge nature (Ebaidalla 2014; Hjort & Poulsen 2019; Khan et al. 2017).

Table 4.1 shows that the average share of digitally delivered services trade to total services trade (35%) is significantly higher than the average share of ICT goods trade to total goods trade (5%). As digitally delivered services trade and ICT goods trade cover both exports and imports, it is difficult to determine what drives the observed values. However, the country-level descriptive statistics appearing in Table A2 in the Appendices reveal that only 11 of the 33 countries are net exporters of digitally delivered services, while all 33 countries are net importers of ICT goods.

The average share of internet usage to total population, in turn, is generally low (11%), with a maximum of 74%. The country-level statistics in Table A2 in the Appendices suggest that low internet usage is a common phenomenon in countries with larger populations (such as Uganda, Burundi, Niger and Central African Republic). Internet usage is relatively higher (but still on the low side by global standards) in only a few African countries, such as Morocco (36%), Tunisia (31%), Mauritius (30%), South Africa (28%) and Egypt (23%). The low shares of digitally delivered services trade and ICT goods trade are accompanied by a low level of ICT infrastructure at 6%.

Control variables

In addition to the three independent variables of interest, other variables – which also affect employment – were included in the models to account for the influence of social, economic, political and governance factors at the country level. While these other variables were also independent variables, they were referred to in the study as 'control variables' to differentiate them from the three independent variables of interest.

The eight control variables used in the study were GDP per capita growth rate (annual %) (Haftu 2019; Roser 2021), net FDI inflows (% of GDP), general government final consumption expenditure (% of GDP), inflation rate (consumer price index [CPI]) (annual %), urban population (% of total population), corruption control in public sector rating, HDI (as a proxy for education), and water and electricity infrastructure development index. As all these control variables impact employment, they provided an important context for the analysis.

The GDP per capita growth rate and net FDI inflows as a share of GDP are on average low (< 4%). The average share of government consumption expenditure to GDP is generally high at 13% (with a maximum of 28%). Similarly, the average share of urban population to total population and the inflation rate are generally high when compared with their maximum values. However, the average shares of variables such as transparency, accountability, corruption control and water/electricity infrastructure are relatively low.

The HDI is a composite index of life expectancy (used as a proxy for health), education and gross national income (GNI) per capita (used as a measure of living standards) (UNDP 2022). It is a geometric mean of the normalised indices for each of the three dimensions and ranges from 0 (lowest) to 1 (highest).

The water and electricity infrastructure development index is a composite index derived from the weighted average of several different indicators. Measured in millions of kilowatts per person, electricity in this context relates to the total (private and public) electricity produced by a given country, including imported energy. Water, in turn, is measured as the share of the population with reasonable access to acceptable sources of water, such as a household connection, standpipe, borehole, protected well or spring, and rainwater tank. 'Reasonable access', according to the AfDB, means the availability of at least 20 L of water per person per day from a source within 1 km of their place of residence (AfDB 2018).[13]

Instrumental variable

Information and communication technology infrastructure (Freund & Weinhold 2002) was included in the analysis as an instrumental variable to moderate the exogenous relationships between the independent variables of interest and the dependent variables. This was to ensure that the effect of digital developments on employment could be more closely determined.

Data and data sources

The empirical study used data that are publicly available in the databases of various global institutions.[14] Data for each of the variables included in the analysis were pooled together for the 33 African countries covering the period 2000–2019 (i.e. 20 years), which translated into a balanced panel of 660 country–year observations. The countries were grouped according to the World Bank's classification system, based on countries' GNI per capita in US$ (World Bank 2020). As shown in Table A1 in the Appendices, the dataset comprised 13 LICs, 16 LMICs and four UMICs. The inclusion and exclusion criteria for the country selection were based on data availability. Seychelles, which is classified as an HIC, was dropped from the analysis as the observed variables for that country appeared to be outliers, which could have skewed the results. A lengthy time period (i.e. 20 years) was

13. Details of the methodology and computation process can be found in the Africa Infrastructure Development Index 2018 at https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/Economic_Brief_-_The_Africa_Infrastructure_Development_Index.pdf.

14. Panel data refer to a dataset (comprising, for example, individuals, organisations or countries) whose movements or values can be observed over a period of time. Balanced panel data allow for consistent observations of the dataset across all units of information and periods under investigation.

deliberately chosen to capture the inevitable lag effect with digital developments and also to ensure a sufficient number of (country–year) observations, particularly in the case of the UMICs.

Data on the three dependent variables (total employment as a share of total population, sector-level employment [agriculture, industry, services] as a share of total employment and gender-based employment as a share of total female population and total male population, respectively) were extracted from the World Bank's WDI database (World Bank 2020).

Data on the two independent variables relating to digital trade (i.e. digitally delivered services trade as a share of total services trade, and ICT goods trade as a share of total goods trade) were extracted from the UNCTADSTAT database (UNCTAD 2020). Data on the independent variable pertaining to internet users were obtained from the World Bank's WDI database (World Bank 2020).

Finally, data on the following control variables were obtained from the World Bank's WDI database (World Bank 2020): GDP per capita growth rate, net FDI inflows, government expenditure, inflation rate, urban population, corruption control and HDI. Data on the other control variable (water and electricity infrastructure development) and the instrumental variable (ICT infrastructure) were extracted from the AfDB's Africa Infrastructure Development Index.

Estimation techniques

Different studies have used different estimation techniques to determine what influences employment in a country and whether the effects are positive or negative. Some scholars have used the feasible generalized least squares (FGLS) method (e.g. Anyanwu 2013; Anyanwu & Augustine 2013; Choudhry, Marelli & Signorelli 2012; Tseloni, Tsoukis & Emmanouilides 2011). Others have used the pooled ordinary least squares (OLS), fixed-effect and random-effect regression techniques (e.g. Pattanaik & Nayak 2014) or the dynamic panel estimation technique (e.g. Demidova & Signorelli 2012).

An advantage of the FGLS method is that it controls for panel autocorrelation, heteroskedasticity and non-stationarity of the panel series (Stock & Watson 2003). A disadvantage, though, is that it is unable to overcome the potential endogeneity arising from the correlation between the lagged employment variables (employment in the previous year). Therefore, none of the aforementioned estimation techniques can resolve the problem of possible biases flowing from the high persistence effect of the dependent variable (Demidova & Signorelli 2012). Moreover, the panel data used in this empirical study had small time dimensions (T = 20 years; 2001–2020) and large country dimensions (N = 33 countries).

Having considered the various options, the researchers decided to use the dynamic panel regression model for the empirical study. Following the work of Cameron and Trivedi (2010), the regression model is shown in Equation 1:

$$EMP_{it} = \beta_0 + \beta_1 EMP_{it-1} + \beta_2 DD_{it} + \beta_3 \Phi_{it} + \epsilon_{it} \quad \text{[Eqn 1]}$$

In Equation 1, EMP_{it} represents the vector of the dependent variables (employment as a share of total population; sector-based [agricultural, industry, services] employment as a share of total employment; and gender-based employment as a share of total female population and total male population, respectively). EMP_{it-1}, in turn, represents the lagged employment variables (i.e. the previous year's employment variables) and addresses the issue of autocorrelation between their current and previous values.

DD_{it} represents the vector of the three independent variables of interest (digitally delivered services trade as a share of total services trade, ICT goods trade as a share of total goods trade and number of internet users as a share of total population), while Φ_{it} denotes the vector of the control variables.

The parameter β_0 is the constant term, which represents employment without any control variables. β_1, β_2 and β_3 are the vectors of coefficients of the lagged employment variables, the independent variables of interest and the control variables, respectively.

The subscripts i…..N, t…..T and t–1 represent the individual countries, the time dimensions and the time lags for the dependent variables, respectively. The country-specific fixed effects are incorporated in the error term, ϵ_{it}, in Equation 1. This error term, which is expanded in Equation 2, comprises both the unobserved country-specific factors that affect employment, ψ_i, and specific errors that are unobserved, η_{it}.

$$\epsilon_{it} = \psi_i \eta_{it} \quad \text{[Eqn 2]}$$

The potential endogeneity between digital developments and employment in this analysis was addressed by applying the Arellano and Bond (1991) two-step generalized method of moments (GMM). The lagged (i.e. previous year's) values of the independent variables of interest were used as instruments.

Furthermore, as some studies have determined that ICT infrastructure is a prerequisite for enhanced digital trade and other digitally enhanced economic activities (Abeliansky & Hilbert 2017; Freund & Weinhold 2002), ICT infrastructure was included as an *instrumental* variable, that is, an enabler or a means to establish a clearer correlation between the digital development variables and the employment variables.

Following the work of Mileva (2007), the country-specific fixed effects were dropped, and the problem was solved by using the first differences to turn Equations 1 and 2 into Equations 3 and 4:

$$\Delta EMP_{it} = \beta_i \Delta EMP_{it-1} + \beta_2 \Delta DD_{it} + \beta_3 \Delta \Phi_{it} + \Delta \epsilon_{it} \quad \text{[Eqn 3]}$$

$$\epsilon_{it} - \epsilon_{it-1} = (\psi_i - \psi_i) + (\eta_{it} - \eta_{it-1}) = \eta_{it} - \eta_{it-1} = \Delta \epsilon_{it} \quad \text{[Eqn 4]}$$

The empirical estimation equations can be derived from Equation 3 as Equations 5a, 5b and 5c, with each of the digital development variables being included in a separate regression model (Models I, II and III) to assess their effects on the employment variables:

$$EMP_{it} = \beta_0 + \beta_1 EMP_{t-1} + \beta_2 DDS_{2t} + \beta_3 GDPC_{3t} + \beta_4 GE_{4t} + \beta_5 INF_{5t} + \beta_6 HDI_{6t} + \beta_7 UPP_{7t} + \beta_8 FDI_{8t} + \beta_9 CR_{9t} + \beta_{10} INFR_{10t} + \mu_{it} \quad \text{[Eqn 5a]}$$

$$EMP_{it} = \beta_0 + \beta_1 EMP_{t-1} + \beta_2 ICTG_{2t} + \beta_3 GDPC_{3t} + \beta_4 GE_{4t} + \beta_5 INF_{5t} + \beta_6 HDI_{6t} + \beta_7 UPP_{7t} + \beta_8 FDI_{8t} + \beta_9 CR_{9t} + \beta_{10} INFR_{10t} + \mu_{it} \quad \text{[Eqn 5b]}$$

$$EMP_{it} = \beta_0 + \beta_1 EMP_{t-1} + \beta_2 Internet_{2t} + \beta_3 GDPC_{3t} + \beta_4 GE_{4t} + \beta_5 INF_{5t} + \beta_6 HDI_{6t} + \beta_7 UPP_{7t} + \beta_8 FDI_{8t} + \beta_9 CR_{9t} + \beta_{10} INFR_{10t} + \mu_{it} \quad \text{[Eqn 5c]}$$

$\beta_1 > 0, \beta_2 > 0 < 0, \beta_3 > 0, \beta_4 > 0, \beta_5 > 0, \beta_6 > 0, \beta_7 > 0, \beta_8 > 0, \beta_9 > 0, \beta_{10} > 0$

Employment levels in a country are largely determined by conditions and circumstances at the national, community, household and individual levels. However, this study used national (macro-level) variables to permit cross-country analyses and comparisons.

In Equation 5, EMP_{t-1} represents the lag of the dependent variables (employment as a share of total population; sector-based employment as a share of total employment; and gender-based employment as a share of total female population and total male population, respectively). DDS represents digitally delivered services trade as a share of total services trade, ICTG represents ICT goods trade as a share of total goods trade, and *Internet* represents the number of internet users as a share of total population.

In terms of the control variables, GDPC represents GDP per capita growth rate; FDI represents net FDI inflows; GE represents government expenditure; INF represents inflation; UPP represents urban population; CR represents corruption control; HDI represents years of schooling and life expectancy; and INFFR represents water and electricity infrastructure.

Expected results of the regression analysis

Judging from the different perspectives and insights conveyed in Chapters 2 and 3, one can conclude that the effects of digital developments

on employment in general and in Africa specifically remain theoretically and empirically uncertain. Many macro- and micro-level factors can influence the relationship between the two phenomena. Nevertheless, it was possible to make some assumptions about the likely outcomes of the regression analysis, based on the results of earlier studies and on logical deductions.

Overall, an increase in digital developments was expected to lead to an increase in total employment, with men potentially benefiting more than women because of a frequent pro-male bias in the workplace (Antonio & Tuffley 2014). In their study on the effects of digital trade on employment in Africa, Orkoh et al. (2021) found some evidence of labour migrating from the agricultural sector to the industry and services sectors as digital trade increased. For the current empirical study, the researchers expected that heightened digital developments would lead to an increase in industry and services sector employment but a decline in agricultural sector employment.

Other studies that have used the dynamic panel approach have found that employment levels in previous years have had a marked positive effect on current employment levels (Demidova & Signorelli 2012; Orkoh et al. 2021; Pastore & Giuliani 2015). Therefore, the lags of the dependent variables in this study were expected to have a positive effect on current employment values.

As mentioned in Chapter 2, African countries need strong and sustainable economic growth as the basis for more *inclusive* growth – provided it is not achieved at the expense of countries' long-term environmental and social well-being. Of course, what constitutes 'strong economic growth' depends on the nature and scale of a country's developmental needs, the size of the population and the number of job seekers, among other factors.

From a theoretical standpoint, uncertainty surrounds the link between government expenditure and employment. On the one hand, increased government consumption expenditure can, via the substitution effect, reduce private wealth and consumption and boost the supply of labour (Bouakez & Rebei 2007). On the other hand, according to the new Keynesian models, there is some stickiness in the effects of government expenditure on economic activity because of the lag between prices and wages (Moloi & Marwala 2020). Ultimately, the extent and direction of the effects of digital developments on employment are determined by any of these paradigms' transmission mechanisms, depending on the prevailing conditions in the country. Although the literature frequently asserts that government expenditure in Africa is wasteful and used to fuel corruption (Anyanwu 2013), in this empirical study it was expected that increased government expenditure would have a positive effect on employment.

Similarly, the effects of inflation on employment, both from a theoretical and empirical standpoint, are not readily discernible (Anyanwu 2013). The neo-Keynesian model sees an inverse relationship between inflation and employment in the short term but no clear link in the long term. By contrast, according to the new classical economics school, attempts to reduce unemployment will drive up inflation in the long term (Ferreira & Palma 2015). In the current empirical study, inflation was expected to have a negative effect on employment because it increases production costs (and therefore labour costs) and can deter investment.

Africa suffers from particularly high unemployment rates among the youth, including many graduates of tertiary institutions, because of deficiencies in many countries' education systems, constrained economic conditions, and a mismatch between formal education and skills programmes and the knowledge and skills required in the workplace (Ndung'u & Signé 2020). However, theories on human development acknowledge the important link between formal (especially tertiary) education and people's employment prospects (UN n.d.). In this study, therefore, a higher ranking on the HDI was expected to have a positive effect on employment.

The link between urbanisation and employment has generated a wide range of opinions. It seems intuitive that an urban environment, with its greater concentration of businesses, would provide more employment opportunities because of agglomeration effects. However, some urban residents live far from their places of work, which makes for an inconvenient, time-consuming and costly daily commute (Sanchez-Reaza, Grover & Lord 2016). Urban areas can also have excessive numbers of job seekers because of heavy rural–urban migration, resulting in insufficient work to go around. Many people have to resort to informal work or simply remain perpetually unemployed. The issue of urban employment is clearly multifaceted, but for this study, it was expected that an increase in the urban population would have a positive effect on employment.

It also seems intuitive that improved water and electricity infrastructure, which are critical for large and small businesses alike, would have a positive effect on employment, particularly if such infrastructure is extended to outlying or rural areas (Ianchovichina 2012) as it could provide the impetus to start micro businesses. On this basis, the current empirical study was expected to show that improvements to water and electricity infrastructure would have a positive effect on employment.

Corruption is one of the most serious problems confronting African countries today as it tends to be insidious, infiltrating large numbers of institutions, and redirecting or syphoning resources needed to build efficient operations and leverage new economic opportunities. According to

Transparency International (2022), the only African country that featured among the top 25 (i.e. least corrupt) countries on the Corruption Perceptions Index 2022 was Seychelles, while 14 African countries were among the bottom (i.e. most corrupt) 25 countries on the index. Corruption control measures (particularly in the public sector) therefore play a critical role in creating a conducive climate for job-rich growth. For this study, corruption control was expected to have a positive effect on employment.

It is a truism that incoming FDI flows are important for employment in the receiving countries, both in a direct sense if the FDI is targeted at specific businesses and in a broader sense if it is used to overhaul national infrastructure or encourage the broad diffusion of internet connectivity and other technologies. It could also improve domestic investor sentiment and economic growth prospects (Hisarciklilar, Gultekin-Karakas & Asici 2014). Therefore, for this study, net FDI inflows were expected to have a positive effect on employment.

Summary and conclusion

A number of studies have been conducted on the effects of digital developments on employment, using a range of indicators. However, few have examined the employment effects according to sector and gender across different country income groups within an African context. The empirical study discussed in this chapter set out to address these research gaps, using a disaggregated approach to reveal possible variations in the effects of digital developments on employment according to sector and gender as well as country income group, using the classification system (LICs, LMICs and UMICs) of the World Bank. The latter was a particularly important dimension of the analysis as African countries are far from homogeneous, and country results were therefore likely to be nuanced.

A quantitative research methodology was adopted, using the dynamic panel regression model, to examine the relationships between three dependent variables (relating to employment) and three independent variables of interest (relating to digital developments) across 33 African countries over a 20-year period. A number of control variables were also included in the regression models.

The three dependent variables chosen for the study were (1) total employment as a share of total population, (2) sector-level employment (agriculture, industry and services) as a share of total employment, and (3) gender-based employment (female and male) as a share of total female and male population, respectively. The availability of data determined the final sample size of 33 countries. The three independent variables of interest chosen for the study were (1) digitally delivered services trade as a share of

total services trade, (2) ICT goods trade as a share of total goods trade, and (3) number of internet users as a share of the total population. The rationale for including two trade-related variables was that digital trade is pivotal to Africa's employment and sustainable development prospects. Likewise, the number of internet users is a clear indicator of countries' economic momentum and capacity for productive growth.

In addition, a number of control variables were used to provide a fuller context for the analysis and to help explain some of the results in the event of anomalies or outliers. The control variables were: GDP per capita growth rate, net FDI inflows, government expenditure, inflation rate, urban population, corruption control (public sector), HDI ranking, and water and electricity infrastructure development. Furthermore, an instrumental variable (ICT infrastructure) was included in the analysis to moderate the exogenous relationships between the independent variables of interest and the dependent variables. All the data used for the study were extracted from publicly available sources, including the World Bank's WDI database, the UNCTADSTAT database and the AfDB's Africa Infrastructure Development Index.

Although the general views and formal studies reviewed in Chapters 2 and 3 confirmed the absence of a clear consensus on the effects of digital developments on employment, either in a global sense or in Africa, it was possible to make some assumptions about the likely outcomes of the regression analysis. For example, it was expected that an increase in digital developments would lead to an increase in total employment in Africa, with men benefiting more than women because of the frequent prevalence of a pro-male bias in the workplace. From a sectoral perspective, it was expected that an increase in digital developments would lead to an increase in industry and services sector employment but a decrease in agricultural sector employment, as agriculture in Africa is dominated by small-scale, low-productivity (and low-tech) farming activities, which would find it difficult to leverage the benefits of digital advances.

On the face of it, certain control variables appeared (intuitively) to have predictable outcomes. For example, it was expected that government expenditure, corruption control, net FDI inflows, the HDI ranking, the urban population, and water and electricity infrastructure development would have a positive effect on employment, while inflation would have a negative effect. However, as demonstrated in Chapter 5, which presents the results of the regression analysis, these assumptions were put to the test and in some cases were proven to be incorrect.

Chapter 5

Results and analysis

Introduction

Chapter 4 discussed the methodology used in the empirical study on the effects of digital developments on employment in Africa, using a selection of dependent, independent and control variables, the data for which were drawn from a range of sources. Chapter 4 also outlined the estimation techniques used in the study.

This chapter presents and analyses the results of the empirical study. The chapter is divided into three main sections. The first section provides a brief discussion of the links between the three dependent (employment) variables and the three independent (digital development) variables of interest across the three different country income groups. This provides some useful context for the analysis of the results. The second section presents the results of the regression analysis, also across the three different country income groups. The third section analyses the results, including whether or not there were any surprises, given the researchers' initial expectations.

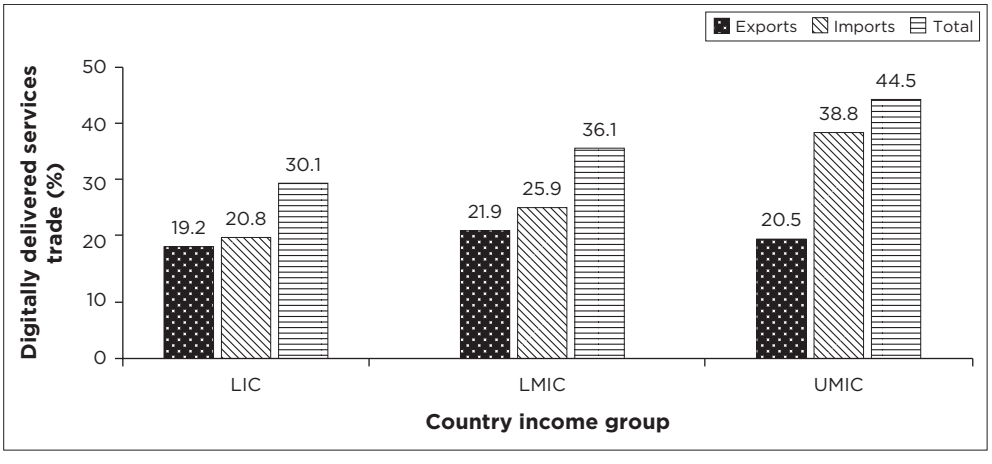
How to cite: Parry, A, Viviers, W, Orkoh, E & Jansen van Rensburg, SJ 2024, 'Results and analysis', in *Digital developments and employment: Understanding trends in Africa*, The future of international trade and development, vol. 2, AOSIS Books, Cape Town, pp. 77–106. https://doi.org/10.4102/aosis.2024.BK471.05

Descriptive statistics showing the dependent and independent variables of interest according to country income group

Figure 5.1 shows that while exports of digitally delivered services make a similar contribution across the three country income groups, imports of digitally delivered services progressively increase from LICs to UMICs. Furthermore, all three country income groups import more digitally delivered services than they export, but the gap between imports and exports is largest in UMICs and smallest in LICs.

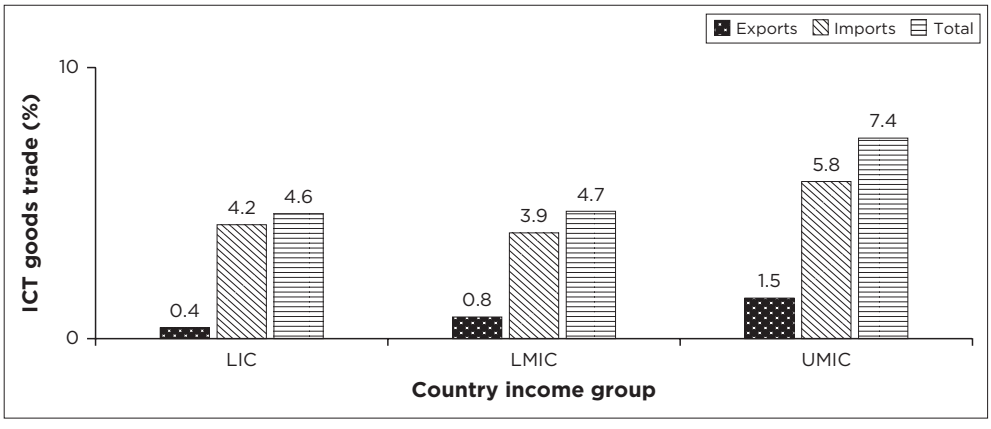
Figure 5.2 shows that UMICs import and export more ICT goods than LMICs and LICs. All three country income groups import far more ICT goods than they export, although exports of ICT goods progressively increase from LICs to UMICs. Low-income countries' and LMICs' exports of ICT goods constitute less than 1% of these countries' total goods trade.

Overall, a similar pattern is evident with the number of internet users across the three country income groups. Figure 5.3 shows that in UMICs, the share of internet users to total population is about five times that in LICs, while in LMICs, the share is about three times that in LICs. Africa's very unequal internet usage patterns can be linked to marked differences in countries' ICT investment, diffusion and cost structures, with the lack of or unreliable electricity also having a major impact on connectivity in various regions.



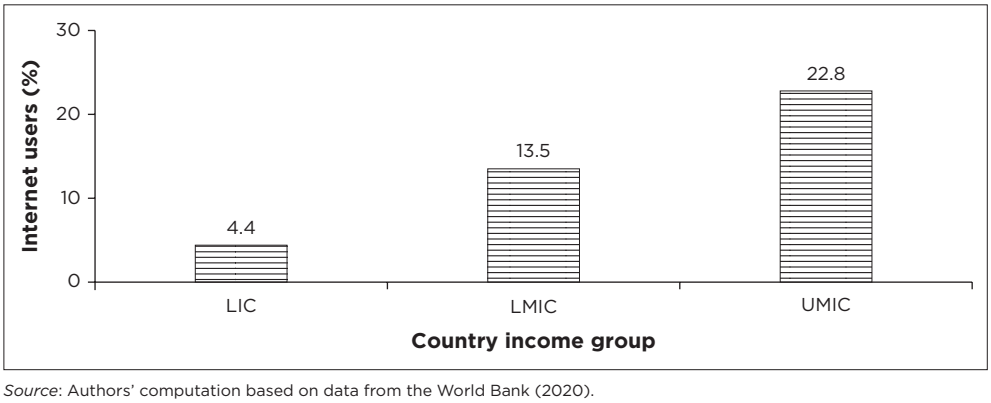
Source: Authors' computation based on data from UNCTAD (2020).
Key: LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country.

FIGURE 5.1: Digitally delivered services trade (as % of total services trade).



Source: Authors' computation based on data from UNCTAD (2020).
Key: ICT, information and communication technology; LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country.

FIGURE 5.2: ICT goods trade (as % of total goods trade).

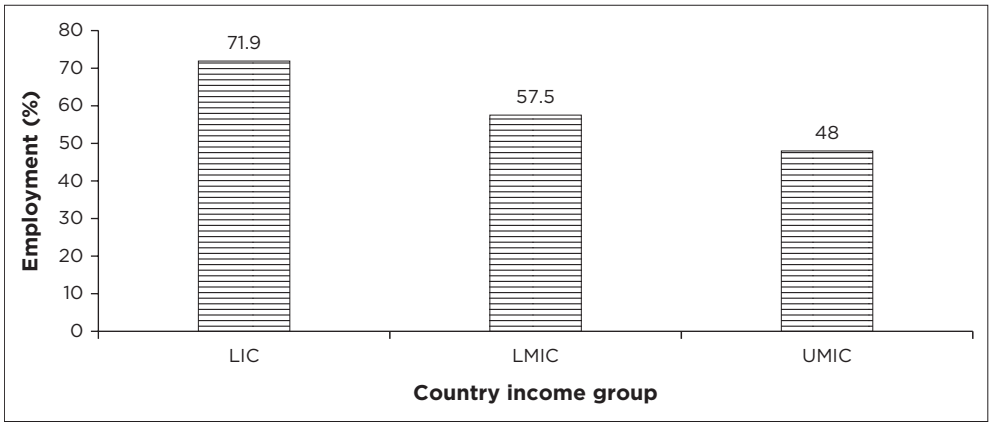


Source: Authors' computation based on data from the World Bank (2020).
Key: LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country.

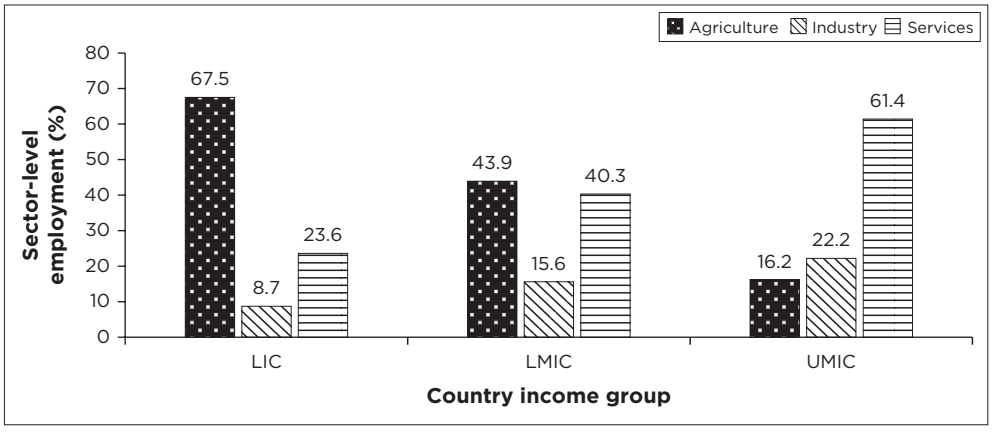
FIGURE 5.3: Internet users (as % of total population).

Figure 5.4 shows that total employment as a share of total population is highest in LICs and lowest in UMICs. It may seem surprising that the figure is so high in LICs. According to Orkoh et al. (2021), this could be a sign of high levels of vulnerable employment (such as single traders), which is less evident in UMICs, such as South Africa, Mauritius or Namibia, where a combination of formal employment and unemployment is more common. However, it should be stressed that a relatively high level of employment in a country says very little about the quality of, or productivity associated with, such employment.

The distribution of total employment varies according to sector, as shown in Figure 5.5. For example, the agricultural sector is the largest employer in



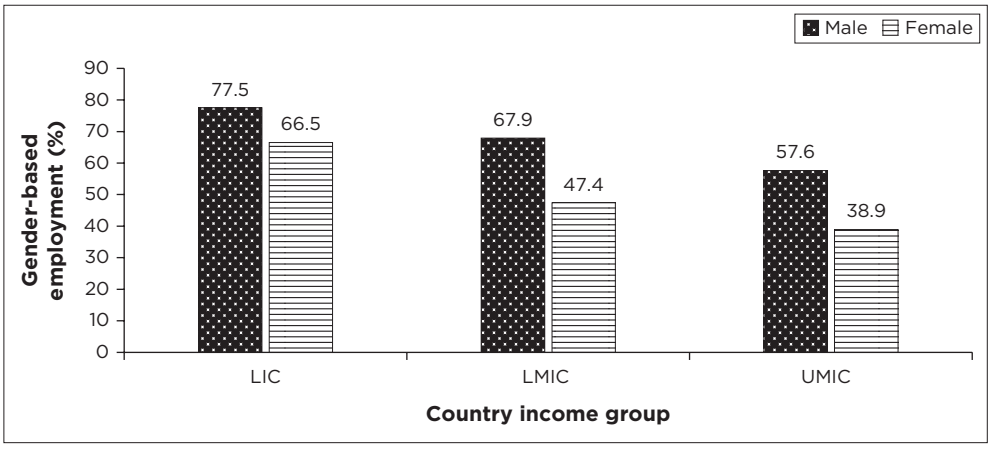
Source: Authors' computation based on data from the World Bank (2020).
Key: LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country.
FIGURE 5.4: Total employment (as % of total population).



Source: Authors' computation based on data from the World Bank (2020).
Key: LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country.
FIGURE 5.5: Sector-level employment (as % of total employment).

LICs, while the services sector is the largest employer in UMICs. In LMICs, the industry sector contributes relatively little in terms of employment (relative to agriculture and services), while industry and services sector employment increases progressively from LICs to UMICs.

Figure 5.6 shows that the level of male employment is higher than that of female employment across all country income groups. However, the gap is less pronounced in LICs than in UMICs and LMICs. This could be because the agricultural sector in Africa, which is dominated by smallholder farming operations, attracts large numbers of female workers (The Borgen Project 2019).



Source: Authors' computation based on data from the World Bank (2020).
Key: LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country.

FIGURE 5.6: Gender-based employment (as % of total female population and total male population, respectively).

In summary, Figure 5.1–Figure 5.6 reveal marked differences between the economic and trade activities and the level of digital advancement of the different country income groups, which in turn give rise to marked differences in employment distribution.

The regression analysis

The reason for using a disaggregated approach in the regression analysis was to reveal possible variations in the effects of digital developments on employment, depending on the countries' stage of development. Clearly, different results would call for different types of policy responses.

Statistical tests conducted

As the data used for the analysis had a relatively long time dimension (20 years), a panel unit root test was conducted to determine whether the dependent (employment) and independent (digital development) variables were non-stationary and followed a random walk process. A number of such tests are covered in the literature. For example, Barbieri (2009) classifies these tests as first generation and second generation. According to Barbieri (2009), the limitation of the first generation of tests (Levin, Lin and Chu test; Im, Pesaran and Shin test; and Fisher-type test) is that they assume cross-sectional independence across units. The second generation of tests rejects the cross-sectional independence hypothesis and adopts covariance–restriction and factor–structure approaches.

In this study, the Fisher-type test was carried out because it accommodates both unbalanced and balanced panels with gaps. The null hypothesis of this test is that all panels contain a unit root, while the alternative (i.e. research) hypothesis states otherwise. Tables A4 and A5 in the Appendices present the values for the test statistics P (inverse chi-squared), Z (inverse normal), L* (inverse logit t) and Pm (modified inverse chi-squared), along with their corresponding *p*-values. As the p-values were all significant at 1% levels, the null hypothesis was rejected in favour of the alternative (i.e. research) hypothesis that there were no unit roots in the panels under the given test conditions. Therefore, the dependent and independent variables were stationary. In addition, the results of the following two tests are presented at the bottom of the different output tables (Table 5.1–Table 5.6): the Arellano-Bond test for serial correlation or autocorrelation and the Hansen test of overidentification.

A regression model may suffer from autocorrelation if the statistic of the second-order test for autocorrelation is significant. In such a case, the previous year's values for the endogenous variable (employment) would not constitute a suitable instrument for the current values. In this study, the tests for the second-order autocorrelation errors were insignificant, which means that the system-GMM models were robust and well specified. In view of these observations, the tests for first-order autocorrelation were rejected. Likewise, the Hansen test of overidentification of restrictions, which assessed the joint validity of the full instrument, appeared to be satisfactory across all three models because the test parameters were also insignificant. The instruments (ICT infrastructure and lagged employment) were correctly identified. Therefore, the models and estimates produced in the regression analysis can confidently be described as robust and reliable.

Presentation and analysis of the results

1. Effects of digital developments on total employment

The results for the effects of digital developments on total employment (as a share of total population) are presented in Table 5.1. The values depicted are β coefficients for the regression equations.

Lagged employment

The estimates of the previous year's (lagged) employment values in Table 5.1 (and in Table 5.2–Table 5.6) provide compelling evidence of the perpetuation of employment levels because of short-term and long-term autocorrelation. These trends are addressed in the modelling to increase the reliability of the estimates (i.e. avoiding upward or downward bias) of

the digital development variables and the control variables, which are thought to have an endogenous effect on employment.

In Model I (in which digitally delivered services trade is the independent variable of interest), a 1% increase in total employment in the previous year would lead to a 0.861% increase in total employment in the current year. (In other words, a 100% increase in [or doubling of] digitally delivered services trade in the previous year would lead to an 86% increase in total employment in the current year.) From a country income group perspective, there would be a 0.866% and 0.868% increase in total employment in the current year in LICs and LMICs, respectively, and a 1.150% increase in UMICs.

In Model II (the model in which ICT goods trade is the independent variable of interest), a 1% increase in total employment in the previous year would lead to a 0.882% increase in total employment in the current year. (In other words, a 100% increase in [or doubling of] ICT goods trade in the previous year would lead to an 88% increase in total employment in the current year.) From a country income group perspective, there would be a 0.861% increase in total employment in LICs, a 0.906% increase in LMICs and a 1.160% increase in UMICs.

In Model III (the model in which the number of internet users is the independent variable of interest), a 1% increase in total employment in the previous year would lead to a 0.847% increase in total employment in the current year. (In other words, a 100% increase in [or doubling of] total employment in the previous year would lead to an 84% increase in total employment in the current year.) From a country income group perspective, there would be a 0.836% increase in total employment in LICs, a 0.869% increase in LMICs and a 1.178% increase in UMICs.

Digital development variables

In Table 5.1, the results show that an increase in digital developments would lead to a decrease in total employment in Model I and Model III. In Model I, a 1% increase in digitally delivered services trade would lead to a 0.086% decrease in total employment. In other words, a 100% increase in (or a doubling of) digitally delivered services trade would lead to an 8.6% decrease in total employment. The scenario changes when viewed in terms of the different country income groups. There would be a 0.092% and 0.083% decrease in LICs and LMICs, respectively, and a 0.038% increase in total employment in UMICs. In Model III, a 1% increase in internet users would lead to a 0.139% decrease in total employment. From a country income group perspective, there would be a 0.170% and 0.125% decrease in total employment in LICs and LMICs, respectively, and a 0.084% increase in total employment in UMICs. Interestingly, in Model II,

there would be a 0.068% increase in LICs and a 0.122% decrease in total employment in UMICs.

The results in Model I suggest that the LICs and LMICs lack the technical skills, capacity and requisite infrastructure to compete with the UMICs in the digitally delivered services trade arena. This assumption is supported by the summary statistics in Table A2 in the Appendices, which show that only 11 of the 33 countries are net exporters of digitally delivered services. The majority of LICs and LMICs in Africa are importers of digitally delivered services, which boosts employment in the foreign (exporting) countries. In contrast, the results in Model II show that an increase in ICT goods trade would make a positive contribution to total employment in the LICs – probably because the LICs are all net exporters of ICT goods (as shown in Table A2 in the Appendices), which are likely to constitute value-added intermediate goods requiring further processing in export markets. From the results in Model III, it can be inferred that the internet is used more productively (and contributes more effectively to job creation) in the UMICs than in the LICs and LMICs.

The employment effects of digitally delivered services trade and ICT goods trade are consistent with the findings of Orkoh et al. (2021) who observed that an increase in ICT goods trade/digitally delivered services trade would lead to an increase/decrease in total employment. These results, including the effects of an increase in internet users on total employment, broadly support the literature which asserts that an increase in digital technologies, such as mobile phones, the internet, ICT services and sub-marine fibre-optic cables, contributes to increased employment in Africa (De Berquin & Mbongo 2019; Ebaidalla 2014; Hjort & Poulsen 2019; Khan et al. 2017).

Control variables

Table 5.1 shows the effects of the control variables on (or at least their contribution to) total employment.

Gross domestic product per capita growth rate: The results show that an increase in the GDP per capita growth rate, which is a key indicator of a country's economic momentum and potential, would contribute to an increase in total employment in all three models. In Model I, a 1% increase in GDP per capita growth would contribute to a 0.105% increase in total employment. From a country income group perspective, there would be a 0.067% increase in total employment in LICs, a 0.144% increase in LMICs and a 0.070% increase in UMICs. In Model II, a 1% increase in GDP per capita growth would contribute to a 0.135% increase in total employment. From a country income group perspective, there would be a 0.092% increase in

TABLE 5.1: Effects of digital developments on total employment (as % of total population).

Effects	Digitally delivered services trade (MODEL I)				ICT goods trade (MODEL II)				Internet users (MODEL III)			
	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total
Lagged employment	0.866*** (0.023)	0.868*** (0.023)	1.150*** (0.029)	**0.861*** (0.020)**	0.861*** (0.026)	0.906*** (0.024)	1.160*** (0.026)	**0.882*** (0.022)**	0.836*** (0.022)	0.869*** (0.022)	1.178*** (0.029)	**0.847*** (0.020)**
Digital development variables	-0.092*** (0.013)	-0.083*** (0.012)	0.038*** (0.014)	**-0.086*** (0.010)**	0.068** (0.034)	0.020 (0.031)	-0.122*** (0.032)	**0.023 (0.030)**	-0.170*** (0.017)	-0.125*** (0.016)	0.084*** (0.022)	**-0.139*** (0.015)**
Control variables												
GDP per capita growth	0.067** (0.032)	0.144*** (0.029)	0.070** (0.033)	**0.105*** (0.024)**	0.092*** (0.033)	0.140*** (0.026)	0.058** (0.027)	**0.135*** (0.025)**	0.090*** (0.029)	0.137*** (0.025)	0.053* (0.029)	**0.133*** (0.023)**
Net FDI inflows	0.007* (0.004)	0.007* (0.004)	0.010*** (0.003)	**0.007** (0.003)**	-0.001 (0.004)	0.002 (0.004)	0.008*** (0.002)	**0.003 (0.003)**	0.003 (0.004)	0.006 (0.003)	0.007*** (0.003)	**0.006* (0.003)**
Government expenditure	0.069*** (0.025)	0.025 (0.020)	-0.144*** (0.026)	**0.047** (0.018)**	0.080*** (0.026)	-0.002 (0.020)	-0.137*** (0.024)	**0.025 (0.019)**	0.082*** (0.023)	-0.009 (0.019)	-0.138*** (0.025)	**0.011 (0.018)**
Inflation rate	0.069*** (0.024)	0.072*** (0.022)	-0.044* (0.024)	**0.090*** (0.019)**	0.088*** (0.025)	0.080*** (0.021)	-0.021 (0.020)	**0.105*** (0.020)**	0.036 (0.022)	0.045** (0.020)	-0.011 (0.022)	**0.060*** (0.019)**
Urban population	-0.002 (0.001)	-0.001 (0.001)	-0.003** (0.001)	**-0.002 (0.001)**	-0.002** (0.001)	-0.002** (0.001)	-0.001 (0.001)	**-0.003*** (0.001)**	0.001 (0.001)	0.001 (0.001)	-0.004*** (0.001)	**-0.000 (0.001)**
Corruption control	0.193*** (0.032)	0.178*** (0.029)	-0.014 (0.038)	**0.188*** (0.027)**	0.092*** (0.030)	0.078*** (0.027)	0.048* (0.026)	**0.081*** (0.025)**	0.096*** (0.026)	0.104*** (0.025)	0.048* (0.028)	**0.109*** (0.023)**
Human Development Index	0.056 (0.153)	0.008 (0.139)	-1.160*** (0.167)	**0.002 (0.130)**	0.517*** (0.147)	0.430*** (0.136)	-0.761*** (0.133)	**0.447*** (0.130)**	0.507*** (0.157)	0.415** (0.164)	-1.539*** (0.209)	**0.496*** (0.153)**
Water/electricity infrastructure	0.004*** (0.000)	0.003*** (0.000)	0.000 (0.000)	**0.004*** (0.000)**	0.004*** (0.000)	0.003*** (0.000)	0.001 (0.000)	**0.003*** (0.000)**	0.004*** (0.000)	0.003*** (0.000)	0.000 (0.001)	**0.003*** (0.000)**
Observations	220	320	80	**620**	220	320	80	**620**	220	320	80	**620**
Number of years	20	20	20	**20**	20	20	20	**20**	20	20	20	**20**
1st order autocorrelation (AB)	0.405	0.001	0.021	**0.215**	0.099	0.178	0.000	**0.024**	0.001	0.037	0.002	**0.220**
2nd order autocorrelation (AB)	0.232	0.173	0.431	**0.304**	0.119	0.475	0.317	**0.254**	0.732	0.147	0.227	**0.547**
Hansen test of overidentification	0.269	0.111	0.237	**0.937**	0.760	0.976	0.243	**0.696**	0.180	0.998	0.289	**0.913**

Source: Authors' computation based on data from the World Bank (2020).
Key: FDI, foreign direct investment; LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country; ICT, information and communication technology.
Note: Models I, II and III relate to Equations 5a, 5b and 5c, respectively; Standard errors in parentheses: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; AB = Arellano-Bond test

total employment in LICs, a 0.140% increase in LMICs and a 0.058% increase in UMICs. In Model III, a 1% increase in internet users would contribute to a 0.133% increase in total employment. From a country income group perspective, there would be a 0.090% increase in total employment in LICs, a 0.137% increase in LMICs and a 0.053% increase in UMICs.

The fact that the different country income groups are highly correlated with the GDP per capita growth rate suggests that there is a non-linear (inverted U-shaped) relationship between this control variable and employment. In other words, employment would increase in line with increases in GDP per capita up to a point where any further increases would be at a decreasing rate.

Net FDI inflows: The results show that an increase in net FDI inflows would contribute to an increase in total employment in Model I and Model III. In Model I, a 1% increase in net FDI inflows would contribute to a 0.007% increase in total employment. From a country income group perspective, there would be a 0.007% increase in total employment in LICs and LMICs and a 0.010% increase in UMICs. In Model III, a 1% increase in net FDI inflows would contribute to a 0.006% increase in total employment. From a country income group perspective, there would be a 0.007% increase in total employment in UMICs. Furthermore, in Model II, there would be a 0.008% increase in total employment in UMICs.

The contribution of net FDI inflows to total employment will depend on a country's economic structure (reflected in the income group to which the country belongs) and other characteristics (Opoku et al. 2022). For example, FDI may either stimulate employment directly by enabling certain businesses to expand or indirectly by triggering backward and forward linkages and multiplier effects in the economy (Brincikova & Darmo 2014). Net FDI inflows are likely to have a weak effect on total employment in LICs as the industry and service sectors – which would typically be the target for foreign investors – do not employ the bulk of the population in these countries. However, the agricultural sector, which absorbs the majority of the workforce in many developing countries, attracts low levels of FDI (Epaphra & Mwakalasya 2017). Curiously, the results show that increased net FDI inflows would have a weak (though positive) effect on total employment in UMICs in all three models.

Government expenditure: The results show that an increase in government expenditure would contribute to an increase in total employment in Model I. In Model I, a 1% increase in government expenditure would contribute to a 0.047% increase in total employment. From a country income group perspective, there would be a 0.069% increase in total employment in LICs but a 0.144% decrease in UMICs. In Model II, there would be a 0.080% increase in total employment in LICs but a 0.137%

decrease in UMICs. In Model III, there would be a 0.082% increase in total employment in LICs but a 0.138% decrease in UMICs.

The contribution of government expenditure to total employment will depend on the government's usual expenditure priorities and patterns, the relationship between high-priority sectors and other sectors, private ownership levels in the country and the investment climate. For example, government spending in labour-intensive sectors such as agriculture, which is a major source of employment in LICs and LMICs, has the potential to stimulate more employment opportunities in such countries than in UMICs. Shen, Yang and Zanna (2018) argue that the importance of government spending on LICs' output and trade is the result of these countries' weak investment climate and reliance on public funds. It can be deduced from the results that increased government expenditure in sectors that have greater linkages with other sectors could have beneficial multiplier effects.

Inflation rate: The results show that an increase in the inflation rate would contribute to an increase in total employment in all three models. In Model I, a 1% increase in the inflation rate would contribute to a 0.090% increase in total employment. From a country income group perspective, there would be a 0.069% and a 0.072% increase in total employment in LICs and LMICs, respectively, but a 0.044% decrease in UMICs. In Model II, a 1% increase in the inflation rate would contribute to a 0.105% increase in total employment. From a country income group perspective, there would be a 0.088% increase in total employment in LICs and a 0.080% increase in LMICs. In Model III, a 1% increase in the inflation rate would contribute to a 0.060% increase in total employment. From a country income group perspective, there would be a 0.045% increase in total employment in LMICs.

It should be noted that inflation is not always bad for an economy; it depends on the level of inflation and the sectors that it affects, as well as the overall structure of the economy. In agriculture-led economies, for example, a moderate rise in food inflation could boost agricultural activity and output, thereby expanding the job pool (Aye & Odhiambo 2021).

Urban population: The results show that an increase in urban population would contribute to a decrease in total employment in Model II. In Model II, a 1% increase in urban population would contribute to a 0.003% decrease in total employment. From a country income group perspective, there would be a 0.002% decrease in total employment in LICs and LMICs. In Model I, there would be a 0.003% decrease in total employment in UMICs, and in Model III, there would be a 0.004% decrease in total employment in UMICs.

Expanding urban populations can promote higher levels of unemployment as job seekers from rural areas converge on the cities looking for (in some cases, non-existent) work. Not only does this worsen the high unemployment

levels in the countries concerned, but it breeds other social ills, including urban decay and criminality (Basu & Basu 2000; Tufail et al. 2023; Zenou 2011). The results corroborate the findings of earlier studies (Potts 2000; Zenou 2011) which assert that migration from rural to urban areas can aggravate unemployment levels because of a dearth of jobs and employment incentives as well as wage inequality.

Corruption control: The results show that an increase in corruption control would contribute to an increase in total employment in all three models. In Model I, a 1% increase in corruption control would contribute to a 0.188% increase in total employment. From a country income group perspective, there would be a 0.193% increase in total employment in LICs and a 0.178% increase in LMICs. In Model II, a 1% increase in corruption control would contribute to a 0.081% increase in total employment. From a country income group perspective, there would be a 0.092% increase in total employment in LICs, a 0.078% increase in LMICs and a 0.048% increase in UMICs. In Model III, a 1% increase in corruption control would contribute to a 0.109% increase in total employment. From a country income group perspective, there would be a 0.096% increase in total employment in LICs, a 0.104% increase in LMICs and a 0.048% increase in UMICs.

The literature highlights that corruption is a severe problem in Africa and is one of the leading factors hampering economic growth and job creation, both of which are urgently needed in view of Africa's rapidly expanding population (Adenike 2013; Ayittey 2000). From the results, it is evident that corruption control has a more pronounced (positive) effect on total employment in LICs and LMICs than in UMICs in Africa.

Human Development Index: The results show that an improvement in the HDI ranking would contribute to an increase in total employment in Models II and III. In Model II, a 1% improvement in the HDI ranking would contribute to a 0.447% increase in total employment. From a country income group perspective, there would be a 0.517% increase in total employment in LICs and a 0.430% increase in LMICs but a 0.761% decrease in UMICs. In Model III, a 1% improvement in the HDI ranking would contribute to a 0.496% increase in total employment. From a country income group perspective, there would be a 0.507% increase in total employment in LICs and a 0.415% increase in LMICs but a 1.539% decrease in UMICs. Moreover, in Model I, there would be a 1.160% decrease in total employment in UMICs.

It is intuitive that an improved HDI score (which acts as a proxy for human capital or educational standards) would contribute to more job opportunities in Africa. However, the literature suggests that many African countries have not been able to turn their abundant human capital into an able, employed workforce. There are several reasons for this, including insufficient numbers of jobs for fast-expanding populations, the

questionable quality of qualifications from most educational institutions across the continent and corruption (Elder & Koné 2014).

The decrease in total employment in UMICs across the three models is quite surprising as one would expect the quality and employability of human capital in UMICs to be higher than in LICs and LMICs. However, the results should be interpreted with caution because, as mentioned, the possession of a tertiary qualification does not necessarily make someone employable. This is because of the frequent disconnect between formal education and skills development programmes and employers' expectations in the workplace. Moreover, organisations are hard-pressed to absorb all the qualified job seekers in the market because of the sheer numbers involved, especially if their countries face economic constraints.

Water/electricity infrastructure: One can assume that infrastructure development in the water and electricity sectors will not have an immediate effect on employment. Therefore, for the purpose of the analysis, the lagged variables for water and electricity infrastructure were used instead of the current variables. The results show that an increase in infrastructure development would contribute to an increase in total employment in all three models. In Model I, a 1% increase in infrastructure development would contribute to a 0.004% increase in total employment. From a country income group perspective, there would be a 0.004% increase in total employment in LICs and a 0.003% increase in LMICs. In Model II, a 1% increase in infrastructure development would contribute to a 0.003% increase in total employment. From a country income group perspective, there would be a 0.004% increase in total employment in LICs and a 0.003% increase in LMICs. In Model III, a 1% increase in infrastructure development would contribute to a 0.003% increase in total employment. From a country income group perspective, there would be a 0.004% increase in total employment in LICs and a 0.003% increase in LMICs.

2. Effects of digital developments on sector-level employment

The results for the effects of digital developments on agricultural sector employment, industry sector employment and services sector employment (as shares of total employment) are presented in Table 5.2, Table 5.3 and Table 5.4, respectively. The values depicted are β coefficients for the regression equations.

Digital development variables

Effects on agricultural sector employment: The results in Table 5.2 show that an increase in digital developments would lead to a decrease in

TABLE 5.2: Effects of digital developments on agricultural sector employment (as % of total employment).

Effect	Digitally delivered services trade (MODEL I)				ICT goods trade (MODEL II)				Internet users (MODEL III)			
	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total
Lagged employment	0.776*** (0.052)	0.732*** (0.040)	1.412*** (0.118)	**0.742*** (0.039)**	0.708*** (0.054)	0.691*** (0.044)	1.678*** (0.121)	**0.752*** (0.041)**	0.688*** (0.051)	0.705*** (0.036)	1.293*** (0.136)	**0.732*** (0.036)**
Digital development variables	-0.195*** (0.026)	-0.205*** (0.022)	-0.106** (0.044)	**-0.206*** (0.021)**	0.293*** (0.067)	0.173*** (0.067)	-0.191 (0.119)	**0.128** (0.058)**	-0.371*** (0.037)	-0.361*** (0.028)	-0.212*** (0.078)	**-0.349*** (0.028)**
Control variables												
GDP per capita growth	0.114* (0.067)	0.181*** (0.050)	0.025 (0.101)	**0.174*** (0.048)**	0.143** (0.067)	0.309*** (0.059)	0.054 (0.096)	**0.247*** (0.049)**	0.164** (0.064)	0.226*** (0.044)	-0.032 (0.106)	**0.208*** (0.042)**
Net FDI inflows	0.012 (0.009)	0.002 (0.007)	0.001 (0.009)	**0.001 (0.007)**	-0.003 (0.008)	-0.009 (0.008)	-0.001 (0.008)	**-0.008 (0.007)**	0.004 (0.008)	0.002 (0.006)	0.004 (0.009)	**0.001 (0.006)**
Government expenditure	0.099* (0.058)	0.114*** (0.039)	-0.371*** (0.115)	**0.133*** (0.038)**	0.150*** (0.058)	0.094** (0.040)	-0.595*** (0.116)	**0.092** (0.038)**	0.151*** (0.056)	0.030 (0.035)	-0.283** (0.118)	**0.032 (0.034)**
Inflation rate	0.194*** (0.049)	0.228*** (0.039)	0.253*** (0.074)	**0.239*** (0.037)**	0.236*** (0.048)	0.295*** (0.042)	0.245*** (0.071)	**0.281*** (0.037)**	0.122** (0.049)	0.150*** (0.035)	0.261*** (0.078)	**0.143*** (0.034)**
Urban population	-0.002 (0.002)	-0.006*** (0.002)	-0.035*** (0.005)	**-0.007*** (0.002)**	-0.003 (0.002)	-0.009*** (0.002)	-0.032*** (0.005)	**-0.010*** (0.002)**	0.004* (0.002)	-0.002 (0.002)	-0.034*** (0.005)	**-0.002 (0.002)**
Corruption control	0.472*** (0.066)	0.521*** (0.056)	0.417*** (0.124)	**0.542*** (0.054)**	0.282*** (0.059)	0.347*** (0.053)	0.213** (0.091)	**0.306*** (0.049)**	0.268*** (0.056)	0.349*** (0.045)	0.261*** (0.091)	**0.347*** (0.044)**
Human Development Index	-0.734** (0.313)	-0.756*** (0.266)	-3.760*** (0.566)	**-0.870*** (0.256)**	-2.080*** (0.291)	-1.888*** (0.268)	-4.306*** (0.469)	**-1.961*** (0.253)**	0.300 (0.341)	0.511* (0.279)	-2.954*** (0.745)	**0.376 (0.277)**
Water/electricity infrastructure	0.010*** (0.001)	0.010*** (0.001)	0.013*** (0.002)	**0.010*** (0.001)**	0.009*** (0.001)	0.008*** (0.001)	0.011*** (0.001)	**0.008*** (0.001)**	0.010*** (0.001)	0.009*** (0.001)	0.013*** (0.001)	**0.009*** (0.001)**
Observations	220	320	80	**620**	220	320	80	**620**	220	320	80	**620**
Number of years	20	20	20	**20**	20	20	20	**20**	20	20	20	**20**
1st order autocorrelation (AB)	0.004	0.525	0.000	**0.001**	0.000	0.001	0.000	**0.001**	0.051	0.033	0.000	**0.002**
2nd order autocorrelation (AB)	0.698	0.147	0.992	**0.198**	0.154	0.406	0.762	**0.955**	0.525	0.259	0.243	**0.276**
Hansen test of overidentification	0.293	0.540	0.905	**0.285**	0.569	0.221	0.916	**0.827**	0.714	0.239	0.997	**0.858**

Source: Authors' computation based on data from the World Bank (2020).
Key: FDI, foreign direct investment; LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country; ICT, information and communication technology.
Note: Models I, II and III relate to Equations 5a, 5b and 5c, respectively; Standard errors in parentheses: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; AB = Arellano-Bond test.

TABLE 5.3: Effects of digital developments on industry sector employment (as % of total employment).

Effect	Digitally delivered services trade (MODEL I)				ICT goods trade (MODEL II)				Internet users (MODEL III)			
	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total
Lagged employment	0.227*** (0.038)	0.271*** (0.033)	0.168*** (0.053)	**0.250*** (0.033)**	0.217*** (0.036)	0.262*** (0.033)	0.176*** (0.054)	**0.238*** (0.032)**	0.272*** (0.039)	0.308*** (0.033)	0.150*** (0.056)	**0.291*** (0.034)**
Digital development variables	0.069*** (0.020)	0.040*** (0.015)	-0.062** (0.031)	**0.037** (0.015)**	0.145*** (0.044)	0.188*** (0.041)	0.095 (0.079)	**0.168*** (0.037)**	0.174*** (0.027)	0.116*** (0.022)	0.059 (0.047)	**0.121*** (0.022)**
Control variables												
GDP per capita growth	0.133*** (0.047)	0.025 (0.034)	-0.045 (0.081)	**0.040 (0.034)**	0.052 (0.046)	-0.045 (0.039)	-0.062 (0.084)	**-0.014 (0.034)**	0.121*** (0.046)	0.012 (0.033)	-0.030 (0.094)	**0.026 (0.032)**
Net FDI inflows	-0.007 (0.006)	0.012** (0.005)	-0.023*** (0.007)	**0.011** (0.005)**	-0.001 (0.006)	0.015*** (0.005)	-0.024*** (0.007)	**0.012** (0.005)**	-0.003 (0.006)	0.011** (0.005)	-0.036*** (0.008)	**0.010** (0.005)**
Government expenditure	0.272*** (0.031)	0.174*** (0.021)	0.266*** (0.051)	**0.165*** (0.022)**	0.245*** (0.029)	0.165*** (0.022)	0.288*** (0.050)	**0.155*** (0.021)**	0.275*** (0.030)	0.197*** (0.022)	0.338*** (0.055)	**0.189*** (0.022)**
Inflation rate	0.069* (0.036)	0.023 (0.028)	-0.026 (0.060)	**0.011 (0.028)**	0.047 (0.034)	0.005 (0.030)	-0.024 (0.062)	**-0.004 (0.027)**	0.100*** (0.037)	0.044 (0.028)	0.059 (0.073)	**0.033 (0.028)**
Urban population	0.005*** (0.002)	0.003** (0.001)	0.001 (0.004)	**0.003** (0.001)**	0.006*** (0.001)	0.003** (0.001)	-0.002 (0.005)	**0.003** (0.001)**	0.003* (0.002)	0.002 (0.001)	-0.003 (0.004)	**0.002 (0.001)**
Corruption control	-0.285*** (0.048)	-0.220*** (0.037)	0.264*** (0.088)	**-0.219*** (0.038)**	-0.206*** (0.041)	-0.180*** (0.033)	0.159** (0.075)	**-0.172*** (0.032)**	-0.236*** (0.043)	-0.204*** (0.034)	0.213*** (0.077)	**-0.203*** (0.034)**
Human Development Index	1.536*** (0.227)	2.470*** (0.176)	3.545*** (0.366)	**2.578*** (0.181)**	1.632*** (0.206)	2.240*** (0.182)	2.983*** (0.357)	**2.392*** (0.180)**	0.876*** (0.256)	1.927*** (0.212)	2.736*** (0.453)	**1.996*** (0.217)**
Water/electricity infrastructure	0.002*** (0.001)	0.001* (0.000)	-0.001 (0.001)	**0.001** (0.000)**	0.003*** (0.001)	0.002*** (0.000)	-0.002* (0.001)	**0.002*** (0.000)**	0.002*** (0.001)	0.001** (0.000)	-0.002** (0.001)	**0.001** (0.000)**
Observations	220	280	80	**580**	220	280	80	**580**	220	280	80	**580**
Number of years	20	20	20	**20**	20	20	20	**20**	20	20	20	**20**
1st order autocorrelation (AB)	0.004	0.525	0.000	**0.000**	0.000	0.001	0.000	**0.001**	0.051	0.033	0.000	**0.002**
2nd order autocorrelation (AB)	0.696	0.147	0.992	**0.198**	0.154	0.406	0.762	**0.955**	0.525	0.259	0.200	**0.858**
Hansen test of overidentification	0.293	0.223	0.905	**0.285**	0.569	0.221	0.916	**0.827**	0.714	0.239	0.997	**0.276**

Source: Authors' computation based on data from the World Bank (2020).
Key: FDI, foreign direct investment; LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country; ICT, information and communication technology.
Note: Models I, II and III relate to Equations 5a, 5b and 5c, respectively; Standard errors in parentheses: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; AB = Arellano-Bond test.

TABLE 5.4: Effects of digital developments on services sector employment (as % of total employment).

Effect	Digitally delivered services trade (MODEL I)				ICT goods trade (MODEL II)				Internet users (MODEL III)			
	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total
Lagged employment	0.363*** (0.034)	0.391*** (0.030)	0.350*** (0.033)	**0.406*** (0.028)**	0.359*** (0.035)	0.380*** (0.030)	0.354*** (0.035)	**0.393*** (0.029)**	0.368*** (0.035)	0.411*** (0.030)	0.362*** (0.035)	**0.424*** (0.029)**
Digital development variables	0.045** (0.020)	0.014 (0.016)	-0.054*** (0.018)	**0.013 (0.015)**	0.011 (0.048)	0.075* (0.044)	0.087* (0.047)	**0.067* (0.038)**	0.131*** (0.028)	0.094*** (0.023)	0.014 (0.026)	**0.100*** (0.022)**
Control variables												
GDP per capita growth	0.115** (0.047)	0.014 (0.040)	0.023 (0.051)	**0.016 (0.033)**	0.089* (0.048)	-0.008 (0.040)	-0.007 (0.053)	**0.001 (0.032)**	0.127** (0.053)	0.016 (0.039)	0.039 (0.052)	**0.017 (0.034)**
Net FDI inflows	0.001 (0.006)	0.013*** (0.005)	-0.010** (0.004)	**0.012** (0.005)**	0.004 (0.006)	0.015*** (0.005)	-0.015*** (0.005)	**0.012*** (0.005)**	0.002 (0.006)	0.012** (0.005)	-0.014*** (0.004)	**0.010** (0.005)**
Government expenditure	0.283*** (0.032)	0.196*** (0.023)	0.299*** (0.029)	**0.179*** (0.022)**	0.272*** (0.032)	0.192*** (0.023)	0.333*** (0.030)	**0.177*** (0.022)**	0.296*** (0.033)	0.213*** (0.024)	0.326*** (0.030)	**0.202*** (0.023)**
Inflation rate	0.108*** (0.035)	0.051* (0.031)	0.012 (0.037)	**0.018 (0.026)**	0.099*** (0.035)	0.044 (0.030)	0.034 (0.038)	**0.016 (0.026)**	0.162*** (0.039)	0.076** (0.031)	0.036 (0.040)	**0.051* (0.028)**
Urban population	0.009*** (0.002)	0.006*** (0.001)	0.004* (0.002)	**0.007*** (0.001)**	0.009*** (0.002)	0.006*** (0.001)	0.001 (0.003)	**0.007*** (0.001)**	0.006*** (0.002)	0.005*** (0.001)	0.003 (0.002)	**0.005*** (0.001)**
Corruption control	-0.236*** (0.049)	-0.128*** (0.040)	-0.001 (0.054)	**-0.134*** (0.039)**	-0.186*** (0.044)	-0.111*** (0.036)	-0.079 (0.048)	**-0.112*** (0.034)**	-0.206*** (0.043)	-0.134*** (0.036)	-0.087* (0.048)	**-0.138*** (0.035)**
Human Development Index	1.774*** (0.225)	2.725*** (0.191)	3.258*** (0.226)	**2.759*** (0.189)**	1.985*** (0.211)	2.667*** (0.190)	2.715*** (0.209)	**2.712*** (0.185)**	1.204*** (0.257)	2.220*** (0.228)	2.774*** (0.275)	**2.205*** (0.223)**
Water/electricity infrastructure	0.002*** (0.001)	0.002*** (0.000)	0.001** (0.000)	**0.002*** (0.000)**	0.003*** (0.001)	0.002*** (0.000)	0.001 (0.000)	**0.002*** (0.000)**	0.002*** (0.001)	0.001*** (0.000)	0.001 (0.000)	**0.002*** (0.000)**
Observations	220	280	80	**580**	220	280	80	**580**	220	280	80	**580**
Number of years	20	20	20	**20**	20	20	20	**20**	20	20	20	**20**
1st order autocorrelation (AB)	0.000	0.093	0.000	**0.000**	0.000	0.000	0.000	**0.000**	0.000	0.003	0.040	**0.003**
2nd order autocorrelation (AB)	0.233	0.235	0.224	**0.238**	0.370	0.135	0.176	**0.224**	0.211	0.114	0.351	**0.745**
Hansen test of overidentification	0.205	0.995	0.403	**0.242**	0.233	0.971	0.718	**0.233**	0.291	0.251	0.186	**0.901**

Source: Authors' computation based on data from the World Bank (2020).
Key: FDI, foreign direct investment; LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country; ICT, information and communication technology.
Note: Models I, II and III relate to Equations 5a, 5b and 5c, respectively; Standard errors in parentheses: ***$p < 0.01$, ** $p < 0.05$, *$p < 0.1$; AB = Arellano-Bond test.

agricultural sector employment in Model I and Model III but an increase in Model II. In Model I, a 1% increase in digitally delivered services trade would lead to a 0.206% decrease in agricultural sector employment. From a country income group perspective, there would be a 0.195% decrease in agricultural sector employment in LICs, a 0.205% decrease in LMICs and a 0.106% decrease in UMICs. In Model II, a 1% increase in ICT goods trade would lead to a 0.128% increase in agricultural sector employment. From a country income group perspective, there would be a 0.293% increase in agricultural sector employment in LICs and a 0.173% increase in LMICs. In Model III, a 1% increase in internet users would lead to a 0.349% decrease in agricultural sector employment. From a country income perspective, there would be a 0.371% decrease in agricultural sector employment in LICs, a 0.361% decrease in LMICs and a 0.212% decrease in UMICs.

Effects on industry sector employment: The results in Table 5.3 show that an increase in digital developments would lead to an increase in industry sector employment in all three models. In Model I, a 1% increase in digitally delivered services trade would lead to a 0.037% increase in industry sector employment. From a country income group perspective, there would be a 0.069% increase in industry sector employment in LICs, a 0.040% increase in LMICs and a 0.062% decrease in UMICs. In Model II, a 1% increase in ICT goods trade would lead to a 0.168% increase in industry sector employment. From a country income group perspective, there would be a 0.145% increase in industry sector employment in LICs and a 0.188% increase in LMICs. In Model III, a 1% increase in internet users would lead to a 0.121% increase in industry sector employment. From a country income group perspective, there would be a 0.174% increase in industry sector employment in LICs and a 0.116% increase in LMICs.

Effects on services sector employment: The results in Table 5.4 show that an increase in digital developments would lead to an increase in services sector employment in Model II and Model III. In Model II, a 1% increase in ICT goods trade would lead to a 0.067% increase in services sector employment. From a country income group perspective, there would be a 0.075% increase in services sector employment in LMICs and a 0.087% increase in UMICs. In Model III, a 1% increase in internet users would lead to a 0.100% increase in industry sector employment. From a country income group perspective, there would be a 0.131% increase in services sector employment in LICs and a 0.094% increase in LMICs. In Model I, there would be a 0.045% increase in services sector employment in LICs but a 0.054% decrease in UMICs.

Control variables

The effects of the control variables on (or their contribution to) total employment have already been discussed in some detail. Specific observations can now be made about their estimated effects on employment in the agricultural, industry and services sectors.

GDP per capita growth rate: The results show that an increase in the GDP per capita growth rate would contribute to an increase only in agricultural sector employment and only in LICs in all three models. This is possibly because agriculture is such an important industry in many African countries and caters to a very large consumer market. The increases in agricultural sector employment in LICs would be 0.115% in Model I, 0.089% in Model II and 0.127% in Model III.

Net foreign direct investment inflows: The results show that an increase in net FDI inflows would contribute to an increase in total industry and services sector employment in all three models. Regarding industry sector employment, a 1% increase in net FDI inflows would contribute to a 0.011% increase in employment in Model I, a 0.012% increase in Model II and a 0.010% increase in Model III. From a country income group perspective, in Model I, there would be a 0.012% increase in employment in LMICs and a 0.023% decrease in UMICs. In Model II, there would be a 0.015% increase in employment in LMICs and a 0.024% decrease in UMICs. In Model III, there would be a 0.011% increase in employment in LMICs and a 0.036% decrease in UMICs.

Regarding services sector employment, a 1% increase in net FDI inflows would contribute to a 0.012% increase in employment in Model I, a 0.012% increase in Model II and a 0.010% increase in Model III. From a country income group perspective, in Model I, there would be a 0.013% increase in employment in LMICs and a 0.010% decrease in UMICs. In Model II, there would be a 0.015% increase in employment in LMICs and a 0.015% decrease in UMICs. In Model III, there would be a 0.012% increase in employment in LMICs and a 0.014% decrease in UMICs.

Many factors could have influenced these results, including the nature of the FDI (which could be either capital-intensive or labour-intensive), the quality of existing infrastructure, the investment climate, the ability of existing human resources to convert investments into productive operations and valuable outputs, and labour-market regulations, which could even discourage job creation in UMICs.

Government expenditure: The results show that an increase in government expenditure would contribute to an increase in agricultural sector employment in Models I and II and an increase in industry and services sector employment in all three models. Regarding agricultural

sector employment, a 1% increase in government expenditure would contribute to a 0.133% increase in employment in Model I and a 0.092% increase in employment in Model II. From a country income group perspective, there would be a 0.099% increase in employment in LICs and a 0.144% increase in LMICs but a 0.371% decrease in UMICs. In Model II, there would be a 0.150% increase in employment in LICs and a 0.094% increase in LMICs but a 0.595% decrease in UMICs. In Model III, there would be a 0.151% increase in employment in LICs but a 0.283% decrease in UMICs.

Regarding industry sector employment, a 1% increase in government expenditure would contribute to a 0.165% increase in employment in Model I, a 0.155% increase in employment in Model II and a 0.189% increase in employment in Model III. From a country income group perspective, in Model I, there would be a 0.272% increase in employment in LICs, a 0.174% increase in LMICs and a 0.266% increase in UMICs. In Model II, there would be a 0.245% increase in employment in LICs, a 0.165% increase in LMICs and a 0.288% increase in UMICs. In Model III, there would be a 0.275% increase in employment in LICs, a 0.197% increase in LMICs and a 0.338% increase in UMICs.

Regarding services sector employment, a 1% increase in government expenditure would contribute to a 0.179% increase in employment in Model I, a 0.177% increase in employment in Model II and a 0.202% increase in employment in Model III. From a country income group perspective, in Model I, there would be a 0.283% increase in employment in LICs, a 0.196% increase in LMICs and a 0.299% increase in UMICs. In Model II, there would be a 0.272% increase in employment in LICs, a 0.192% increase in LMICs and a 0.333% increase in UMICs. In Model III, there would be a 0.296% increase in employment in LICs, a 0.213% increase in LMICs and a 0.326% increase in UMICs.

The rather surprising results for the effects of government expenditure on agricultural sectoral employment in UMICs might be attributed to the relative strength of large, commercial farms and the inability of many smallholder farmers in those countries to access or benefit from government funding. By contrast, the fact that government expenditure would contribute to an increase in employment in the industry and services sectors in LICs, LMICs and UMICs could suggest that these sectors are more productive and able to achieve scale, given the right conditions.

Inflation rate: The results show that an increase in the inflation rate would contribute to an increase in agricultural sector employment in all three models and in services sector employment in Model III. Regarding agricultural sector employment, a 1% increase in the inflation rate would contribute to a 0.239% increase in employment in Model I, a 0.281% increase in employment in Model II and a 0.143% increase in employment in Model III.

From a country income group perspective, in Model I, there would be a 0.194% increase in employment in LICs, a 0.228% increase in LMICs and a 0.253% increase in UMICs. In Model II, there would be a 0.236% increase in employment in LICs, a 0.295% increase in LMICs and a 0.245% increase in UMICs. In Model III, there would be a 0.122% increase in employment in LICs, a 0.150% increase in LMICs and a 0.261% increase in UMICs.

Regarding industry sector employment, from a country income group perspective, in Model I, there would be a 0.069% increase in employment in LICs, and in Model III, there would be a 0.100% increase in employment. Regarding services sector employment, a 1% increase in the inflation rate would contribute to a 0.051% increase in employment in Model III. From a country income group perspective, in Model I, there would be a 0.108% increase in employment in LICs and a 0.051% increase in LMICs. In Model II, there would be a 0.099% increase in employment in LICs. In Model III, there would be a 0.162% increase in employment in LICs and a 0.076% increase in LMICs.

The fact that higher inflation would contribute to increased agricultural sector employment in all three models might be attributed to the fact that many African countries' main economic activity is agriculture. Therefore, higher food prices resulting from inflation could be financially beneficial to producers, who may in turn expand their workforce (at least in the short term).

Urban population: The results show that an increase in urban population would contribute to a decrease in agricultural sector employment in Models I and II, an increase in industry sector employment in Models I and II, and an increase in services sector employment in all three models. Regarding agricultural sector employment, a 1% increase in urban population would contribute to a 0.007% decrease in employment in Model I and a 0.010% decrease in employment in Model II. From a country income group perspective, in Model I, there would be a 0.006% decrease in employment in LMICs and a 0.035% decrease in UMICs. In Model II, there would be a 0.009% decrease in employment in LMICs and a 0.032% decrease in UMICs. In Model III, there would be a 0.004% increase in employment in LICs and a 0.034% decrease in UMICs.

Regarding industry sector employment, a 1% increase in urban population would contribute to a 0.003% increase in employment in Model I and a 0.003% increase in employment in Model II. From a country income group perspective, in Model I, there would be a 0.005% increase in employment in LICs and a 0.003% increase in LMICs. In Model II, there would be a 006% increase in employment in LICs and a 0.003% increase in LMICs. In Model III, there would be a 0.003% increase in employment in LICs.

Regarding services sector employment, a 1% increase in urban population would contribute to a 0.007% increase in employment in Model I, a 0.007% increase in employment in Model II and a 0.005% increase in employment in Model III. From a country income group perspective, in Model I, there would be a 0.009% increase in employment in LICs, a 006% increase in LMICs and a 0.004% increase in UMICs. In Model II, there would be a 0.009% increase in employment in LICs and a 0.006% increase in LMICs. In Model III, there would be a 0.006% increase in employment in LICs and a 0.005% increase in LMICs.

Corruption control: The results show that an increase in corruption control would contribute to an increase in agricultural sector employment in all three models and a decrease in industry and services sector employment in all three models. Regarding agricultural sector employment, a 1% increase in corruption control would contribute to a 0.542% increase in employment in Model I, a 0.306% increase in employment in Model II and a 0.347% increase in employment in Model III. From a country income group perspective, in Model I, there would be a 0.472% increase in employment in LICs, a 0.521% increase in LMICs and a 0.417% increase in UMICs. In Model II, there would be a 0.282% increase in employment in LICs, a 0.347% increase in LMICs and a 0.213% increase in UMICs. In Model III, there would be a 0.268% increase in employment in LICs, a 0.349% increase in LMICs and a 0.261% increase in UMICs.

Regarding industry sector employment, a 1% increase in corruption control would contribute to a 0.219 decrease in employment in Model I, a 0.172% decrease in Model II and a 0.203% decrease in Model III. From a country income group perspective, in Model I, there would be a 0.285% decrease in employment in LICs, a 0.220% decrease in LMICs and a 0.264% increase in UMICs. In Model II, there would be a 0.206% decrease in employment in LICs, a 0.180% decrease in LMICs and a 0.159% increase in UMICs. In Model III, there would be a 0.236% decrease in employment in LICs, a 0.204% decrease in LMICs and a 0.213% increase in UMICs.

Regarding services sector employment, a 1% increase in corruption control would contribute to a 0.134% decrease in employment in Model I, a 0.112% decrease in employment in Model II and a 0.138% decrease in employment in Model III. From a country income group perspective, in Model I, there would be a 0.236% decrease in employment in LICs and a 0.128% decrease in LMICs. In Model II, there would be a 0.186% decrease in employment in LICs and a 0.111% decrease in LMICs. In Model III, there would be a 0.206% decrease in employment in LICs, a 0.134% decrease in LMICs and a 0.087% decrease in UMICs.

It seems curious that heightened corruption control would contribute to an increase in agricultural sector employment but a decrease in industry

and services sector employment. However, Efobi, Vo and Orkoh (2021) and Lavalée and Roubaud (2018) emphasise that corruption control, though a worthwhile pursuit, could have unexpected consequences. For example, less corruption in organisations in the industry and services sectors could be accompanied by less bureaucratic red tape and more streamlined operations, which could negatively affect employment levels.

Human Development Index: The results show that an improved HDI ranking would contribute to a decrease in agricultural sector employment in Model I and Model II and an increase in industry sector and services sector employment in all three models. Regarding agricultural sector employment, a 1% improvement in the HDI ranking would contribute to a 0.870% decrease in employment in Model I and a 1.961% decrease in employment in Model II. From a country income group perspective, in Model I, there would be a 0.734% decrease in employment in LICs, a 0.756% decrease in LMICs and a 3.760% decrease in UMICs. In Model II, there would be a 2.080% decrease in employment in LICs, a 1.888% decrease in LMICs and a 4.306% decrease in UMICs. In Model III, there would be a 0.511% increase in employment in LMICs but a 2.954% decrease in UMICs.

Regarding industry sector employment, a 1% improvement in the HDI ranking would contribute to a 2.578% increase in employment in Model I, a 2.392% increase in employment in Model II and a 1.996% increase in employment in Model III. From a country income group perspective, in Model I, there would be a 1.536% increase in employment in LICs, a 2.470% increase in employment in LMICs and a 3.545% increase in employment in UMICs. In Model II, there would be a 1.632% increase in employment in LICs, a 2.240% increase in employment in LMICs and a 2.983% increase in employment in UMICs. In Model III, there would be a 0.876% increase in employment in LICs, a 1.927% increase in LMICs and a 2.736% increase in UMICs.

Regarding services sector employment, a 1% improvement in the HDI ranking would contribute to a 2.759% increase in employment in Model I, a 2.712% increase in employment in Model II and a 2.205% increase in employment in Model III. From a country income group perspective, in Model I, there would be a 1.774% increase in employment in LICs, a 2.725% increase in LMICs and a 3.258% increase in UMICs. In Model II, there would be a 1.985% increase in employment in LICs, a 2.667% increase in LMICs and a 2.715% increase in UMICs. In Model III, there would be a 1.204% increase in employment in LICs, a 2.220% increase in LMICs and a 2.774% increase in UMICs.

As pointed out earlier, an improved HDI ranking may elevate young people's professional aspirations, but it does not necessarily translate into

more jobs in Africa. In fact, it could simply accelerate urbanisation and prompt more and more agricultural migrants to look for work in the industry and services sectors.

Water and electricity infrastructure: The results show that an increase in infrastructure development would contribute to an increase in agricultural, industry and services sector employment in all three models. Regarding agricultural sector employment, a 1% increase in infrastructure development would contribute to 0.010% increase in employment in Model I, a 0.008% increase in employment in Model II and a 0.009% increase in employment in Model III. From a country income group perspective, in Model I, there would be a 0.010% increase in employment in LICs, a 0.010% increase in LMICs and a 0.013% increase in UMICs. In Model II, there would be a 0.009% increase in employment in LICs, a 0.008% increase in LMICs and a 0.011% increase in UMICs. In Model III, there would be a 0.010% increase in employment in LICs, a 0.009% increase in LMICs and a 0.013% increase in UMICs.

Regarding industry sector employment, a 1% increase in infrastructure development would contribute to a 0.001% increase in employment in Model I, a 0.002% increase in employment in Model II and a 0.001% increase in employment in Model III. From a country income group perspective, in Model I, there would be a 0.002% increase in employment in LICs and a 0.001% increase in LMICs. In Model II, there would be a 0.003% increase in employment in LICs, a 0.002% increase in LMICs and a 0.002% decrease in UMICs. In Model III, there would be a 0.002% increase in employment in LICs, a 0.001% increase in LMICs and a 0.002% decrease in UMICS.

Regarding services sector employment, a 1% increase in infrastructure development would contribute to a 0.002% increase in employment in Model I, Model II and Model III. From a country income group perspective, in Model I, there would be a 0.002% increase in employment in LICs, a 0.002% increase in LMICs and a 0.001% increase in UMICs. In Model II, there would be a 0.003% increase in employment in LICs and a 0.002% increase in LMICs. In Model III, there would be a 0.002% increase in employment in LICs and a 0.001% increase in LMICs.

The fact that an increase in infrastructure development would contribute to a decrease in industry sector employment in UMICs in Models II and III could be attributed to the fact that infrastructure development takes time to deliver value to certain (e.g. heavy-duty) industries. The other sectors (agriculture and services) may not experience the same lag effect in infrastructure delivering value and can therefore accommodate job seekers more quickly.

3. Effects of digital developments on gender-based employment

The results for the effects of digital developments on female employment (as a share of total female population) and male employment (as a share of total male population) are presented in Tables 5.5 and 5.6, respectively. The values depicted are β coefficients for the regression equations.

Digital development variables

Effects on female employment: The results in Table 5.5 show that an increase in digital developments would lead to a decrease in female employment in Model I and Model III. In Model I, a 1% increase in digitally delivered services trade would lead to a 0.120% decrease in female employment. From a country income group perspective, there would be a 0.143% decrease in employment in LICs and a 0.108% decrease in LMICs. In Model II, a 1% increase in ICT goods trade would, from a country income group perspective, lead to a 0.094% increase in employment in LICs and a 0.202% decrease in UMICs. In Model III, a 1% increase in internet users would lead to a 0.247% decrease in female employment. From a country income perspective, there would be a 0.282% decrease in employment in LICs and a 0.224% decrease in LMICs.

Effects on male employment: The results in Table 5.6 show that an increase in digital developments would lead to a decrease in male employment in Model I and Model III and an increase in male employment in Model II. In Model I, a 1% increase in digitally delivered services trade would lead to a 0.067% decrease in male employment. From a country income group perspective, there would be a 0.057% decrease in employment in LICs, a 0.069% decrease in LMICs and a 0.029% increase in UMICs. In Model II, a 1% increase in ICT goods trade would lead to a 0.049% increase in employment. From a country income group perspective, there would be a 0.073% increase in employment in LICs, a 0.053% increase in LMICs and a 0.045% decrease in UMICs. In Model III, a 1% increase in internet users would lead to a 0.075% decrease in male employment. From a country income group perspective, there would be a 0.092% decrease in employment in LICs, a 0.070% decrease in LMICs and a 0.096% increase in UMICs.

Control variables

Regarding the effects of the different control variables on (or their contribution to) female employment, the results show that an increase in the GDP per capita growth rate, government expenditure, inflation, corruption control, and water and electricity infrastructure development

TABLE 5.5: Effects of digital developments on female employment (as % of total female population).

Effect	Digitally delivered services trade (MODEL I)				ICT goods trade (MODEL II)				Internet users (MODEL III)			
	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total
Lagged employment	0.672*** (0.036)	0.714*** (0.034)	1.236*** (0.059)	**0.681*** (0.031)**	0.662*** (0.038)	0.775*** (0.035)	1.289*** (0.052)	**0.708*** (0.033)**	0.640*** (0.032)	0.706*** (0.032)	1.238*** (0.062)	**0.652*** (0.029)**
Digital development variables	-0.143*** (0.020)	-0.108*** (0.017)	0.029 (0.024)	**-0.120*** (0.016)**	0.094* (0.054)	0.002 (0.046)	-0.202*** (0.058)	**0.016 (0.045)**	-0.282*** (0.025)	-0.224*** (0.022)	0.035 (0.038)	**-0.247*** (0.021)**
Control variables												
GDP per capita growth	0.196*** (0.052)	0.281*** (0.042)	0.088 (0.058)	**0.214*** (0.036)**	0.244*** (0.052)	0.269*** (0.037)	0.094* (0.049)	**0.267*** (0.037)**	0.209*** (0.045)	0.244*** (0.034)	0.068 (0.051)	**0.240*** (0.033)**
Net FDI inflows	0.014** (0.007)	0.003 (0.005)	0.019*** (0.005)	**0.005 (0.005)**	0.002 (0.007)	-0.001 (0.005)	0.016*** (0.004)	**-0.000 (0.005)**	0.007 (0.006)	0.004 (0.005)	0.016*** (0.004)	**0.005 (0.005)**
Government expenditure	0.091** (0.041)	0.084*** (0.030)	-0.135*** (0.047)	**0.129*** (0.028)**	0.115*** (0.042)	0.041 (0.029)	-0.164*** (0.044)	**0.101*** (0.029)**	0.098*** (0.037)	0.023 (0.027)	-0.118** (0.046)	**0.065** (0.026)**
Inflation rate	0.201*** (0.038)	0.209*** (0.032)	0.055 (0.042)	**0.224*** (0.029)**	0.235*** (0.038)	0.208*** (0.030)	0.067* (0.036)	**0.251*** (0.029)**	0.132*** (0.035)	0.132*** (0.028)	0.066* (0.039)	**0.156*** (0.028)**
Urban population	-0.005*** (0.002)	-0.004** (0.002)	-0.002 (0.003)	**-0.004** (0.002)**	-0.006*** (0.002)	-0.005*** (0.002)	0.002 (0.003)	**-0.005*** (0.002)**	-0.001 (0.002)	-0.000 (0.001)	-0.003 (0.003)	**-0.001 (0.001)**
Corruption control	0.438*** (0.051)	0.333*** (0.042)	-0.090 (0.068)	**0.363*** (0.041)**	0.294*** (0.048)	0.197*** (0.039)	-0.049 (0.049)	**0.218*** (0.038)**	0.275*** (0.041)	0.234*** (0.036)	-0.034 (0.051)	**0.252*** (0.034)**
Human Development Index	0.562 (0.353)	-0.165 (0.290)	-3.183*** (0.475)	**0.046 (0.283)**	-0.592* (0.341)	-0.811*** (0.287)	-2.523*** (0.377)	**-0.731** (0.285)**	1.598*** (0.340)	1.140*** (0.318)	-3.273*** (0.585)	**1.413*** (0.305)**
Water/electricity infrastructure	0.005*** (0.001)	0.004*** (0.001)	0.003*** (0.001)	**0.005*** (0.001)**	0.004*** (0.001)	0.004*** (0.001)	0.003*** (0.001)	**0.004*** (0.001)**	0.005*** (0.001)	0.004*** (0.001)	0.004*** (0.001)	**0.004*** (0.000)**
Observations	220	320	80	**620**	220	320	80	**620**	220	320	80	**620**
Number of years	20	20	20	**20**	20	20	20	**20**	20	20	20	**20**
1st order autocorrelation (AB)	0.376	0.004	0.000	**0.500**	0.125	0.000	0.000	**0.000**	0.056	0.151	0.000	**0.033**
2nd order autocorrelation (AB)	0.388	0.880	0.427	**0.851**	0.197	0.916	0.520	**0.715**	0.756	0.429	0.703	**0.418**
Hansen test of overidentification	0.151	0.346	0.242	**0.493**	0.506	0.355	0.879	**0.126**	0.545	0.730	0.892	**0.399**

Source: Authors' computation based on data from the World Bank (2020).
Key: FDI, foreign direct investment; LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country; ICT, information and communication technology.
Note: Models I, II and III relate to Equations 5a, 5b and 5c, respectively; Standard errors in parentheses: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; AB = Arellano-Bond test.

TABLE 5.6: Effects of digital developments on male employment (as % of total male population).

Effect	Digitally delivered services trade (MODEL I)				ICT goods/ trade (MODEL II)				Internet users (MODEL III)			
	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total
Lagged employment	0.937*** (0.019)	0.911*** (0.019)	1.102*** (0.023)	**0.915*** (0.017)**	0.937*** (0.020)	0.937*** (0.020)	1.085*** (0.019)	**0.933*** (0.018)**	0.913*** (0.019)	0.913*** (0.020)	1.159*** (0.020)	**0.908*** (0.018)**
Digital development variables	-0.057*** (0.009)	-0.069*** (0.009)	0.029*** (0.011)	**-0.067*** (0.008)**	0.073*** (0.026)	0.053** (0.025)	-0.045* (0.024)	**0.049** (0.023)**	-0.092*** (0.014)	-0.070*** (0.013)	0.096*** (0.014)	**-0.075*** (0.012)**
Control variables												
GDP per capita growth	0.021 (0.024)	0.087*** (0.024)	0.060** (0.026)	**0.061*** (0.019)**	0.029 (0.025)	0.081*** (0.021)	0.037* (0.022)	**0.079*** (0.020)**	0.040* (0.024)	0.086*** (0.021)	0.043** (0.019)	**0.084*** (0.019)**
Net FDI inflows	0.000 (0.003)	0.007** (0.003)	0.003 (0.002)	**0.006** (0.003)**	-0.004 (0.003)	0.003 (0.003)	0.002 (0.002)	**0.003 (0.003)**	-0.003 (0.003)	0.004 (0.003)	0.000 (0.002)	**0.005* (0.003)**
Government expenditure	0.073*** (0.019)	0.011 (0.016)	-0.130*** (0.020)	**0.021 (0.014)**	0.079*** (0.020)	-0.006 (0.015)	-0.107*** (0.018)	**0.003 (0.015)**	0.082*** (0.019)	-0.010 (0.015)	-0.133*** (0.016)	**-0.004 (0.015)**
Inflation rate	-0.014 (0.018)	-0.013 (0.018)	-0.093*** (0.019)	**0.005 (0.015)**	-0.004 (0.019)	0.004 (0.017)	-0.068*** (0.016)	**0.014 (0.016)**	-0.029 (0.018)	-0.013 (0.017)	-0.054*** (0.015)	**-0.007 (0.016)**
Urban population	-0.001 (0.001)	-0.001 (0.001)	-0.004*** (0.001)	**-0.001* (0.001)**	-0.001* (0.001)	-0.002** (0.001)	-0.004*** (0.001)	**-0.002*** (0.001)**	0.001 (0.001)	-0.001 (0.001)	-0.005*** (0.001)	**-0.001 (0.001)**
Corruption control	0.079*** (0.024)	0.119*** (0.023)	0.077*** (0.028)	**0.121*** (0.021)**	0.022 (0.022)	0.046** (0.021)	0.120*** (0.020)	**0.045** (0.020)**	0.017 (0.021)	0.052** (0.021)	0.120*** (0.018)	**0.053*** (0.019)**
Human Development Index	0.034 (0.170)	0.408** (0.165)	-0.549*** (0.191)	**0.338** (0.152)**	-0.535*** (0.164)	-0.204 (0.160)	-0.221 (0.160)	**-0.231 (0.153)**	0.354* (0.189)	0.567*** (0.200)	-1.359*** (0.200)	**0.597*** (0.188)**
Water/electricity infrastructure	0.003*** (0.000)	0.002*** (0.000)	-0.001** (0.000)	**0.002*** (0.000)**	0.003*** (0.000)	0.002*** (0.000)	-0.001* (0.000)	**0.002*** (0.000)**	0.003*** (0.000)	0.002*** (0.000)	-0.002*** (0.000)	**0.002*** (0.000)**
Observations	220	320	80	**620**	220	320	80	**620**	220	320	80	**620**
Number of years	20	20	20	**20**	20	20	20	**20**	20	20	20	**20**
1st order autocorrelation	0.000	0.003	0.000	**0.000**	0.000	0.000	0.000	**0.002**	0.000	0.023	0.000	**0.000**
2nd order autocorrelation	0.616	0.992	0.150	**0.982**	0.365	0.953	0.204	**0.879**	0.280	0.983	0.809	**0.379**
Hansen test of overidentification	0.698	0.883	0.458	**0.919**	0.214	0.946	0.692	**0.867**	0.262	0.872	0.933	**0.962**

Source: Authors' computation based on data from the World Bank (2020).
Key: FDI, foreign direct investment; LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country; ICT, information and communication technology.
Note: Models I, II and III relate to Equations 5a, 5b and 5c, respectively; Standard errors in parentheses: ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$; AB = Arellano-Bond test.

would contribute to an increase in total female employment in all three models.

Regarding the effects of the different control variables on male employment, the results show that an increase in the GDP per capita growth rate, corruption control, and water and electricity infrastructure development would contribute to an increase in total male employment in all three models. However, there are certain variations in the contribution of the control variables to female and male employment in different country income groups. For example, an increase in government expenditure would contribute to an increase in female and male employment in LICs but to a decrease in female and male employment in UMICs in all three models.

Meanwhile, an increase in urban population would contribute to a decrease in female employment in LICs and LMICs in Models I and II, a decrease in male employment in UMICs in Model I and Model III, and a decrease in male employment in LICs, LMICs and UMICs in Model II. Furthermore, an increase in net FDI inflows would contribute to an increase in female employment in UMICs in all three models but to an increase in male employment in LMICs in Model I only. Unexpectedly, an improved HDI ranking would contribute to a sizeable decrease in female employment in UMICs in all three models and to a decrease in male employment in UMICs in Model I and Model III.

Summary and conclusion[15]

This chapter set out to determine, by means of a regression analysis, the effects of digital developments on employment in Africa, using three independent variables of interest, three dependent variables and several control variables.

A common theme emanating from the literature is that African countries are extremely heterogeneous, not only in their resource allocation and physical characteristics but also in their human capital and development potential. For that reason, the countries making up the study sample were analysed according to income group: LICs, LMICs and UMICs. The regression results were presented both as total employment values and as disaggregated sector-level and gender-based employment values in terms of these three country income groups.

Table 5.7 provides a summary of the key results from the regression analysis, while also highlighting their levels of statistical significance. The overarching finding was that the effects of digital developments on

15. Parts of the sections 'Total employment', 'Sector-level employment' and 'Gender-based employment' have previously been published in Parry and Viviers (2023).

TABLE 5.7: Summary: Regression results, with significance levels.

DEPENDENT VARIABLES	INDEPENDENT VARIABLES OF INTEREST											
	MODEL I Digitally delivered services trade (% of total services trade)				MODEL II ICT goods trade (% of total goods trade)				MODEL III Internet users (% of total population)			
	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total	LIC	LMIC	UMIC	Total
Total employment (% of total population)	-0.092 ***	-0.083 ***	0.038 ***	-0.086 ***	0.068 **	0.020	-0.122 ***	0.023	-0.170 ***	-0.125 ***	0.084 ***	-0.139 ***
Sector employment (% of total employment)												
• Agriculture	-0.195 ***	-0.205 ***	-0.106 **	-0.206 ***	0.293 ***	0.173 ***	-0.191	0.128 **	-0.371 ***	-0.361 ***	-0.212 ***	-0.349 ***
• Industry	0.069 ***	0.040 ***	-0.062 **	0.037 **	0.145 ***	0.188 ***	0.095	0.168 ***	0.174 ***	0.116 ***	0.059	0.121 ***
• Services	0.045 **	0.014	-0.054 ***	0.013	0.011	0.075 *	0.087 *	0.067 *	0.131 ***	0.094 ***	0.014	0.100 ***
Gender employment (% of total female and male populations)												
• Female	-0.143 ***	-0.108 ***	0.029	-0.120 ***	0.094 *	0.002	-0.202 ***	0.016	-0.282 ***	-0.224 ***	0.035	-0.247 ***
• Male	-0.057 ***	-0.069 ***	0.029 ***	-0.067 ***	0.073 ***	0.053 **	-0.045 *	0.049 **	-0.092 ***	-0.070 ***	0.096 ***	-0.075 ***

Source: Authors' compilation from the regression analysis.
Key: LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country; ICT, information and communication technology.
Note: Standard errors: ***p < 0.01, **p < 0.05, *p < 0.1; light grey blocks = positive effect; mid-tone grey blocks = negative effect; dark grey blocks = not statistically significant.

employment in Africa are highly contextual, with some distinct differences observed across sectors, genders and country income groups. Some of the key findings are discussed in the following sections in relation to different employment categories.

Total employment

Total employment values (even before disaggregation) were influenced differently by the three digital development variables. Contrary to expectations, an increase in digitally delivered services trade and an increase in the number of internet users would lead to a *decrease* in total (i.e. overall) employment across the sample of countries. The negative impact of an increase in internet users is particularly surprising and concerning, as a certain level of internet connectivity is essential for most types of work (both formal and informal). Moreover, expanded connectivity is on all African governments' policy agendas.

The decrease in total employment might be attributable to the unusually heavy influence of the decrease in agricultural sector employment (see Table 5.7), which effectively overshadows the increases in industry and services sector employment, respectively. This suggests that the agricultural sector in Africa is not only the main employer but is also made up of a large number of unskilled or low-skilled workers who – as the digital era gains momentum – are more at risk of job losses than more highly skilled and/or digitally literate workers who could be more readily accommodated in the industry and services sectors.

Sector-level employment

Another key finding, which was largely anticipated, was that an increase in digitally delivered services trade and the number of internet users would lead to a *decrease* in agricultural sector employment. Unexpectedly, however, an increase in ICT goods trade would lead to an *increase* in agricultural sector employment. A possible reason for this is that ICT goods are tangible and therefore require traditional handling and transportation, which would help to preserve jobs – despite employment (at least at certain levels) in the agricultural sector being vulnerable in the face of digital advances.

Different (but expected) patterns emerged in the case of the effects on industry and services sector employment. For example, an increase in digitally delivered services trade, ICT goods trade and number of internet users would lead to an *increase* in industry sector employment. In addition, an increase in ICT goods trade and number of internet users would lead to an *increase* in services sector employment.

An apparent anomaly was that an increase in digitally delivered services trade would lead to a *decrease* in industry sector employment in UMICs, which would not be the case in LICs and LMICs. Intuitively, greater access to digitally delivered services should enhance the industry sector's performance and create more jobs. The unexpected result might have something to do with the type of competition that digitally delivered services trade would unleash in UMICs, but one cannot arrive at any firm conclusion without further investigation.

Gender-based employment

Another expected finding was that an increase in digitally delivered services trade and internet users would lead to a *decrease* in agricultural sector employment among both men and women. Interestingly, though, women would be twice as vulnerable to job losses as men (as is evident from Table 5.7). Two key factors that are likely to contribute to this significant gender bias are the fact that women constitute more than two-thirds of the workforce in the agricultural sector in LICs in Africa but often lack access to education, which hampers their employability and/or professional advancement prospects.

Employment per country income group

The findings from the different country income groups were mixed, sometimes without a discernible pattern – particularly in the case of the UMICs. This suggests that various other factors might come into play (apart from the independent variables of interest), notably control variables like government expenditure, urban population, HDI ranking and corruption control, which could sway the results in unexpected directions.

Chapter 6 discusses the overall contribution of the study against the backdrop of the research objectives, the existing literature, as well as new insights that it offers. It also suggests areas for further research which could help to inform policies aimed at bringing about more inclusive growth in African countries through well-crafted digitalisation strategies and investment decisions.

Chapter 6

Digital developments and employment in Africa: The way forward

Introduction

The digital era, also sometimes known as 'the Fourth Industrial Revolution' or 'Industry 4.0', is firmly upon us. Yet, it lacks a precise definition and therefore means different things to different people. It is also constantly evolving and impacting all areas of life, which makes it difficult to navigate but also impossible to ignore.

Africa is the poorest continent, with very high levels of unemployment, informal employment, poverty and inequality. It is also the least digitally connected continent. This means that African countries are often hampered in their efforts to leverage digital technologies to 'catch up' with many of their developing country peers in other parts of the world. However, the fact that the digital era poses particular challenges for African countries makes it all the more important that they understand and address their digital shortcomings. 'Catching up' is, of course, critical, but countries on the continent also have a unique opportunity to design their own futures,

How to cite: Parry, A, Viviers, W, Orkoh, E & Jansen van Rensburg, SJ 2024, 'Digital developments and employment in Africa: The way forward', in *Digital developments and employment: Understanding trends in Africa*, The future of international trade and development, vol. 2, AOSIS Books, Cape Town, pp. 107–116. https://doi.org/10.4102/aosis.2024.BK471.06

employing the right blend of digital technologies to create more productive and inclusive economies and societies. Given the growing problem of inequality in the world – particularly in Africa – many governments have adopted 'inclusive growth' strategies. Inclusive growth defies a universal definition, but there is broad agreement that it is the desired outcome of efforts to narrow the gap between poor or marginalised members of society and wealthy or privileged members of society.

A number of quantitative studies have been conducted to explore the links between digital developments and inclusive growth, using different indicators or proxies for each phenomenon. For example, inclusive growth indicators have included the GDP per capita growth rate, poverty levels, employment levels and wages, while digital development indicators have included mobile phone users, internet users, ICT infrastructure and digital trade flows. Despite these studies, there is still much uncertainty surrounding the links between digital developments and inclusive growth. As the literature shows, this makes policymaking challenging.

Similarly, the authors of this book set out to examine the effects of digital developments on inclusive growth, but they used various employment indicators to denote the latter. They focused specifically on employment because, in their view, it holds the key to inclusive growth in Africa. Moreover, employment is particularly sensitive to digital developments, which can create, enrich or destroy jobs. Analysing the links between digital developments and employment had the potential to yield interesting results in an important research domain. While some earlier studies have focused on the digital developments–employment nexus, very few have had an Africa focus. Even fewer have disaggregated the employment effects of digital developments according to sector and gender across the three country groups of LICs, LMICs and UMICs (as this study did, which added texture to the results). This study addressed these research gaps while also exploring new, uncharted territory, providing a platform for further research on related topics. The contribution of the study is evident in three main areas:

- key findings from the literature study
- methodology used in the empirical study
- results of the empirical study.

Each of these is discussed in the following sections.

Key findings from the literature study

The first research objective of the study was to identify the main themes and perspectives emanating from the global discourse on inclusive growth

and digital developments, with a specific emphasis on the effects of digital developments on inclusive growth in Africa. This involved conducting a literature review to arrive at an integrated understanding of inclusive growth and digital developments (set out in chs. 2 and 3), including whether or not they are compatible concepts, how each is measured, and whether or not digital developments can positively influence inclusive growth and under what conditions.

The critical analysis of the literature revealed wide-ranging views on what inclusive growth and digital developments mean, how they should be measured and how they can be realised. Some scholars, for example, believe that inclusive growth strategies should be directed primarily at the poor via a process of redistribution (i.e. social welfare and other forms of government support). Others assert that the pursuit of inclusive growth should be more broad-based, directed at all segments of society and aimed at growing the economy and making it more productive, which will result in more people working and benefiting from expanded economic activity. Notwithstanding these different perspectives, there is a general consensus that employment creation goes to the core of inclusive growth policies and initiatives. Another commonly held view is that inclusive growth is dependent on strong economic growth and, in Africa's case, accelerated economic growth.

Many people claim that the digital era is proving to be transformative, changing the nature and pace of work and everyday life in innumerable ways. Frequent references are made to sophisticated, 'frontier' technologies such as AI, robotics, IoT or cloud computing, which have the potential to streamline work methods but also to displace people from jobs that can be done more efficiently and at lower cost by machines. While developed countries may take this transformation in their stride and help their workforces to adapt to, and work with, new technologies, developing countries are less well equipped to deal with the challenges of digitalisation. The perceived threat that digital technologies pose to jobs has discouraged some countries from embracing digital transformation. Yet, this will inevitably lead to their being left behind in a fast-changing world, with devastating consequences for their economic growth and development and trade performance.

What emerges from the literature, however, is the fact that digital technologies can also be of a more fundamental nature – such as a simple broadband internet service. It is therefore important to view digitalisation in contextual terms. Given their uneven development patterns, many developing countries (particularly in Africa) should adopt a mixed digitalisation approach, investing in a combination of frontier technologies to drive growth in high-productivity sectors and more fundamental

technologies to give low-productivity sectors the tools with which to accelerate their development and gradually move up the productivity scale. In other words, countries should not try to aspire (too soon) to unrealistic levels of digital sophistication. In this way, digitalisation becomes an inclusive rather than a divisive force and complements efforts to drive more inclusive growth.

Also evident in the literature is the widespread belief that digital developments will become an effective lever of inclusive growth only if the foundations have been laid, such as macroeconomic stability and efficient and inclusive public services. Interestingly, despite the attention given to employment in conversations about and studies on inclusive growth and digital developments, few quantitative studies have focused on the impact of digital developments on employment. Economic growth has been a much more popular measure, although it largely conceals economic divisions in a country.

The insights distilled from the wide range of views and qualitative and quantitative studies covered in the literature review exposed key research gaps and informed the direction and scope of the empirical study outlined in Chapters 4 and 5. These insights also enabled the authors to formulate their own synthesised working definitions of inclusive growth (with an emphasis on employment) and digital developments, which helped to steer their empirical work.

Methodology used in the empirical study

The second and third research objectives of the study (relating to the empirical analysis in chs. 4 and 5) were to determine (quantitatively) the effects of digital developments on employment in 33 African countries for which data were available over a 20-year period, which was considered long enough to reveal specific patterns and trends. This involved performing a regression analysis to examine the effects of three independent variables (acting as proxies for digital development) on three dependent variables (acting as proxies for employment). The digital development variables were digitally delivered services trade, ICT goods trade and the number of internet users, while the employment variables were total employment, sectoral (agriculture, industry and services) employment and gender-based (male and female) employment.

The regression analysis was conducted in such a way that the results were disaggregated according to sector and gender and presented across three different country income groups (LICs, LMICs and UMICs). The latter was in acknowledgement of the fact that African countries are at different stages of economic and digital development. When viewed together,

the effects of digital developments on employment might reveal important differences between country income groups. Being aware of such differences would help African policymakers to tailor their digitalisation and employment strategies to their countries' development profile rather than trying to adopt a 'one-size-fits-all' approach. For example, the effects of digital developments on LICs (whose economies are more agriculturally driven) and UMICs (whose economies are more industry- and services-driven) would be different and would therefore require different policy responses.

Presenting and analysing the total employment, sectoral employment and gender-based employment effects of digital developments according to country income group was a novel approach which the authors had not seen in previous studies. Another distinctive (and somewhat unusual) element of the research methodology was the use of two digital trade variables (for services and goods, respectively) in view of what the authors considered to be the critical importance of regional and international trade to countries' employment dynamics and future prospects. The variegated methodological approach adopted in the empirical study provides a useful framework that could be used or adapted by other researchers who are keen to better understand Africa's digital development–employment trajectory.

Results of the empirical study

Drawing on the literature, the authors were able to formulate their expected results and compare these with the actual results from the regression analysis. What this exercise demonstrated was how assumptions – based on broad views and some formal studies in the literature – can sometimes be challenged or overturned in the wake of a more in-depth statistical analysis, using a wide cross-section of data.

With reference to earlier studies (De Berquin & Mbongo 2019; Khan et al. 2017; Orkoh et al. 2021; Parry 2022; Viviers et al. 2019), the authors expected that the regression analysis would reveal that an increase in digital developments would lead to an increase in *total employment* in Africa, with men benefiting more than women because the latter are more vulnerable in the job market. They also expected that there would be a decrease in *agricultural* sector employment and an increase in *industry* and *services* sector employment – a phenomenon that the authors called the 'digitally induced sectoral reallocation of labour'.

The backbone of many African economies is agriculture, which employs large numbers of people (Orkoh et al. 2021; Viviers et al. 2019). The sector is dominated by subsistence farmers, with little access to mechanisation

and digital tools and embellishments. It was for this reason that the authors expected that digital developments would displace rather than create jobs in the agricultural sector. In contrast, they anticipated that digital developments would create jobs in the industry and services sectors because these normally attract more highly skilled workers and are better prepared to adopt digital technologies to make inroads into new markets and enhance their production capabilities. How the expectations measured up to the actual results was explored in Chapter 5. However, some broad comments about the results can be made at this point.

The agricultural sector accounts for 69% and 45% of total employment in LICs and LMICs, but only 14% in UMICs (see Table A3 in the Appendices). The fact that, in the results, an increase in digitally delivered services trade and internet users would lead to a decrease in both total employment and agricultural sector employment in LICs and LMICs could be because of low levels of digital adoption and literacy in that sector, with digital advances possibly making some traditional jobs redundant. Another possible explanation is that many people are leaving the farms in Africa to seek alternative employment in the cities (Rodrik 2016). This may have less to do with the challenges associated with farming and the perceived threat of digitalisation and more to do with the allure of city life.

The services sector is a natural drawcard, but it is becoming saturated and unable to absorb the rising numbers of job seekers. Moreover, the services sector in Africa, as the literature shows, is often characterised by low-level, low-productivity work (Fosu 2017; Monga et al. 2019). There is also the risk of a mismatch between low-skilled job seekers and available jobs in the city. Nevertheless, migration to the cities may be fuelled by the fact that, as the number of internet users rises, people (the youth in particular) become increasingly aware of the economic opportunities in other sectors, largely in urban areas. This trend has worrying implications for the sustainability of the agricultural sector (which still has much untapped potential) as well as for food security on the continent.

Internet usage in Africa creates a paradox. The internet is the lifeblood of the digital era and has become an essential tool in the daily lives of billions of people around the world (Friedrich Ebert Stiftung 2020). However, despite Africa's well-publicised 'mobile revolution', it appears that mobile phone usage and internet access have not translated into increased employment in the agricultural sector. Instead, an increase in the number of internet users would lead to a decrease in employment in total agricultural sector employment and in agricultural employment in LICs, LMICs and UMICs. This could be because of a lack of knowledge and ability to leverage the internet for productive employment purposes (Banga & Te Velde 2018; Cirera & Sabetti 2016). In this regard, only 4% and 13.5% of the

populations of LICs and LMICs, respectively, use the internet, compared with 23% who use it in UMICs. This could help to explain why an increase in the number of internet users would lead to an increase in agricultural sector employment in UMICs.

The impact of ICT goods trade on employment is different from that of digitally delivered services trade and number of internet users (Orkoh et al. 2021; Viviers et al. 2019). For example, the fact that an increase in ICT goods trade would lead to an increase in total agricultural, industry and services sector employment and in agricultural and industry sector employment in LICs and LMICs could be attributed to the fact that ICT goods trade centres largely on imports. Some of these imports might constitute efficiency-enhancing machinery and equipment, thus enabling commercial operations to expand and employ more workers. In addition, a proportion of imports would constitute inputs for production purposes, which could help to generate additional employment opportunities. Moreover, ICT goods span an extensive range of tangible items that lend themselves to transportation, handling, storage and processing, which are typically labour-intensive.

Concerns are expressed in the literature that advancing digitalisation (evidenced in the more widespread use of automation, AI and other digital technologies) poses a threat to industry-based (i.e. manufacturing) employment in many parts of the world (Bacchetta et al. 2021; Friederici et al. 2017). However, the effects of digital developments on total industry sector employment and on industry sector employment in LICs and LMICs suggest that Africa's industry sector is not threatened by job losses, contrary to popular opinion. Indeed, it could be a source of expanded employment opportunities. A possible contributing factor is that, in view of Africa's low levels of industrialisation, medium-skilled industry jobs, which are the most vulnerable to automation, are less at risk than they are in other parts of the world (Strydom 2021). However, this could be a temporary effect, with employment dynamics possibly changing in the future as African countries' industrialisation efforts become more digitally mature. The fact that an increase in digitally delivered services trade would lead to a decrease in industry sector employment in UMICs (unlike in LICs and LMICs) is difficult to explain. This result might be influenced by the fact that UMICs in Africa have large, labour-intensive industry and services sectors, which are potentially vulnerable to job displacement in the face of increasing digitalisation. The influence of certain control variables might also come into play.

The results for the services sector were mixed. The fact that an increase in ICT goods trade and internet users would lead to an increase in total services sector employment and in services sector employment in LMICs could be a sign that the sector is effectively leveraging digital technologies to expand employment in certain areas. Again (as with the industry sector),

why an increase in digitally delivered services trade would lead to a decrease in services sector employment in UMICs is not known. Perhaps, if UMICs are net importers of digitally delivered services, an increase in imports of such services would lead to the export of job opportunities rather than the creation of jobs in the domestic economy because of the limited contribution that such services make to value addition.

Table A3 in the Appendices provides some descriptive statistics on the distribution of female and male employment according to sector and country income group. For example, in LICs, women work largely in the agricultural sector, with far fewer working in the industry and services sectors. In LMICs, there is a fairly even distribution of women across the agricultural and services sectors, but they are still poorly represented in the industry sector. In UMICs, the bulk of women work in the services sector, with far fewer in the agricultural and industry sectors. It is evident that industry is not a particular drawcard for women, irrespective of a country's stage of development.

Several scholars have indicated that women in Africa are economically very vulnerable, often because they have limited access to education and employment opportunities (Friederici et al. 2017; Van Niekerk 2017). While the results show that an increase in digitally delivered services trade and internet users would lead to a decrease in both female and male agricultural employment, the adverse effect on women would be at least twice that of the effect on men. This resonates with Antonio and Tuffley's (2014) observation that many industries have a pro-male bias. Interestingly, an increase in ICT goods trade would have an adverse effect on female and male employment in UMICs. The results, of course, do not give any indication of how digital developments would affect the *quality* of women's work versus that of men, which could be influenced by societal norms and men's and women's access to education, among other factors.

In LICs, men, too, work primarily in the agricultural sector, with a much smaller representation in the industry and services sectors. In LMICs, there is a more even distribution of men across the agricultural and services sectors, but their involvement in the industry sector is still comparatively low (although higher than that of women). In UMICs, the services sector attracts just over 50% of men (much lower than the percentage of women), with comparatively less involvement in the industry sector (although double that of women) and limited involvement in the agricultural sector.

Men's (and indeed women's) relatively limited involvement in the industry sector should be of particular concern, given African countries' industrialisation aspirations and the fact that, according to scholars, quick growth has traditionally been achieved by following an industrialisation path.

Conclusion and recommendations

The results clearly show 'that the effects of digital developments on employment in Africa [are] highly contextual, with [numerous variations] across sectors, genders and country income groups' (Parry & Viviers 2023). To some degree, these variations (and some apparent anomalies) could also be influenced by certain control variables introduced to add context and authenticity to the study. Interestingly, some control variables, such as government expenditure, net FDI inflows, HDI ranking and water/electricity infrastructure development did not necessarily have positive effects on employment (though intuition suggests that they should have), while inflation did not necessarily have negative effects (which, likewise, is contrary to expectations).

In general, the results from the empirical study suggest that the industry and services sectors in Africa are more digitally responsive and prepared, and more resilient on the employment front, than the agricultural sector. This is despite concerns often being expressed about the risks that advancing digitalisation poses to jobs in various industry and services sectors. It is therefore an encouraging sign and provides hope that Africa's industrial potential can still be unlocked. However, the fact that agriculture is seriously lagging in terms of digital developments is of great concern, particularly as the sector is often seen to hold the key to food security and accelerated industrialisation on the continent (through a greater emphasis on agro-processing) as well as more substantial and lucrative intraregional trade. Moreover, as suggested by the WEF (2023), the agricultural sector has the advantage of being potentially more resilient against the risk of human job losses as generative AI systems gain traction.

From a policy perspective, invigorating Africa's agricultural sector will involve more than simply investing in more and better technologies. This may accelerate job losses among unskilled or low-skilled workers, with women likely to be the main casualties. A better solution would be to adopt and use digital technologies in ways that help to professionalise and scale farming activities, without threatening farmers' livelihoods. At the same time, the interests of large agricultural operations need to be served, as the latter are critical players in their own right. Such operations could also help smaller farming entities gain access to agricultural RVCs via mutually beneficial supply partnerships.

If Africa is to pursue an effective industrialisation strategy, the agricultural, industry and services sectors need to complement one another to create employment that is socially and environmentally sustainable. For example, there are obvious synergies between the agricultural sector and the industry sector, with a stronger shift towards agro-processing forming the

logical bridge between the two. Various service sectors, such as energy, transport, logistics and ICT, have important coordinating roles to play, while training and capacity building constitute essential building blocks in all sectors at all stages of development.

The fact that African countries have different digital development needs and priorities should not hamper the continent's plans going forward. By adopting a mixed approach, that is, investing in appropriate frontier technologies to boost high-productivity sectors and more basic technologies to energise lower-productivity sectors, the prospects of the digital era acting as an inclusive rather than a divisive force are greatly improved.

Future studies could retain an Africa focus and use the same or very similar variables but involve country-specific empirical analyses with employment effects disaggregated at the firm level. This would help to reveal more nuanced, country- and industry-specific effects of digital developments on employment, from which more discernible trends could be identified – particularly in countries in the UMIC group where, in this study, there were some unusual results that could not easily be explained. In addition, the quantitative analysis could be supported by qualitative inputs from employers, employees and other stakeholders, which could help to explain certain results (especially apparent anomalies). It would also reveal various parties' attitudes towards digital advances, from basic internet connectivity to sophisticated AI applications, and whether they see a link between digital access and literacy, on the one hand, and employment, on the other.

Another recommendation would be to use the same approach as that adopted in this empirical study but to apply it to other developed or developing countries in other regions, such as Asia, Latin America or Europe. It would be useful to determine the effects of digital developments on employment in other parts of the world and to compare them with the results obtained in this study. Insights into other countries' digital developments–employment dynamics could, in turn, help to inform African countries' digitalisation, growth and employment policies and interventions.

Finally, future studies could be conducted on the digital developments–inclusive growth relationship in Africa using *other* variables as proxies for the two concepts. These could include GDP per capita, income levels, HCI scores or labour productivity (for inclusive growth) and broadband connections, ICT literacy levels, cost of internet connectivity or formal digital policies and strategies (for digital developments). This modified approach would then accommodate other views (as reflected in the literature) about the meanings of and linkages between inclusive growth and digital developments.

APPENDICES

TABLE A1: African countries included in the study by income group.

LIC			LMIC			UMIC		
Country	**Freq.**	**%**	**Country**	**Freq.**	**%**	**Country**	**Freq.**	**%**
Burkina Faso	20	7.69	Benin	20	6.25	Botswana	20	25
Burundi	20	7.69	Cameroon	20	6.25	Mauritius	20	25
Central African Rep.	20	7.69	Comoros	20	6.25	Namibia	20	25
Ethiopia	20	7.69	Côte d'Ivoire	20	6.25	South Africa	20	25
Gambia, The	20	7.69	Egypt	20	6.25	-	-	-
Madagascar	20	7.69	Eswatini	20	6.25	-	-	-
Malawi	20	7.69	Ghana	20	6.25	-	-	-
Mali	20	7.69	Kenya	20	6.25	-	-	-
Mozambique	20	7.69	Morocco	20	6.25	-	-	-
Niger	20	7.69	Nigeria	20	6.25	-	-	-
Rwanda	20	7.69	São Tomé & Principe	20	6.25	-	-	-
Togo	20	7.69	Senegal	20	6.25	-	-	-
Uganda	20	7.69	Tanzania	20	6.25	-	-	-
-	-	-	Tunisia	20	6.25	-	-	-
-	-	-	Zambia	20	6.25	-	-	-
-	-	-	Zimbabwe	20	6.25	-	-	-
Total	**260**	**100**	**Total**	**320**	**100**	**Total**	**80**	**100**

Source: Authors' computation based on data from the World Bank (2020).
Key: LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country; Freq., frequency.

TABLE A2: Summary statistics of digital development and employment variables by country.

Country	Digitally delivered services trade (% of total services trade)			ICT goods trade (% of total goods trade)			Internet users (% of total population)	Sector-based employment (% of total employment)			Gender-based employment (% of total female and male populations)		Total employment (% of total population)
	Export	Import	Total	Export	Import	Total	Total	Agriculture	Industry	Services	Female	Male	Total
Benin	21.083	23.365	**33.336**	0.068	2.270	**2.337**	**6.317**	43.888	18.891	37.223	66.538	74.003	**70.173**
Botswana	22.522	39.763	**46.713**	0.202	3.635	**3.837**	**18.822**	22.268	19.299	58.436	45.519	60.714	**52.725**
Burkina Faso	30.295	31.754	**46.537**	0.128	3.071	**3.200**	**4.262**	50.841	19.005	30.156	57.822	78.829	**67.984**
Burundi	12.062	11.500	**17.671**	0.312	4.737	**5.049**	**1.391**	88.548	2.940	8.515	80.109	76.782	**78.488**
Cameroon	31.269	34.486	**49.316**	0.029	3.214	**3.243**	**9.219**	55.184	12.204	32.614	70.817	79.897	**75.314**
Central African Rep.	1.416	3.437	**3.640**	0.030	4.587	**4.617**	**1.320**	72.996	7.272	19.734	62.064	77.288	**69.504**
Comoros	23.163	18.790	**31.464**	0.419	3.573	**3.992**	**3.529**	46.286	16.713	37.005	30.611	50.926	**40.779**
Côte d'Ivoire	32.338	21.943	**40.710**	0.232	3.260	**3.492**	**12.510**	46.937	11.898	41.169	43.364	68.675	**56.416**
Egypt	10.895	30.877	**31.329**	0.996	4.094	**5.090**	**23.286**	28.090	23.428	48.483	16.330	68.069	**42.193**
Eswatini	49.021	47.950	**72.728**	0.165	2.525	**2.690**	**8.113**	16.218	25.965	57.820	33.070	44.108	**38.163**
Ethiopia	7.764	15.336	**17.326**	0.520	5.221	**5.741**	**5.708**	73.516	7.935	18.552	70.994	86.920	**78.858**
Gambia, The	6.507	20.263	**21.416**	0.243	2.773	**3.016**	**13.467**	31.481	16.287	52.233	43.202	63.659	**53.230**
Ghana	39.986	36.707	**57.520**	0.068	3.653	**3.721**	**13.425**	46.846	15.583	37.574	63.116	69.281	**66.215**
Kenya	18.678	31.407	**37.564**	0.506	4.236	**4.742**	**8.980**	57.515	6.939	35.548	65.071	72.601	**68.771**
Madagascar	19.846	31.477	**38.492**	0.221	3.261	**3.482**	**2.165**	72.953	6.776	20.272	81.923	87.450	**84.659**
Malawi	34.796	28.136	**47.199**	0.330	3.906	**4.236**	**4.214**	78.778	5.793	15.432	68.651	77.313	**72.849**
Mali	36.802	17.069	**40.403**	0.070	2.337	**2.407**	**5.513**	68.052	8.027	23.923	54.238	75.807	**64.828**
Mauritius	29.339	40.774	**52.585**	4.074	6.612	**10.686**	**30.514**	8.746	30.056	61.199	37.284	71.016	**53.873**
Morocco	19.335	24.001	**33.469**	4.246	5.477	**9.723**	**36.639**	40.495	21.179	38.329	21.922	67.162	**43.953**
Mozambique	17.470	45.995	**47.599**	0.129	3.274	**3.403**	**4.027**	76.302	5.523	18.178	80.452	78.741	**79.661**
Namibia	7.403	42.091	**37.121**	0.604	4.117	**4.721**	**13.914**	27.650	14.864	57.487	40.871	51.178	**45.748**
Niger	35.821	16.207	**39.021**	0.183	3.041	**3.223**	**1.259**	74.996	7.403	17.602	65.252	87.230	**76.024**
Nigeria	8.710	33.685	**31.797**	0.003	4.153	**4.156**	**13.033**	41.560	11.503	46.940	50.414	59.994	**55.224**
Rwanda	3.445	2.595	**4.530**	0.650	7.239	**7.889**	**8.482**	77.559	5.613	16.830	83.314	84.073	**83.680**
São Tomé & Principe	12.626	17.861	**22.865**	0.746	4.367	**5.112**	**18.599**	24.946	18.157	56.901	31.387	67.180	**49.021**
Senegal	32.776	27.293	**48.055**	0.417	3.335	**3.752**	**12.600**	38.412	12.747	48.843	30.750	60.171	**44.709**
South Africa	22.775	32.774	**41.661**	1.306	9.213	**10.520**	**28.129**	6.232	24.906	68.865	32.305	47.890	**39.912**
Tanzania	12.915	13.557	**19.854**	0.666	4.427	**5.093**	**5.516**	71.982	5.321	22.700	80.556	87.020	**83.745**
Togo	26.751	19.816	**34.925**	0.114	2.671	**2.785**	**5.135**	42.644	14.374	42.985	53.480	60.171	**56.771**
Tunisia	12.333	13.813	**19.609**	4.119	5.132	**9.251**	**30.923**	17.259	32.841	49.900	19.584	60.366	**39.668**
Uganda	17.765	27.007	**33.579**	2.524	6.151	**8.675**	**0.496**	69.486	7.442	23.074	63.703	74.299	**68.809**
Zambia	11.605	16.573	**21.134**	0.343	3.293	**3.636**	**4.122**	62.781	8.718	28.502	63.413	72.981	**68.078**
Zimbabwe	14.301	22.055	**27.267**	0.120	3.750	**3.871**	**10.026**	65.076	8.908	26.019	72.760	84.299	**78.099**
Total	**20.715**	**25.459**	**34.801**	**0.751**	**4.140**	**4.891**	**11.080**	**49.894**	**13.773**	**36.334**	**53.966**	**70.487**	**62.064**

Source: Authors' computation based on data from the World Bank (2020).
Key: ICT, information and communication technology.

TABLE A3: Distribution of female and male employment by sector.

Income group of countries	Sector		Female employment			Male employment		
		Obs	Mean	Min	Max	Mean	Min	Max
LIC	Agricultural sector	260	69.860 (18.671)	21.410	96.620	65.101 (16.179)	22.560	86.370
	Industry sector	260	6.816 (5.933)	0.310	32.430	10.595 (6.005)	3.990	30.890
	Services sector	260	23.326 (14.725)	2.680	62.90	24.306 (10.828)	9.630	54.300
LMIC	Agricultural sector	320	44.984 (20.635)	8.560	85.700	43.618 (15.187)	13.960	80.350
	Industry sector	320	11.428 (8.786)	1.220	35.620	18.142 (6.980)	4.390	33.790
	Services sector	320	43.591 (16.969)	13.070	88.190	38.242 (9.370)	15.260	61.580
UMIC	Agricultural sector	80	13.560 (8.615)	3.200	30.840	18.285 (10.307)	5.450	33.790
	Industry sector	80	14.125 (7.766)	5.190	43.490	28.453 (5.446)	16.940	37.150
	Services sector	80	72.316 (8.037)	47.740	84.770	53.263 (5.905)	44.410	63.820

Source: Authors' computation based on data from the World Bank (2020).
Key: LIC, low-income country; LMIC, lower middle-income country; UMIC, upper middle-income country.
Note: Standard errors in parentheses

Table A4: Unit root tests of the employment variables.

Post-estimation tests	Total employment		Agriculture		Industry		Services		Male		Female	
Augmented Dickey–Fuller (ADF)	**Statistic**	***p*-value**	**Statistic**	***p*-value**	**Statistic**	***p*-value**	**Statistic**	***p*-value**	**Statistic**	***p*-value**	**Statistic**	***p*-value**
Inverse chi-squared (40) P	141.394	0.000	175.736	0.000	172.255	0.000	162.150	0.000	187.552	0.000	105.985	0.000
Inverse normal Z	-8.433	0.000	-10.013	0.000	-9.874	0.000	-9.349	0.000	-10.539	0.000	-6.428	0.000
Inverse logit *t* (104) L*	-8.677	0.000	-10.851	0.000	-10.633	0.000	-9.983	0.000	-11.594	0.000	-6.325	0.000
Modified inv. chi-squared Pm	11.336	0.000	15.176	0.000	14.787	0.000	13.657	0.000	16.497	0.000	7.377	0.000

Source: Authors' computation.
Note: H0: All panels contain unit roots. Number of panels = 20; Ha: At least one panel is stationary. Number of periods = 33; ADF regressions: 3 lags.

Table A5: Unit root tests of the digital development variables.

Post-estimation tests	**ICT goods trade**		**Digitally delivered services trade**		**Internet users**	
Augmented Dickey–Fuller (ADF)	**Statistic**	***p*-value**	**Statistic**	***p*-value**	**Statistic**	***p*-value**
Inverse chi-squared (40) P	197.471	0.000	137.883	0.000	184.780	0.000
Inverse normal Z	−10.814	0.000	−8.808	0.000	−10.308	0.000
Inverse logit t(104) L*	−12.199	0.000	−9.523	0.000	−11.406	0.000
Modified inv. chi-squared Pm	17.606	0.000	13.235	0.000	16.187	0.000

Source: Authors' computation.
Key: ICT, information and communication technology.
Note: H0: All panels contain unit roots. Number of panels = 20; Ha: At least one panel is stationary. Number of periods = 33; ADF regressions: 3 lags.

References

Chapter 1

Ade, ND 2018, 'Understanding the developed and developing economies', *Asian Journal of Research in Social Sciences and Humanities*, vol. 8, no. 3, pp. 1–7. https://doi.org/10.5958/2249-7315.2018.00041.2

African Development Bank (AfDB) 2013, *At the center of Africa's transformation: Strategy for 2013–2022*, Technical report, viewed 06 June 2022, <https://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/AfDB_Strategy_for_2013%E2%80%932022_-_At_the_Center_of_Africa%E2%80%99s_Transformation.pdf>

African Union (AU) 2020, *Digital transformation strategy for Africa*, viewed 21 April 2022, <https://au.int/sites/default/files/documents/38507-doc-dts-english.pdf>

Alliance for Affordable Internet (A4AI) 2022, *Affordability Drivers Index 2021*, viewed 04 July 2022, <https://adi.a4ai.org/affordability-report/data/?_year=2021&indicator=INDEX>

Banga, K & Te Velde, DW 2018, *Digitalisation and the future of manufacturing in Africa: Supporting economic transformation*, March 2018, viewed 20 February 2022, <https://set.odi.org/wp-content/uploads/2018/03/SET_Digitalisation-and-future-of-African-manufacturing_Final.pdf>

Boru, T 2018, 'Research design and methodology' (Chapter Five), PhD thesis, University of South Africa, viewed 10 March 2022, <https://www.researchgate.net/publication/329715052_CHAPTER_FIVE_RESEARCH_DESIGN_AND_METHODOLOGY_51_Introduction_Citation_Lelissa_TB_2018_Research_Methodology_University_of_South_Africa_PHD_Thesis>

Cerra, V 2022, 'An inclusive growth framework', in V Cerra, B Eichengreen, A El-Ganainy & M Schindler (eds.), *How to achieve inclusive growth*, Oxford University Press, Oxford, pp. 1–31.

Cirera, X & Sabetti, L 2016, *The effects of innovation on employment in developing countries: Evidence from enterprise surveys*, World Bank Policy Research Working Paper no. 7775, viewed 19 August 2021, <https://openknowledge.worldbank.org/bitstream/handle/10986/24857/WPS7775.pdf?sequence=4&isAllowed=y>

De Berquin, L & Mbongo, E 2019, 'ICT diffusion and employment in Africa', *Economics Bulletin,* vol. 39, no. 1, pp. 521–532.

De Vos, AS, Delport, CSL, Fouche, C & Strydom, H 2011, *Research at Grass Roots: A primer for the social science and human professions*, Van Schaik, Pretoria.

Dedola, L, Ehrmann, M, Hoffmann, P, Lamo, A, Paz Pardo, G, Slacalek, J & Strasser, G 2023, *Digitalisation and the economy*, European Central Bank Working Paper Series no. 2309, viewed 15 February 2024, <https://www.ecb.europa.eu/pub/pdf/scpwps/ecb.wp2809~6d29dc358d.en.pdf>

Digital Regulation Platform 2023, *National digital transformation strategy – Mapping the digital journey*, International Telecommunication Union (ITU) and World Bank, 06 July, viewed 10 November 2023, <https://digitalregulation.org/national-digital-transformation-strategy-mapping-the-digital-journey/>

Friederici, N, Ojanperä, S & Graham, M 2017, 'The impact of connectivity in Africa: Grand visions and the mirage of inclusive digital development', *The Electronic Journal of Information Systems in Developing Countries,* vol. 79, no. 2, pp. 1–20. https://doi.org/10.1002/j.1681-4835.2017.tb00578.x

Hjort, J & Poulsen, J 2019, 'The arrival of fast internet and employment in Africa', *American Economic Review*, vol. 109, no. 3, pp. 1032–1079. https://doi.org/10.1257/aer.20161385

Hosono, A 2022, 'Transforming economies for jobs and inclusive growth', in *SDGs, transformation, and quality growth*, Sustainable Development Goals Series, Springer, Singapore, pp. 103–120.

Ianchovichina, E 2012, 'What is inclusive growth?', in R Arezki, C Pattillo, M Quintyn & M Zhu (eds.), *Commodity price volatility and inclusive growth in low-income countries,* IMF eLibrary, viewed 05 February 2022, <https://www.elibrary.imf.org/view/book/9781616353797/ch008.xml?rskey=nt60OG&result=5>

Ianchovichina, E & Lundstrom, S 2009, *Inclusive growth analytics: Framework and application*, World Bank Policy Research Working Paper no. 4851, viewed 26 April 2021, <https://documents1.worldbank.org/curated/en/771771468180864543/pdf/WPS4851.pdf>

International Telecommunication Union (ITU) 2023, *Measuring digital development – ICT Development Index 2023*, viewed 10 February 2024, <https://www.itu.int/hub/publication/D-IND-ICT_MDD-2023-2/>

Kumar, R 2014, *Research methodology: A step-by-step guide for beginners*, SAGE Publications, London.

Lythreatis, S, Singh, SK & El-Kassar, A-N 2022, 'The digital divide: A review and future research agenda', *Technological Forecasting and Social Change*, vol. 175, a121359. https://doi.org/10.1016/j.techfore.2021.121359

Madanaguli, A, Parida, V, Sjödin, D & Oghazi, P 2023, 'Literature review on industrial digital platforms: A business model perspective and suggestions for future research', *Technological Forecasting & Social Change*, vol. 194, a122606. https://doi.org/10.1016/j.techfore.2023.122606

Organisation for Economic Co-operation and Development (OECD) 2014, *Report on the OECD Framework for Inclusive Growth*, Meeting of the OECD Council at Ministerial Level, Paris, 06–07 May, viewed 19 October 2023, <https://www.oecd.org/mcm/IG_MCM_ENG.pdf>

Organisation for Economic Co-operation and Development (OECD) 2023, *OECD digital education Outlook 2023: Towards an effective digital education ecosystem*, viewed 15 January 2024, <https://www.oecd-ilibrary.org/sites/c74f03de-en/index.html?itemId=/content/publication/c74f03de-en>

Orkoh, E, Viviers, W & Jansen van Rensburg, SJ 2021, 'Can digital trade promote greater employment? Empirical evidence from Sub-Saharan Africa', in W Viviers, A Parry & SJ Jansen van Rensburg (eds.), *Africa's digital future: From theory to action*, AOSIS Books, Cape Town, pp. 67–100. https://doi.org/10.4102/aosis.2021.BK199.03

Qureshi, Z & Woo, C (eds.) 2022, *Shifting paradigms: Growth, finance, jobs and inequality in the digital economy*, Brookings Institution Press, Washington DC.

Sassi, M 2023, 'Economic connectiveness and pro-poor growth in sub-Saharan Africa: The role of agriculture', *Sustainability*, vol. 15, no. 3, pp. 1–17. https://doi.org/10.3390/su15032026

United Nations (UN) 2020a, *World social report 2020: Inequality in a rapidly changing world*, viewed 14 May 2022, <https://www.un.org/development/desa/dspd/wp-content/uploads/sites/22/2020/02/World-Social-Report2020-FullReport.pdf>

United Nations (UN) 2020b, *Inequality – bridging the divide: UN75 2020 and beyond*, viewed 15 October 2023, <https://www.un.org/sites/un2.un.org/files/2020/02/un75_inequality.pdf>

United Nations Conference on Trade and Development (UNCTAD) 2021, *Reaping the potential benefits of the African Continental Free Trade Area for inclusive growth*, viewed 16 June 2023, <https://unctad.org/system/files/official-document/aldcafrica2021_intro_en.pdf>

United Nations Conference on Trade and Development (UNCTAD) 2023, *UNCTAD's inclusive growth index underscores need to move beyond GDP*, 17 November 2023, viewed 20 January 2024, <https://unctad.org/news/unctads-inclusive-growth-index-underscores-need-move-beyond-gdp>

Unwin, T 2018, *Why we shouldn't use terms such as 'bridging the digital divide' or 'digital leapfrogging',* 03 October, viewed 25 October 2021, <https://unwin.wordpress.

com/2018/10/03/why-we-shouldnt-use-terms-such-as-bridging-the-digital-divide-or-digital-leapfrogging/>

Viviers, W, Parry, A & Jansen van Rensburg, A 2019, 'Are digital advances and inclusive growth compatible goals? Implications for trade policy in developing countries', Paper presented at the WTO Chairs Programme Annual Conference, Geneva, Switzerland, 02 July.

World Economic Forum (WEF) 2022, *Nearly 3 billion people are offline. Here's a step towards bridging the digital divide,* 23 May, viewed 20 June 2022, <https://www.weforum.org/agenda/2022/05/nearly-3-billion-people-are-offline-how-to-bridge-the-digital-divide/>

World Economic Forum (WEF) 2023a, *Here's why Africa is the world leader in digital and mobile banking*, 21 November 2023, viewed 17 December 2023, <https://www.weforum.org/agenda/2023/11/africa-digital-mobile-banking-financial-inclusion/>

World Economic Forum (WEF) 2023b, *The future of jobs report 2023*, viewed 31 May 2023, <https://www.weforum.org/reports/the-future-of-jobs-report-2023/>

World Trade Organization (WTO) 2018, *World trade report 2018. The future of world trade: How digital technologies are transforming global commerce*, viewed 18 October 2022, <https://www.wto.org/english/res_e/publications_e/world_trade_report18_e.pdf>

Chapter 2

Acemoğlu, D 2021, *The post-COVID world: To reverse widening inequality, keep a tight rein on automation*, International Monetary Fund, Finance & Development, March 2021, viewed 28 September 2021, <https://www.imf.org/external/pubs/ft/fandd/2021/03/pdf/COVID-inequality-and-automation-acemoglu.pdf>

Acemoğlu, D & Restrepo, P 2019, *The wrong kind of AI? Artificial intelligence and the future of labour demand*, NBER Working Paper no. 25682, March 2019, viewed 19 October 2020, <https://www.nber.org/system/files/working_papers/w25682/w25682.pdf>

Adarov, A 2022, *Global income inequality and the COVID-19 pandemic in three charts*, World Bank Blogs, 07 February, viewed 14 April 2022, <https://blogs.worldbank.org/developmenttalk/global-income-inequality-and-covid-19-pandemic-three-charts>

African Development Bank (AfDB) 2013, *At the center of Africa's transformation: Strategy for 2013–2022*, Technical report, viewed 06 June 2022, <https://www.afdb.org/fileadmin/uploads/afdb/Documents/Policy-Documents/AfDB_Strategy_for_2013%E2%80%932022_-_At_the_Center_of_Africa%E2%80%99s_Transformation.pdf>

African Union (AU) 2020, *Digital transformation strategy for Africa*, viewed 21 April 2022, <https://au.int/sites/default/files/documents/38507-doc-dts-english.pdf>

African Union (AU) n.d., *Agenda 2063. Our aspirations for the Africa we want*, viewed 14 May 2022, <https://au.int/en/agenda2063/aspirations>

Aikins, ER & McLauchlan, JD-T 2022, *Africa is losing the battle against extreme poverty*, Institute for Security Studies, 13 June, viewed 15 July 2022, <https://issafrica.org/iss-today/africa-is-losing-the-battle-against-extreme-poverty>

Alliance for Affordable Internet (A4AI) 2022, *Affordability report 2021*, viewed 04 July 2022, <https://a4ai.org/wp-content/uploads/2021/12/A4AI_2021_AR_AW.pdf>

Anderton, R, Reimers, P & Botelho, V 2023, *Digitalisation and productivity: Gamechanger or sideshow?*, European Central Bank Working Paper no. 2023/2794, 09 March, viewed 14 October 2023, <https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4382563>

Aoyagi, C & Ganelli, G 2015, *Asia's quest for inclusive growth revisited*, International Monetary Fund Working Paper no. 15/42, viewed 03 February 2022, <https://www.imf.org/external/pubs/ft/wp/2015/wp1542.pdf>

Asongu, S & Boateng, A 2018, 'Introduction to special issue: Mobile technologies and inclusive development in Africa', *Journal of African Business*, vol. 19, no. 3, pp. 297–301. https://doi.org/10.1080/15228916.2018.1481307

Azmeh, S & Foster, C 2018, *Bridging the digital divide and supporting increased digital trade: Scoping study*, GEG Africa Discussion Paper, August 2018, viewed 19 November 2022, <https://saiia.org.za/wp-content/uploads/2018/08/GA_Th3_DP-Azmeh-Foster_20180906.pdf>

Bacchetta, V, Cerra, V, Piermartini, R & Smeets, M 2021, *Trade and inclusive growth*, IMF Working Paper no. 21/74, viewed 03 March 2022, <https://www.elibrary.imf.org/view/journals/001/2021/074/001.2021.issue-074-en.xml>

Baily, MN, Brynjolfsson, E & Korinek, A 2023, 'Machines of mind: The case for an AI-powered productivity boom', *Brookings*, May 2023, viewed 31 May 2023, <https://www.brookings.edu/research/machines-of-mind-the-case-for-an-ai-powered-productivity-boom/>

Baldwin, R 2019, *The globotics upheaval: Globalisation, robotics and the future of work*, Weidenfeld & Nicolson, London.

Banga, K & Te Velde, DW 2018, *Digitalisation and the future of manufacturing in Africa: Supporting economic transformation*, March 2018, viewed 20 February 2022, <https://set.odi.org/wp-content/uploads/2018/03/SET_Digitalisation-and-future-of-African-manufacturing_Final.pdf>

Barefoot, K, Curtis, D, Jolliff, W, Nicholson, JR & Omohundro, R 2018, *Defining and measuring the digital economy*, Bureau of Economic Research Working Paper, viewed 04 April 2022, <https://www.bea.gov/sites/default/files/papers/defining-and-measuring-the-digital-economy.pdf>

Bell, J & Derviş, K 2019, 'Foreword', in *Productive equity: The twin challenges of reviving productivity and reducing inequality*, Brookings Institution and Chumir Foundation for Ethics in Leadership, viewed 25 May 2022, <https://www.brookings.edu/wp-content/uploads/2019/05/productive_equity_190522.pdf>

Benner, C & Pastor, M 2016, *Inclusive growth indicators: Framework and indicator recommendations*, viewed 20 March 2022, <https://www.rockefellerfoundation.org/wp-content/uploads/Inclusive-Economies-Indicators-Full-Report-DEC6.pdf>

Bernstein, A 2017, 'CDE's opportunities first: Don't compensate the poor for the exclusion – Focus on inclusion', *Daily Maverick*, 14 August, viewed 08 August 2021, <https://www.cde.org.za/cdes-opportunities-first-dont-compensate-the-poor-for-the-exclusion-focus-on-inclusion/>

Bernstein, A 2023, *Grants have benefits, but they don't stimulate economic growth*, Centre for Enterprise and Development, 23 April, viewed 06 July 2023, <https://www.cde.org.za/grants-have-benefits-but-they-dont-stimulate-economic-growth/>

Bhorat, H, Signé, L, Asmal, Z, Monnakgotla, J & Rooney, C 2023, *Digitalization and digital skills gaps in Africa: An empirical profile*, Brookings Institution, 30 May, viewed 12 November 2023, <https://www.brookings.edu/articles/digitalization-and-digital-skills-gaps-in-africa-an-empirical-profile/>

Blaauw, PF 2017, 'Informal employment in South Africa: Still missing pieces in the vulnerability puzzle', *Southern African Business Review*, vol. 17, p. 344.

Blanke, J 2016, *What is GDP, and how are we misusing it?*, World Economic Forum, 13 April, viewed 19 December 2021, <https://www.weforum.org/agenda/2016/04/what-is-gdp-and-how-are-we-misusing-it/>

Boarini, R, Murtin, F & Schreyer, P 2015, *Inclusive growth: The OECD measurement framework*, OECD Working Paper no. 64, viewed 07 July 2021, <https://www.oecd-ilibrary.org/docserver/5jrqppxjqhg4-en.pdf?expires=1656149401&id=id&accname=guest&checksum=C707AE5949F0379F8B042BA1B77017B0>

Broom, D 2021, *10 surprising things that rely on artificial intelligence*, World Economic Forum, 05 May, viewed 18 September 2021, <https://www.weforum.org/agenda/2021/05/everyday-services-rely-on-artificial-intelligence-ai/>

Cerra, V 2022, 'An inclusive growth framework', in V Cerra, B Eichengreen, A El-Ganainy & M Schindler (eds.), *How to achieve inclusive growth*, Oxford University Press, Oxford, pp. 1–31.

Chair, C & De Lannoy, A 2018, *Youth, deprivation and the internet in Africa*, ResearchICTAfrica.net, viewed 19 October 2020, <https://researchictafrica.net/after-access-survey-papers/2018/After_Access:_youth_and_digital_inequality_in_Africa.pdf>

Chen, L, Cheng, W, Ciuriak, D, Kimura, F, Nakagawa, J, Pomfret, R, Rigoni, G & Schwarzer, J 2019, *The digital economy for economic development: Free flow of data and supporting policies: Trade, investment and globalization*, T20 Japan 2019, viewed 10 January 2020, <https://t20japan.org/wp-content/uploads/2019/03/t20-japan-tf8-4-digital-economy-economic-development.pdf>

Chivunga, M & Tempest, A 2021, *Digital disruption in Africa: Mapping innovations for the AfCFTA in post-COVID times*, South African Institute of International Affairs Occasional Paper no. 317, 28 January 2021, viewed 02 July 2022, <https://saiia.org.za/research/digital-disruption-in-africa-mapping-innovations-for-the-afcfta-in-post-covid-times/>

Derviş, K 2019, 'International cooperation and global governance', in *Productive equity: The twin challenges of reviving productivity and reducing inequality*, Brookings Institution and Chumir Foundation for Ethics in Leadership, viewed 22 May 2022, <https://www.brookings.edu/wp_content/uploads/2019/05/productive_equity_190522.pdf>

Derviş, K & Chandy, L 2016, *Are technology and globalization destined to drive up inequality?*, Brookings Institution, 05 October, viewed 04 February 2020, <https://www.brookings.edu/research/are-technology-and-globalization-destined-to-drive-up-inequality/>

Draper, P, Freytag, A, Dörfell, C & Schuhmann, S 2019, 'Trade, inclusive development, and the global order', *Global Summitry*, vol. 4, no. 1, pp. 30–49. https://doi.org/10.1093/global/guz001

Duncan, J 2019, 'What can the Fourth Industrial Revolution learn from the Third Industrial Revolution?', *Daily Maverick*, 25 July, viewed 08 November 2019, <https://www.dailymaverick.co.za/article/2019-07-25-what-can-the-fourth-industrial-revolution-learn-from-the-third-industrial-revolution/>

Economist Impact 2022, *Inclusive Internet Index*, viewed 01 June 2022, <https://impact.economist.com/projects/inclusive-internet-index/2022>

European Commission 2024, *EU secures results at WTO Ministerial but important work remains to reform global trade rulebook*, 01 March, viewed 29 February 2024, <https://ec.europa.eu/commission/presscorner/detail/en/ip_24_1294>

Floyd, R 2022, *Imagine Africa's digital economy of the future*, African Center for Economic Transformation, 04 February, viewed 16 August 2023, <https://acetforafrica.org/research-and-analysis/insights-ideas/commentary/imagine-africas-digital-economy-of-the-future/>

Fosu, AK 2017, 'Growth, inequality, and poverty reduction in developing countries: Recent global evidence', *Research in Economics*, vol. 79, no. 2, pp. 306–335. https://doi.org/10.1016/j.rie.2016.05.005

Fourie, F 2013, 'Reducing high employment: Waiting for high growth. Waiting for Godot?', *Econ3x3*, 12 March, viewed 20 October 2020, <http://www.econ3x3.org/article/reducing-unemployment-waiting-high-growth-waiting-godot>

Fourie, F 2014, 'How inclusive is economic growth in South Africa?', *Econ3x3*, 09 September, viewed 19 November 2020, <http://www.econ3x3.org/article/how-inclusive-economic-growth-south-africa>

Fourie, F 2018, 'Informal sector must be on the menu for inclusive growth', *The Broker*, 23 October, viewed 19 February 2021, <https://www.thebrokeronline.eu/informal-sector-must-be-on-the-menu-for-inclusive-growth-d30/>

Friederici, N, Ojanperä, S & Graham, M 2017, 'The impact of connectivity in Africa: Grand visions and the mirage of inclusive digital development', *The Electronic Journal of Information Systems in Developing Countries*, vol. 79, no. 2, pp. 1–20. https://doi.org/10.1002/j.1681-4835.2017.tb00578.x

Friedrich Ebert Stiftung 2020, *What is digitalization? Opportunities and challenges in East Africa*, 20 April, viewed 01 May 2020, <http://library.fes.de/pdf-files/bueros/ruanda/16158.pdf>

FutureLearn 2021, *What does sustainability mean?*, FutureLearn, 09 April, viewed 31 July 2023, <https://www.futurelearn.com/info/blog/what-does-sustainability-mean>

G20 Leaders 2016, *2016 Hangzhou Summit Communiqué*, viewed 19 August 2021, <https://www.consilium.europa.eu/media/23621/leaders_communiquehangzhousummit-final.pdf>

GetSmarter 2022, *What digital transformation means and how it impacts you*, GetSmarter, 13 May, viewed 01 June 2022, <https://www.getsmarter.com/blog/career-advice/what-digital-transformation-means-and-how-it-impacts-you/>

Gillwald, A 2019, *4IR in South Africa is too important to remain the domain of the elite*, Research ICT Africa, 05 September, viewed 15 September 2021, <https://researchictafrica.net/2019/07/08/4ir-in-sa-is-too-important-to-remain-the-domain-of-the-elite/>

Goldin, I 2021, 'Covid-19 has made fighting inequality more critical than ever', *Financial Times*, 21 September, viewed 01 December 2021, <https://www.ft.com/content/24a39617-4ed9-491d-9195-d68191927655>

González, JL & Jouanjean, M-A 2017, *Digital trade: Developing a framework for analysis*, OECD Trade Policy Paper no. 205, viewed 02 February 2022, <https://ideas.repec.org/p/oec/traaab/205-en.html>

Harari, Y 2020, *Read Yuval Harari's blistering warning to Davos in full*, WeForum, 24 January, viewed 03 March 2022, <https://www.weforum.org/agenda/2020/01/yuval-hararis-warning-davos-speech-future-predications/#:~:text=Harari%20speaking%20at%20the%20'How,Survive%20the%2021st%20Century'%20session.&text=Humanity%20faces%20three%20existential%20threats,data%20colonies%2C%22%20he%20explained>

Hardoon, D 2017, *An economy for the 99%,* Oxfam Briefing Paper, January 2017, viewed 20 January 2022, <https://www-cdn.oxfam.org/s3fs-public/file_attachments/bp-economy-for-99-percent-160117-en.pdf>

Hausmann, R 2013, *The tacit knowledge economy*, Project Syndicate, 30 October, viewed 09 March 2022, <https://www.project-syndicate.org/commentary/ricardo-hausmann-on-the-mental-sources-of-productivity-growth>

Hausmann, R 2014, *The economics of inclusion*, Project Syndicate, 07 November, viewed 09 March 2022, <https://www.project-syndicate.org/commentary/inclusiveness-key-strategy-for-growth-by-ricardo-hausmann-2014-11?barrier=accesspaylog>

Hausmann, R, O'Brien, T, Fortunato, A, Lochmann, A, Shah, K, Venturi, L, Enciso-Valdivia, S, Vashkinskaya, E, Ahuja, K, Klinger, B, Sturzenegger, F, Tokman, M & the President and Fellows of Harvard College 2023, *Growth through inclusion in South Africa*, CID Faculty Working Paper no. 434, Centre for International Development, Harvard University, viewed 06 December 2023, <https://growthlab.hks.harvard.edu/sites/projects.iq.harvard.edu/files/growthlab/files/2023-11-cid-wp-434-south-africa-growth-through-inclusion.pdf>

Ianchovichina, E 2012, 'What is inclusive growth?', in R Arezki, C Pattillo, M Quintyn & M Zhu (eds.), *Commodity price volatility and inclusive growth in low-income countries,* IMF eLibrary, October 2012, viewed 05 February 2022, <https://www.elibrary.imf.org/view/book/9781616353797/ch008.xml?rskey=nt60OG&result=5>

Ianchovichina, E & Lundstrom, S 2009, *Inclusive growth analytics: Framework and application*, World Bank Policy Research Working Paper no. 4851, viewed 26 April 2021, <https://documents1.worldbank.org/curated/en/771771468180864543/pdf/WPS4851.pdf>

Ighobor, K 2019, *Africa's jobless youth cast a shadow over economic growth*, African Renewal e-magazine, viewed 14 July 2021, <https://www.un.org/africarenewal/magazine/special-edition-youth-2017/africas-jobless-youth-cast-shadow-over-economic-growth>

Institute for Economics & Peace (IEP) 2023, *Ecological threat report 2023*, viewed 20 January 2024, <https://www.economicsandpeace.org/wp-content/uploads/2023/12/ETR-2023-web.pdf>

International Labour Organization (ILO) 2018, *Women and men in the informal economy: A statistical picture*, 3rd edn., International Labour Office, Geneva, viewed 24 August 2021, <https://www.ilo.org/wcmsp5/groups/public/---dgreports/---dcomm/documents/publication/wcms_626831.pdf>

International Labour Organization (ILO) 2019, *Youth employment in Africa*, viewed 30 August 2021, <https://www.ilo.org/africa/areas-of-work/youth-employment/lang--en/index.htm>

International Labour Organization (ILO) 2023, *African youth face pressing challenges in the transition from school to work*, 10 August 2023, viewed 02 February 2024. <https://ilostat.ilo.org/african-youth-face-pressing-challenges-in-the-transition-from-school-to-work/>

International Monetary Fund (IMF) 2021, *Five things to know about the informal economy*, 28 July, viewed 18 August 2023, <https://www.imf.org/en/News/Articles/2021/07/28/na-072821-five-things-to-know-about-the-informal-economy>

International Telecommunication Union (ITU) 2021, *Global Cybersecurity Index 2020: Measuring commitment to cybersecurity*, viewed 03 April 2022, <https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2021-PDF-E.pdf>

Internet World Stats 2023, *Usage and population statistics,* viewed 30 November 2023, <https://www.internetworldstats.com/stats.htm>

Jansen van Rensburg, SJ, Strydom, PDF, Viviers, W, Kühn, M-L & Parry, A 2021, 'Economic development and industrialisation in the digital era: Where does Africa stand?', in W Viviers, A Parry & SJ Jansen van Rensburg (eds.), *Africa's digital future: From theory to action*, AOSIS Books, Cape Town, pp. 39–65. https://doi.org/10.4102/aosis.2021.BK199.02

Juma, C 2019, 'Digital services and industrial inclusion: Growing Africa's technological complexity', in M Graham (ed.), *Digital economies at global margins*, MIT Press, Cambridge, pp. 33–37.

Kiaga, A & Leung, V 2020, *The transition from the informal to the formal economy in Africa*, ILO Global Employment Policy Review Background Paper no. 4, December 2020, viewed 15 July 2022, <https://www.ilo.org/wcmsp5/groups/public/---ed_emp/documents/publication/wcms_792078.pdf>

Kjøller-Hansen, AO & Sperling, LL 2020, 'Measuring inclusive growth experiences: Five criteria for productive employment', *Review of Development Economics*, vol. 24, no. 1, pp. 1413–1429. https://doi.org/10.1111/rode.12689

Klasen, S 2010, *Measuring and monitoring inclusive growth: Multiple definitions, open questions, and some constructive proposals*, Asian Development Bank Sustainable Development Working Paper Series no. 12, June 2010, viewed 19 November 2020, <https://www.adb.org/sites/default/files/publication/28492/adb-wp12-measuring-inclusive-growth.pdf>

Kruger, PS & Yadavalli, VSS 2016, 'Probability management and the flaw-of-averages', *South African Journal of Industrial Engineering*, vol. 27, no. 4, pp. 1–17. https://doi.org/10.7166/27-4-1572

Lakner, C & Milanovic, B 2015, *Global income distribution: From the fall of the Berlin Wall to the Great Recession*, World Bank Policy Research Working Paper no. 6719, viewed 20 December 2021, <https://openknowledge.worldbank.org/bitstream/handle/10986/16935/WPS6719.pdf?sequence=1&isAllowed=y>

Lederman, D 2013, *International trade and inclusive growth: A primer for busy policy analysts*, World Bank Policy Research Working Paper no. 5586, viewed 18 April 2021, <https://openknowledge.worldbank.org/entities/publication/7f80e8f9-254f-594d-9df1-9dd3238b296d>

Li, C 2012, 'Equality and inequality in Confucianism', *Dao*, vol. 11, no. 3, pp. 295–313. https://doi.org/10.1007/s11712-012-9283-0

Lin, JY 2011, *From flying geese to leading dragons: New opportunities and strategies for structural transformation in developing countries*, World Bank Policy Research Working Paper no. 5702, June 2011, viewed 22 December 2021, <https://openknowledge.worldbank.org/bitstream/handle/10986/3466/WPS5702.pdf?sequence=1&isAllowed=y>

Marwala, T 2020, *Closing the gap: The Fourth Industrial Revolution in Africa*, Pan Macmillan South Africa, Johannesburg.

Masters, L 2021, 'Africa, the Fourth Industrial Revolution, and digital diplomacy: (Re) negotiating the international knowledge structure', *South African Journal of International Affairs*, vol. 28, no. 3, pp. 361–377. https://doi.org/10.1080/10220461.2021.1961605

Miller, MG 2019, *Socialism: In plain view*, Post Falls Press, viewed 12 April 2024, <https://cdapress.com/news/2019/apr/19/socialism-in-plain-view-5/>

Mok, A 2023, 'It's not AI that is going to take your job, but someone who knows how to use AI might, economist says', *Business Insider*, 03 May, viewed 18 October 2023, <https://www.businessinsider.com/ai-wont-take-your-job-someone-who-uses-it-might-2023-5>

Monga, C, Abebe, S & Andinet, W (eds.) 2019, *Creating decent jobs: Strategies, policies, and instruments*, African Development Bank Group, viewed 24 January 2022, <https://www.afdb.org/en/documents/creating-decent-jobs-strategies-policies-and-instruments>

Moyo, S 2019, *4 ways Africa can prepare its young people for the digital economy*, World Economic Forum, 29 May, viewed 14 March 2022, <https://www.weforum.org/agenda/2019/05/4-ways-africa-can-prepare-its-young-people-for-the-digital-economy/>

Muro, M, Maxim, R & Whiton, J 2019, *Automation and artificial intelligence: How machines are affecting people and places*, Brookings Institution, January 2019, viewed 28 November 2021, <https://www.brookings.edu/wp-content/uploads/2019/01/2019.01_BrookingsMetro_Automation-AI_Report_Muro-Maxim-Whiton-FINAL-version.pdf>

Naudé, W 2017, *Entrepreneurship, education and the fourth industrial revolution in Africa*, IZA Institute of Labor Economics Discussion Paper Series no. 10855, June 2017, viewed 10 January 2022, <http://ftp.iza.org/dp10855.pdf>

Naudé, W 2019, *African countries can't industrialise? Yes, they can*, UNU-MERIT, 7 November, viewed 15 October 2021, <https://www.merit.unu.edu/african-countries-cant-industrialise-yes-they-can/>

Ndemo, B & Weiss, T 2017, 'Making sense of Africa's emerging digital transformation and its many futures', *Africa Journal of Management*, vol. 3, nos. 3–4, pp. 328–347. https://doi.org/10.1080/23322373.2017.1400260

Ordonez, V, Dunn, T & Noll, E 2023, 'OpenAI CEO Sam Altman says AI will reshape society, acknowledges risks: "A little bit scared of this"', *ABC News*, 16 March, viewed 25 September 2023, <https://abcnews.go.com/Technology/openai-ceo-sam-altman-ai-reshape-society-acknowledges/story?id=97897122>

Organisation for Economic Co-operation and Development (OECD) 2023, *Key issues in digital trade*, OECD Global Forum on Trade 2023, 'Making Digital Trade Work for All', viewed 10 December 2023, <https://www.oecd.org/trade/OECD-key-issues-in-digital-trade.pdf>

Organisation for Economic Co-operation and Development (OECD) 2024, *Breaking the vicious circles of informal employment and low-paying work*, 15 January, viewed 27 February 2024, <https://www.oecd-ilibrary.org/development/breaking-the-vicious-circles-of-informal-employment-and-low-paying-work_f95c5a74-en>

Organisation for Economic Co-operation and Development (OECD) n.d., *Inclusive growth*, viewed 02 March 2022, <https://www.oecd.org/inclusive-growth/about.htm>

Organisation for Economic Co-operation and Development (OECD), World Trade Organisation (WTO) & International Monetary Fund (IMF) 2020, *Handbook on measuring digital trade*, viewed 02 March 2022, <https://www.oecd.org/sdd/its/Handbook-on-Measuring-Digital-Trade-Version-1.pdf>

Ouma, S, Stenmanns, J & Verne, J 2019, 'African economies: Simply connect? Problematizing the discourse in connectivity and communication', in M Graham (ed.), *Digital economies at global margins*, MIT Press, Cambridge, pp. 341–363.

Oxfam International 2022, *Profiting from pain: The urgency of taxing the rich amid a surge in billionaire wealth and a global cost-of-living crisis*, 23 May, viewed 02 June 2022, <https://oi-files-d8-prod.s3.eu-west-2.amazonaws.com/s3fs-public/2022-05/Oxfam%20Media%20

Brief%20-%20EN%20-%20Profiting%20From%20Pain%2C%20Davos%202022%20Part%202.pdf>

Parry, A 2021, 'Turning theory into action: The power is in Africa's hands', in W Viviers, A Parry & SJ Jansen van Rensburg (eds.), *Africa's digital future: From theory to action,* AOSIS Books, Cape Town, pp. 303–318. https://doi.org/10.4102/aosis.2021.BK199.10

Parry, A, Jansen van Rensburg, A, Viviers, W & Orkoh, E 2021, 'Are digital advances and inclusive growth compatible goals? Implications for trade policy in developing countries', in M Smeets (ed.), *Adapting to the digital trade era: Challenges and opportunities*, WTO, Geneva, pp. 280–295.

Parviainen, P, Maarit, T, Kääriäninen, J & Teppola, S 2017, 'Tackling the digitalization challenge: How to benefit from digitalization in practice', *International Journal of Information Systems and Project Management*, vol. 5, no. 1, pp. 63–77. https://doi.org/10.12821/ijispm050104

Qureshi, Z 2019, 'Boosting productivity and reducing inequality: An interconnected policy agenda', in *Productive equity: The twin challenges of reviving productivity and reducing inequality*, Brookings Institution and Chumir Foundation for Ethics in Leadership, viewed 29 January 2022, <https://www.brookings.edu/wp_content/uploads/2019/05/productive_equity_190522.pdf>

Qureshi, Z 2023, 'Rising inequality: A major issue of our time', Brookings Institution, 16 May, viewed 20 June 2023, <https://www.brookings.edu/articles/rising-inequality-a-major-issue-of-our-time/>

Ramos, RA, Ranieri, R & Lammes, J 2013, *Mapping inclusive growth*, International Policy Centre for Inclusive Growth Working Paper no. 5, 13 March, viewed 14 March 2022, <https://www.econstor.eu/bitstream/10419/71778/1/73672866X.pdf>

Ranieri, R & Ramos, RA 2013, *After all, what is inclusive growth?*, International Policy Centre for Inclusive Growth Working Paper no. 104, viewed 19 September 2021, <https://ideas.repec.org/p/ipc/oparab/188.html>

Rodrik, D 2016, 'An African growth miracle?' *Journal of African Economies*, vol. 27, no. 1, pp. 1–18. https://doi.org/10.1093/jae/ejw027

Rodrik, D 2021, *The metamorphosis of growth policy*, Project Syndicate, 11 October, viewed 04 April 2022, <https://www.project-syndicate.org/commentary/new-growth-policies-for-developing-countries-by-dani-rodrik-2021-10>

Roser, M 2021, *What is economic growth? And why is it so important?*, Our World in Data, 13 May, viewed 03 October 2021, <https://ourworldindata.org/what-is-economic-growth>

Ryder, G 2019, 'Correctly valuing the work of the future', *Journal of International Affairs*, vol. 72, no. 1, pp. 23–36.

Sanders, C & Scanlon, E 2021, 'The digital divide is a human rights issue: Advancing social inclusion through social work advocacy', *Journal of Human Rights and Social Work*, vol. 6, pp. 130–143. https://doi.org/10.1007/s41134-020-00147-9

Schwab, K 2016, *The Fourth Industrial Revolution: What it means and how to respond*, 14 January, viewed 06 September 2019, <https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/>

Signé, L 2019, *African economies, digitalization, and fragility: Insights from the Spring Meetings*, Brookings Institution, 18 April, viewed 29 July 2021, <https://www.brookings.edu/blog/africa-in-focus/2019/04/18/african-economies-digitalization-and-fragility-insights-from-spring-meetings/>

Southern African Development Community (SADC) 2001, *Declaration on information and communications technology*, viewed 01 June 2021, <https://www.sadc.int/files/7813/5292/8380/Declaration_on_Information_and_Communication_Technology2001.pdf>

Statista n.d., *Population without access to electricity in sub-Saharan Africa from 2000 to 2021*, viewed 30 September 2023, <https://www.statista.com/statistics/1221698/population-without-access-to-electricity-in-africa/#:~:text=Access%20to%20electricity%20in%20sub,inaccessible%20to%20581%20million%20Africans>

Strydom, PDF 2021, 'Digital technologies, employment and labour-market polarisation in Africa', in W Viviers, A Parry & SJ Jansen van Rensburg (eds.), *Africa's digital future: From theory to action*, AOSIS Books, Cape Town, pp. 101–127. https://doi.org/10.4102/aosis.2021.BK199.04

Strydom, PDF & Viviers, W 2021, 'Leveraging global value chains and digital technologies to strengthen Africa's industrial base', in W Viviers, A Parry & SJ Jansen van Rensburg (eds.), *Africa's digital future: From theory to action*, AOSIS Books, Cape Town, pp. 129–160. https://doi.org/10.4102/aosis.2021.BK199.05

Sustainability and Livelihood Research Organisation (Suliver) n.d., *Harnessing inclusive growth,* viewed 04 March 2022, <https://www.suliver.org/harnessing-inclusive-growth/>

Swartz, E, Scheepers, C, Lindgreen, A, Yousafzai, S & Matthee, M (eds.) 2023, *Technological leapfrogging and innovation in Africa: Digital transformation and opportunity for the next growth continent,* Edward Elgar, Cheltenham.

Tempest, A 2020, *The digital economy and ecommerce in Africa: Drivers of the African Free Trade Area?*, South African Institute of International Affairs, June 2020, viewed 22 May 2022, <https://saiia.org.za/research/the-digital-economy-and-e-commerce-in-africa-drivers-for-the-african-free-trade-area/>

The Economist 2023, *Large, creative AI models will transform lives and labour markets*, 22 April, viewed 22 May 2023, <https://www.economist.com/interactive/science-and-technology/2023/04/22/large-creative-ai-models-will-transform-how-we-live-and-work>

Third World Network 2019, *South needs data digitalization policies, say CSO experts*, 17 April, viewed 16 June 2021, <https://www.twn.my/title2/wto.info/2019/ti190412.htm>

Tralac, 2019, *Trade in the digital economy: A tralac guide*, viewed 30 January 2022, <https://www.tralac.org/documents/resources/booklets/3175-trade-in-the-digital-economy-a-tralac-guide-march-2020/file.html>

United Nations (UN) n.d., *#Envision2030 Goal 8: Decent work and economic growth*, viewed 10 May 2022, <https://www.un.org/development/desa/disabilities/envision2030-goal8.html>

United Nations Conference on Trade and Development (UNCTAD) 2019, *Digital economy report 2019: Value creation and capture: Implications for developing countries*, viewed 15 June 2021, <https://unctad.org/system/files/official-document/der2019_en.pdf>

United Nations Conference on Trade and Development (UNCTAD) 2021a, *Technology and innovation report 2021: Catching technological waves: Innovation with equity*, viewed 15 June 2022, <https://unctad.org/system/files/official-document/tir2020_en.pdf>

United Nations Conference on Trade and Development (UNCTAD) 2021b, *Digital economy report 2021: Cross-border data flows and development: From whom the data flow*, viewed 17 June 2022, <https://unctad.org/system/files/official-document/der-2021_en.pdf>

United Nations Conference on Trade and Development (UNCTAD) 2023, *Technology and innovation report 2023. Opening green windows: Technological opportunities for a low-carbon world*, viewed 10 December 2023, <https://unctad.org/tir2023#:~:text=The%20report%20assesses%20countries'%20preparedness,activity%20and%20access%20to%20finance>

United Nations Educational, Scientific and Cultural Organization (UNESCO) 2022, *Education and skills for women's integration into the labour market: A comparative analysis of eight sub-Saharan African countries*, viewed 12 November 2023, <https://unesdoc.unesco.org/ark:/48223/pf0000383086>

Unwin, T 2019, *Why the notion of a Fourth Industrial Revolution is so problematic*, 09 March, viewed 16 September 2021, <https://unwin.wordpress.com/2019/03/09/why-the-notion-of-a-fourth-industrial-revolution-is-so-problematic/>

Van Niekerk, AJ 2017, *Towards inclusive growth in Africa*, Paper presented at the Biennial Conference of the Economic Society of South Africa (ESSA), viewed 23 March 2018, <https://2017.essa.org.za/fullpaper/essa_3648.pdf>

Van Niekerk, AJ 2020, 'Towards inclusive growth in Africa', *Development Southern Africa*, vol. 37, no. 1, pp. 1–15. https://doi.org/10.1080/0376835X.2020.1736004

Viviers, W, Parry, A & Jansen van Rensburg, A 2019, *Are digital advances and inclusive growth compatible goals? Implications for trade policy in developing countries*, Paper presented at the WTO Chairs Programme Annual Conference, Geneva, Switzerland, 02 July.

Whiting, K 2024, *This is how inclusion benefits the global economy, according to experts at Davos*, World Economic Forum, 24 January, viewed 15 February 2024, <https://www.weforum.org/agenda/2024/01/how-inclusion-benefits-global-economy/>

World Bank 2019, *World development report 2019: The changing nature of work*, viewed 14 October 2021, <https://documents1.worldbank.org/curated/en/816281518818814423/pdf/2019-WDR-Report.pdf>

World Bank 2023, *Year in review: 2023 in nine charts: A growing inequality*, viewed 10 February 2024, <https://www.worldbank.org/en/news/feature/2023/12/18/2023-in-nine-charts-a-growing-inequality>

World Bank n.d., *Poverty*, viewed 30 November 2023, <https://www.worldbank.org/en/topic/poverty/overview>

World Economic Forum (WEF) 2018, *The future of jobs report 2018*, viewed 22 February 2021, <https://www3.weforum.org/docs/WEF_Future_of_Jobs_2018.pdf>

World Economic Forum (WEF) 2020, *Global social mobility report. Equality, opportunity and a new economic imperative*, January 2020, viewed 22 February 2022, <https://www3.weforum.org/docs/Global_Social_Mobility_Report.pdf>

World Economic Forum (WEF) 2023, *The future of jobs report 2023*, viewed 31 May 2023, <https://www.weforum.org/reports/the-future-of-jobs-report-2023/>

World Health Organization (WHO) 2021, *More than half a billion people pushed or pushed further into extreme poverty due to health care costs*, 12 December, viewed 14 March 2022, <https://www.who.int/news/item/12-12-2021-more-than-half-a-billion-people-pushed-or-pushed-further-into-extreme-poverty-due-to-health-care-costs>

World Trade Organization (WTO) 2018, *World trade report 2018. The future of world trade: How digital technologies are transforming global commerce*, viewed 18 October 2021, <https://www.wto.org/english/res_e/publications_e/world_trade_report18_e.pdf>

World Trade Organization (WTO) 2021, *World trade report 2021. Economic resilience and trade*, viewed 01 June 2022, <https://www.wto.org/english/res_e/booksp_e/wtr21_e/00_wtr21_e.pdf>

Chapter 3

Albiman, M & Sulong, S 2016, 'The role of ICT use to the economic growth in sub-Saharan African region', *Journal of Science and Technology Policy Management*, vol. 7, no. 3, pp. 306–309. https://doi.org/10.1108/JSTPM-06-2016-0010

Alliance for Affordable Internet (A4AI) 2022a, *Affordability Drivers Index 2021*, viewed 04 July 2022, <https://adi.a4ai.org/affordability-report/data/?_year=2021&indicator=INDEX>

Alliance for Affordable Internet (A4AI) 2022b, *Affordability report 2021*, viewed 04 July 2022, <https://a4ai.org/wp-content/uploads/2021/12/A4AI_2021_AR_AW.pdf>

Amponsah, M, Agbola, FW & Mahmood, A 2023, 'The relationship between poverty, income inequality and inclusive growth in Sub-Saharan Africa', *Economic Modelling*, vol. 126, a106415. https://doi.org/10.1016/j.econmod.2023.106415

Asongu, S 2015, 'The impact of mobile phone penetration on African inequality', *International Journal of Social Economics*, vol. 42, no. 8, pp. 706–716. https://doi.org/10.1108/IJSE-11-2012-0228

Banga, K & Te Velde, DW 2018, *Digitalisation and the future of manufacturing in Africa: Supporting Economic Transformation*, March 2018, viewed 20 February 2022, <https://

set.odi.org/wp-content/uploads/2018/03/SET_Digitalisation-and-future-of-African-manufacturing_Final.pdf>

Bankole, F, Osei-Bryston, K & Brown, I 2015, 'The impact of information and communications technology infrastructure and complementary factors on intra-African trade', *Information Technology for Development*, vol. 21, no. 1, pp. 12–28. https://doi.org/10.1080/02681102.2013.832128

Batuo, M 2015, 'The role of telecommunications infrastructure in the regional economic growth of Africa', *The Journal of Developing Areas*, vol. 49, no. 1, pp. 313–330. https://doi.org/10.1353/jda.2015.0005

Bhorat, H, Signé, L, Asmal, Z, Monnakgotla, J & Rooney, C 2023, *Digitalization and digital skills gaps in Africa: An empirical profile*, Brookings Institution, 30 May, viewed 12 August 2023, <https://www.brookings.edu/articles/digitalization-and-digital-skills-gaps-in-africa-an-empirical-profile/>

Bureau of Economic Analysis (BEA) 2018, Working Paper, 15 March, viewed 15 January 2022, <https://www.bea.gov/system/files/papers/WP2018-4.pdf>

Chakravorti, B, Bhalla, A & Chaturvedi, RS 2020, 'Which economies showed the most digital progress in 2020?', *Harvard Business Review*, 18 December, viewed 03 February 2022, <https://hbr.org/2020/12/which-economies-showed-the-most-digital-progress-in-2020?ab=hero-subleft-3>

Cirera, X & Sabetti, L 2016, *The effects of innovation on employment in developing countries: Evidence from enterprise surveys*, World Bank Policy Research Working Paper no. 7775, viewed 19 August 2018, <https://openknowledge.worldbank.org/bitstream/handle/10986/24857/WPS7775.pdf?sequence=4&isAllowed=y>

David, OO 2019, 'Powering economic growth and development in Africa: Telecommunications operations', *Applied Economics*, vol. 51, no. 33, pp. 3583–3607. https://doi.org/10.1080/00036846.2019.1578852

De Berquin, L & Mbongo, E 2019, 'ICT diffusion and employment in Africa', *Economics Bulletin*, vol. 9, no. 1, pp. 521–532.

Donou-Adonsou, F, Lim, S & Mathey, S 2016, 'Technological progress and economic growth in Sub-Saharan Africa: Evidence from telecommunications infrastructure', *International Advances in Economic Research*, vol. 22, no. 1, pp. 65–75. https://doi.org/10.1007/s11294-015-9559-3

Dörffel, C & Schuhmann, S 2022, 'What is inclusive development? Introducing the Multidimensional Inclusiveness Index', *Social Indicators Research*, vol. 162, pp. 1117–1148. https://doi.org/10.1007/s11205-021-02860-y

Ebaidalla, EM 2014, *Effect of ICTs on youth unemployment in sub-Saharan Africa: A panel data analysis*, African Economic Conference, 14 November, viewed 18 July 2022, <https://www.researchgate.net/publication/273131082_Effect_of_ICTs_on_Youth_Unemployment_in_Sub_Saharan_Africa_a_Panel_Data_Analysis>

Economist Impact 2022a, *Inclusive Internet Index*, viewed 01 June 2022, <https://impact.economist.com/projects/inclusive-internet-index/2022>

Economist Impact 2022b, *The Inclusive Internet Index. Five-year lookback report*, viewed 03 June 2022, <https://impact.economist.com/projects/inclusive-internet-index/downloads/ei-meta_3i_5yr_lookback_report_0.pdf>

Evans, O 2019, 'Repositioning for increased digital dividends: Internet usage and economic well-being in sub-Saharan Africa', *Journal of Global Information Technology Management*, vol. 22, no. 1, pp. 47–70. https://doi.org/10.1080/1097198X.2019.1567218

Friederici, N, Ojanperä, S & Graham, M 2017, 'The impact of connectivity in Africa: Grand visions and the mirage of inclusive digital development', *The Electronic Journal of Information Systems in Developing Countries*, vol. 79, no. 2, pp. 1–20. https://doi.org/10.1002/j.1681-4835.2017.tb00578.x

Haftu, GG 2019, 'Information and communications technology and economic growth in sub-Saharan Africa: A panel data approach', *Telecommunications Policy*, vol. 43, no. 1, pp. 88–99. https://doi.org/10.1016/j.telpol.2018.03.010

Hjort, J & Poulsen, J 2019, 'The arrival of fast internet and employment in Africa', *American Economic Review*, vol. 109, no. 3, pp. 1032–1079. https://doi.org/10.1257/aer.20161385

International Institute for Management Development (IMD) World Competitiveness Center 2023, *World Digital Competitiveness Index*, viewed 01 December 2023, <https://www.imd.org/centers/wcc/world-competitiveness-center/rankings/world-digital-competitiveness-ranking/>

International Telecommunication Union (ITU) 2021, *Global Cybersecurity Index 2020: Measuring commitment to cybersecurity*, viewed 03 April 2022, <https://www.itu.int/dms_pub/itu-d/opb/str/D-STR-GCI.01-2021-PDF-E.pdf>

Kacem, S, Abid, L & Ghorbel-Zouari, S 2019, 'Measurement of inclusive growth: Evidence from Tunisia', *Economics of Development*, vol. 18, no. 3, pp. 19–33. https://doi.org/10.21511/ed.18(3).2019.03

Khan, S, Lilenstein, L, Oosthuizen, M & Rooney, C 2017, *Correlates of ICTs and employment in sub-Saharan Africa*, University of Cape Town Development Policy Research Unit Working Paper no. 201703, viewed 20 June 2021, <http://www.dpru.uct.ac.za/sites/default/files/image_tool/images/36/Publications/Working_Papers/DPRU%20WP201703.pdf>

Kjøller-Hansen, AO & Sperling, LL 2020, 'Measuring inclusive growth experiences: Five criteria for productive employment', *Review of Development Economics*, vol. 24, no. 1, pp. 1413–1429. https://doi.org/10.1111/rode.12689

Marwala, T 2020, *Closing the gap: The Fourth Industrial Revolution in Africa*, Pan Macmillan South Africa, Johannesburg.

Mo Ibrahim Foundation n.d., *Ibrahim Index of African Governance (IIAG) 2022,* viewed 18 November 2023, <https://mo.ibrahim.foundation/sites/default/files/2023-01/2022-index-report.pdf>

Niyigena, J-P, Jiang, Q, Ziou, D, Shaw, R-S & Hasan, T 2020, 'Modeling the measurement of the determinants of ICT fluency and evolution of digital divide among students in developing countries – East Africa case study', *Applied Sciences*, vol. 10, no. 7, pp. 1–27. https://doi.org/10.3390/app10072613

Njoh, AJ 2018, 'The relationship between modern information and communications technologies (ICT) and development in Africa', *Utilities Policy*, vol. 50, pp. 83–90. https://doi.org/10.1016/j.jup.2017.10.005

Orkoh, E, Viviers, W & Jansen van Rensburg, SJ 2021, 'Can digital trade promote greater employment? Empirical evidence from sub-Saharan Africa', in W Viviers, A Parry & SJ Jansen van Rensburg (eds.), *Africa's digital future: From theory to action*, AOSIS Books, Cape Town, pp. 67–100. https://doi.org/10.4102/aosis.2021.BK199.03

Ramos, RA, Ranieri, R & Lammes, J 2013, *Mapping inclusive growth*, International Policy Centre for Inclusive Growth Working Paper no. 5, 13 March, viewed 14 March 2022, <https://www.econstor.eu/bitstream/10419/71778/1/73672866X.pdf>

Rangkakulnuwat, P & Dunyo, S 2018, 'The effects of internet usage on economic growth in Africa', *Asian Journal of Applied Economics*, vol. 25, no. 2, pp. 19–33.

Reichstein, C, Härting, R-C & Neumaier, P 2018, 'Understanding the potential value of digitization for business: Quantitative research reports for European experts', in G Jezic, YH Chen-Burger, R Howlett, L Jain, L Vlacic & R Šperka (eds.), *Agents and multi-agent systems: Technologies and applications 2018*, KES-AMSTA-18 2018, Smart Innovation, Systems and Technologies, vol. 96, Springer, s.l., pp. 287–298. <https://doi.org/10.1007/978-3-319-92031-3_29>

The Heritage Foundation 2023, *Index of Economic Freedom 2023*, viewed 12 June 2023, <https://www.heritage.org/index/>

United Nations Conference on Trade and Development (UNCTAD) 2022, *SDG Pulse*, 21 June, viewed 30 June 2022, <https://sdgpulse.unctad.org/inclusive-growth/>

United Nations Conference on Trade and Development (UNCTAD) 2023, *Technology and innovation report 2023. Opening green windows: Technological opportunities for a low-carbon world*, viewed 10 December 2023, <https://unctad.org/tir2023#:~:text=The%20report%20assesses%20countries'%20preparedness,activity%20and%20access%20to%20finance>

United Nations Conference on Trade and Development Statistics (UNCTADSTAT) 2023, *Inclusive Growth Index (IGI)*, viewed 20 November 2023, <https://unctadstat.unctad.org/datacentre/dataviewer/US.InclusiveGrowth>

United Nations Development Programme (UNDP) n.d., *Human Development Index*, viewed 22 July 2022, <https://hdr.undp.org/data-center/human-development-index#/indicies/HDI>

Van Niekerk, AJ 2017, *Towards inclusive growth in Africa*, Paper presented at the Biennial Conference of the Economic Society of South Africa (ESSA), viewed 23 March 2018, <https://2017.essa.org.za/fullpaper/essa_3648.pdf>

Van Niekerk, AJ 2020, 'Towards inclusive growth in Africa', *Development Southern Africa*, vol. 37, no. 1, pp. 1–15. https://doi.org/10.1080/0376835X.2020.1736004

Viviers, W, Parry, A & Jansen van Rensburg, A 2019, *Are digital advances and inclusive growth compatible goals? Implications for trade policy in developing countries*, Paper presented at the WTO Chairs Programme Annual Conference, Geneva, Switzerland, 02 July.

World Bank 2020, *World development indicators database*, viewed 14 February 2022, <https://databank.worldbank.org/source/world-development-indicators>

World Bank n.d., *Human Capital Index (HCI)*, viewed 30 May 2022, <https://www.worldbank.org/en/publication/human-capital#Index>

World Economic Forum (WEF) 2018, *Inclusive Development Index (IDI)*, viewed 01 April 2022, <http://www3.weforum.org/docs/WEF_Forum_IncGrwth_2018.pdf>

Chapter 4

Abeliansky, AL & Hilbert, M 2017, 'Digital technology and international trade: Is it the quantity of subscriptions or the quality of data speed that matters?', *Telecommunications Policy*, vol. 41, no. 1, pp. 35–48. https://doi.org/10.1016/j.telpol.2016.11.001

African Development Bank (AfDB) 2018, *Africa Infrastructure Development Index 2018*, viewed 20 October 2022, <https://www.afdb.org/fileadmin/uploads/afdb/Documents/Publications/Economic_Brief_-_The_Africa_Infrastructure_Development_Index.pdf>

Antonio, A & Tuffley, D 2014, 'The gender digital divide in developing countries', *Future Internet*, vol. 6, no. 4, pp. 673–687. https://doi.org/10.3390/fi6040673

Anyanwu, JC 2013, 'Characteristics and macroeconomic determinants of youth employment in Africa', *African Development Review*, vol. 25, no. 2, pp. 107–129. https://doi.org/10.1111/j.1467-8268.2013.12019.x

Anyanwu, JC & Augustine, D 2013, 'Gender equality in employment in Africa: Empirical analysis and policy implications', *African Development Review*, vol. 25, no. 4, pp. 4400–4420. https://doi.org/10.1111/1467-8268.12038

Arellano, M & Bond, S 1991, 'Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations', *The Review of Economic Studies*, vol. 58, no. 2, pp. 277–297. https://doi.org/10.2307/2297968

Asongu, S 2015, 'The impact of mobile phone penetration on African inequality', *International Journal of Social Economics*, vol. 42, no. 8, pp. 706–716. https://doi.org/10.1108/IJSE-11-2012-0228

Banga, K & Te Velde, DW 2018, *Digitalisation and the future of manufacturing in Africa: Supporting economic transformation*, March 2018, viewed 20 February 2022, <https://set.odi.org/wp-content/uploads/2018/03/SET_Digitalisation-and-future-of-African-manufacturing_Final.pdf>

Bernstein, A 2017, 'CDE's opportunities first: Don't compensate the poor for the exclusion – Focus on inclusion', *Daily Maverick*, 14 August, viewed 08 August 2021, <https://www.cde.org.za/cdes-opportunities-first-dont-compensate-the-poor-for-the-exclusion-focus-on-inclusion/>

Bhorat, H, Signé, L, Asmal, Z, Monnakgotla, J & Rooney, C 2023, *Digitalization and digital skills gaps in Africa: An empirical profile*, Brookings Institution, 30 May, viewed 12 August 2023, <https://www.brookings.edu/articles/digitalization-and-digital-skills-gaps-in-africa-an-empirical-profile/>

Boru, T 2018, 'Research design and methodology', PhD thesis, University of South Africa, viewed 10 March 2022, <https://www.researchgate.net/publication/329715052_CHAPTER_FIVE_RESEARCH_DESIGN_AND_METHODOLOGY_51_Introduction_Citation_Lelissa_TB_2018_Research_Methodology_University_of_South_Africa_PHD_Thesis>

Bouakez, H & Rebei, N 2007, 'Why does private consumption rise after a government spending shock?', *Canadian Journal of Economics*, vol. 40, no. 3, pp. 954–979. https://doi.org/10.1111/j.1365-2966.2007.00438.x

Cameron, AC & Trivedi, PK 2010, *Microeconometrics using Stata*, 2nd edn., Stata Press, College Station.

Cerra, V 2022, 'An inclusive growth framework', in V Cerra, B Eichengreen, A El-Ganainy & M Schindler (eds.), *How to achieve inclusive growth*, Oxford University Press, Oxford, pp. 1–31.

Choudhry, MT, Marelli, E & Signorelli, M 2012, 'Youth unemployment rate and impact of financial crises', *International Journal of Manpower*, vol. 33, no. 1, pp. 76–95. https://doi.org/10.1108/01437721211212538

De Vos, AS, Delport, CSL, Fouche, C & Strydom, H 2011, *Research at grass roots: A primer for the social science and human professions*, Van Schaik, Pretoria.

Demidova, O & Signorelli, M 2012, 'Determinants of youth unemployment in Russian regions', *Post-Communist Economies*, vol. 24, no. 2, pp. 191–217. https://doi.org/10.1080/14631377.2012.675155

Ebaidalla, EM 2014, *Effect of ICTs on youth unemployment in sub-Saharan Africa: A panel data analysis*, African Economic Conference, 14 November, viewed 18 July 2022, <https://www.researchgate.net/publication/273131082_Effect_of_ICTs_on_Youth_Unemployment_in_Sub_Saharan_Africa_a_Panel_Data_Analysis>

Ferreira, D & Palma, AA 2015, 'Forecasting inflation with the Phillips curve: A dynamic model averaging approach for Brazil', *Revista Brasileira de Economia*, vol. 69, no. 4, pp. 451–465. https://doi.org/10.5935/0034-7140.20150021

Freund, C & Weinhold, D 2002, 'The internet and international trade in services', *American Economic Review*, vol 92, no. 2, pp. 236–240. https://doi.org/10.1257/000282802320189320

González, JL & Jouanjean, M-A 2017, *Digital trade: Developing a framework for analysis*, OECD Trade Policy Paper no. 205, viewed 02 February 2022, <https://ideas.repec.org/p/oec/traaab/205-en.html>

Haftu, GG 2019, 'Information and communications technology and economic growth in sub-Saharan Africa: A panel data approach', *Telecommunications Policy*, vol. 43, no. 1, pp. 88–99. https://doi.org/10.1016/j.telpol.2018.03.010

Hisarciklilar, M, Gultekin-Karakas, D & Asici, AA 2014, 'Can FDI be a panacea for unemployment? The Turkish case', in T Dereli, P Soykut & A Şen (eds.), *Labor and employment relations in a globalized world: New perspectives on work, social policy, and labor market implications*, Springer, New York, pp. 43–70.

Hjort, J & Poulsen, J 2019, 'The arrival of fast internet and employment in Africa', *American Economic Review*, vol. 109, no. 3, pp. 1032–1079. https://doi.org/10.1257/aer.20161385

Hodder, G & Migwalla, B 2023, *Africa's agricultural revolution: From self-sufficiency to global food powerhouse*, viewed 31 January 2024, <https://www.whitecase.com/insight-our-thinking/africa-focus-summer-2023-africas-agricultural-revolution#article-content>

Hsiao, C 2007, 'Panel data analysis – Advantages and challenges', *Test*, vol. 16, no. 1, pp. 1–22. https://doi.org/10.1007/s11749-007-0046-x

Ianchovichina, E 2012, 'What is inclusive growth?', in R Arezki, C Pattillo, M Quintyn & M Zhu (eds.), *Commodity price volatility and inclusive growth in low-income countries*, IMF eLibrary, viewed 05 February 2022, <https://www.elibrary.imf.org/view/book/9781616353797/ch008.xml?rskey=nt60OG&result=5>

International Labour Organization (ILO) 2016, *World employment and social outlook: Trends 2016*, viewed 19 August 2021, <https://www.ilo.org/wcmsp5/groups/public/@dgreports/@dcomm/@publ/documents/publication/wcms_443480.pdf>

Khan, S, Lilenstein, L, Oosthuizen, M & Rooney, C 2017, *Correlates of ICTs and employment in sub-Saharan Africa*, University of Cape Town Development Policy Research Unit Working Paper no. 201703, viewed 20 June 2021, <http://www.dpru.uct.ac.za/sites/default/files/image_tool/images/36/Publications/Working_Papers/DPRU%20WP201703.pdf>

Kumar, R 2014, *Research methodology: A step-by-step guide for beginners*, SAGE Publications, London.

Mileva, E 2007, *Using Arellano-Bond dynamic panel GMM estimators in Stata*, Tutorial with examples using Stata 9.0, Fordham University Economics Department, New York, viewed 16 May 2022, <https://www.scirp.org/(S(czeh2tfqw2orz553k1w0r45))/reference/referencespapers?referenceid=3296478>

Moloi, T & Marwala, T 2020, 'The Phillips curve', in T Moloi & T Marwala (eds.), *Artificial intelligence in economics and finance theories*, Springer, New York, pp. 53–62.

Ndung'u, N & Signé, L 2020, *The Fourth Industrial Revolution and digitisation will transform Africa into a global powerhouse*, Brookings, 08 January, viewed 29 November 2021, <https://www.brookings.edu/research/the-fourth-industrial-revolution-and-digitization-will-transform-africa-into-a-global-powerhouse/>

Niyigena, J-P, Jiang, Q, Ziou, D, Shaw, R-S & Hasan, T 2020, 'Modeling the measurement of the determinants of ICT fluency and evolution of digital divide among students in developing countries – East Africa case study', *Applied Sciences*, vol. 10, no. 7, pp. 1–27. https://doi.org/10.3390/app10072613

Orkoh, E, Viviers, W & Jansen van Rensburg, SJ 2021, 'Can digital trade promote greater employment? Empirical evidence from sub-Saharan Africa', in W Viviers, A Parry & SJ Jansen van Rensburg (eds.), *Africa's digital future: From theory to action*, AOSIS Books, Cape Town, pp. 67–100. https://doi.org/10.4102/aosis.2021.BK199.03

Pastore, F & Giuliani, L 2015, *The determinants of youth unemployment. A panel data analysis*, Discussion Papers 2_2015, CRISEI, University of Naples 'Parthenope', Naples.

Pattanaik, F & Nayak, NC 2014, 'Macroeconomic determinants of employment intensity of growth in India', *Margin: The Journal of Applied Economic Research*, vol. 8, no. 2, pp. 137–154. https://doi.org/10.1177/0973801013519997

Popelo, O, Kychko, I, Tulchynska, S, Zhygalkevych, Z & Treitiak, O 2021, 'The impact of digitalization on the forms change of employment and the labor market in the context of the information economy development', *IJCSNS International Journal of Computer Science and Network Security*, vol. 21, no. 5, pp. 160–167.

Ramos, RA, Ranieri, R & Lammes, J 2013, *Mapping inclusive growth*, International Policy Centre for Inclusive Growth Working Paper no. 5, 13 March, viewed 14 March 2022, <https://www.econstor.eu/bitstream/10419/71778/1/73672866X.pdf>

Rodrik, D 2021, *The metamorphosis of growth policy*, Project Syndicate, 11 October, viewed 04 April 2022, <https://www.project-syndicate.org/commentary/new-growth-policies-for-developing-countries-by-dani-rodrik-2021-10>

Roser, M 2021, *What is economic growth? And why is it so important?* Our World in Data, 13 May, viewed 03 October 2021, <https://ourworldindata.org/what-is-economic-growth>

Sanchez-Reaza, J, Grover, R & Lord, NC 2016, *Looking at urbanization through a job lens*, World Bank Blogs, 13 June, viewed 29 May 2022, <https://blogs.worldbank.org/jobs/looking-urbanization-through-jobs-lens>

Stock, J & Watson, M 2003, *Introduction to econometrics*, Addison-Wesley, New York.

Transparency International 2022, *Corruption Perceptions Index 2022,* viewed 02 June 2023, <https://www.transparency.org/en/cpi/2022/index/nga>

Tseloni, A, Tsoukis, C & Emmanouilides, C 2011, 'Globalisation, development, and gender inequality across the world: A multivariate multilevel approach', *Quantitative and Qualitative Analysis in Social Sciences*, vol. 5, no. 1, pp. 1–25.

United Nations (UN) n.d., *Inequality – Bridging the divide*, viewed 23 February 2022, <https://www.un.org/en/un75/inequality-bridging-divide>

United Nations Conference on Trade and Development (UNCTAD) 2020, *UNCTADSTAT*, viewed 12 February 2022, <https://unctadstat.unctad.org/EN/>

United Nations Development Programme (UNDP) 2022, *Uncertain time, unsettled lives. Shaping our future in a transforming world. Human development report 2021/22*, New York, viewed 03 April 2023, <https://hdr.undp.org/system/files/documents/global-report-document/hdr2021-22pdf_1.pdf>

Van Niekerk, AJ 2020, 'Towards inclusive growth in Africa', *Development Southern Africa*, vol. 37, no. 1, pp. 1–15. https://doi.org/10.1080/0376835X.2020.1736004

Viviers, W, Parry, A & Jansen van Rensburg, A 2019, 'Are digital advances and inclusive growth compatible goals? Implications for trade policy in developing countries', Paper presented at the WTO Chairs Programme Annual Conference, Geneva, Switzerland, 02 July.

World Bank 2020, *World development indicators database*, viewed 14 February 2022, <https://databank.worldbank.org/source/world-development-indicators>

Wu, B & Yang, W 2022, 'Empirical test of the impact of the digital economy on China's employment structure', *Finance Research Letters*, vol. 49, a103047. https://doi.org/10.1016/j.frl.2022.103047

Xia, T & Pei, J 2021, 'The impact of digital economy on employment – Thinking based on the epidemic situation in 2020', *E3S Web of Conferences*, vol. 235, a03034. https://doi.org/10.1051/e3sconf/202123503034

Chapter 5

Adenike, ET 2013, 'An econometric analysis of the impact of corruption on economic growth in Nigeria', *E3 Journal of Business Management and Economics*, vol. 4, no. 3, pp. 54–65.

Aye, GC & Odhiambo, NM 2021, 'Threshold effect of inflation on agricultural growth: Evidence from developing countries', *Advances in Decision Sciences*, vol. 25, no. 2, pp. 1–22. https://doi.org/10.47654/v25y2021i2p28-50

Ayittey, GB (ed.) 2000, 'Combating corruption in Africa: Analysis and context', in *Corruption and development in Africa: Lessons from country case studies*, Palgrave Macmillan, London, pp. 104–118.

Barbieri, L 2009, 'Panel unit root tests under cross-sectional dependence: An overview', *Journal of Statistics: Advances in Theory and Applications*, vol. 1, no. 2, pp. 117–158.

Basu, K & Basu, S 2000, 'Urban poor women: Coping with poverty and ill-health in slums of Delhi', *Social Change*, vol. 30, no. 1–2, pp. 179–191. https://doi.org/10.1177/004908570003000212

Brincikova, Z & Darmo, L 2014, 'The impact of FDI inflow on employment in V4 countries', *European Scientific Journal*, vol. 10, no. 7, pp. 245–252.

De Berquin, L & Mbongo, E 2019, 'ICT diffusion and employment in Africa', *Economics Bulletin*, vol. 39, no. 1, pp. 521–532.

Ebaidalla, EM 2014, *Effect of ICTs on youth unemployment in sub-Saharan Africa: A panel data analysis*, African Economic Conference, 14 November, viewed 18 July 2022, <https://www.researchgate.net/publication/273131082_Effect_of_ICTs_on_Youth_Unemployment_in_Sub_Saharan_Africa_a_Panel_Data_Analysis>

Efobi, U, Vo, XV & Orkoh, E 2021, 'Are there wages from "sin"? Working conditions spillover from paying bribes in Vietnam', *Small Business Economics*, vol. 58, pp. 1975–1995. https://doi.org/10.1007/s11187-021-00492-7

Elder, S & Koné, KS 2014, *Labour market transitions of young women and men in sub-Saharan Africa*, Work4Youth publication series no. 9, International Labour Organization, Geneva.

Epaphra, M & Mwakalasya, A 2017, 'Analysis of foreign direct investment, agricultural sector and economic growth in Tanzania', *Modern Economy*, vol. 8, no. 1, pp. 111–140. https://doi.org/10.4236/me.2017.81008

Hjort, J & Poulsen, J 2019, 'The arrival of fast internet and employment in Africa', *American Economic Review*, vol. 109, no. 3, pp. 1032–1079. https://doi.org/10.1257/aer.20161385

Khan, S, Lilenstein, L, Oosthuizen, M & Rooney, C 2017, *Correlates of ICTs and employment in sub-Saharan Africa*, University of Cape Town Development Policy Research Unit Working Paper no. 201703, viewed 20 June 2021, <http://www.dpru.uct.ac.za/sites/default/files/image_tool/images/36/Publications/Working_Papers/DPRU%20WP201703.pdf>

Lavalée, E & Roubaud, F 2018, 'Corruption in the informal sector: Evidence from West Africa', *The Journal of Development Studies,* vol. 55, no. 6, pp. 1–14. https://doi.org/10.1080/00220388.2018.1438597

Opoku, EEO, Acheampong, AO, Dzator, J & Kufuor, NK 2022, 'Does environmental sustainability attract foreign investment? Evidence from developing countries', *Business Strategy and the Environment*, vol. 31, no. 7, pp. 3542–3573. https://doi.org/10.1002/bse.3104

Orkoh, E, Viviers, W & Jansen van Rensburg, SJ 2021, 'Can digital trade promote greater employment? Empirical evidence from sub-Saharan Africa', in W Viviers, A Parry & SJ Jansen van Rensburg (eds.), *Africa's digital future: From theory to action*, AOSIS Books, Cape Town, pp. 67–100. https://doi.org/10.4102/aosis.2021.BK199.03

Parry, A & Viviers, W 2023, 'Africa is going digital. Is this good or bad for employment?', ISS African Futures, 14 March, viewed 23 October 2023, <https://futures.issafrica.org/blog/2023/Africa-is-going-digital-Is-this-good-or-bad-for-employment.html>

Potts, D 2000, 'Urban unemployment and migrants in Africa: Evidence from Harare 1985–1994', *Development and Change*, vol. 31, no. 4, pp. 879–910. https://doi.org/10.1111/1467-7660.00181

Shen, W, Yang, S-C & Zanna, LF 2018, 'Government spending effects in low-income countries', *Journal of Development Economics*, vol. 133, pp. 201–219. https://doi.org/10.1016/j.jdeveco.2018.02.005

The Borgen Project 2019, *10 facts about agriculture in Africa*, 17 July, viewed 29 November 2021, <https://borgenproject.org/10-facts-about-agriculture-in-africa/>

Tufail, M, Song, L, Ali, S, Wahab, S & Hassan, T 2023, 'Does more immigration lead to more violent and property crimes? A case study of 30 selected OECD countries', *Economic Research*, vol. 36, no. 1, pp. 1867–1885. https://doi.org/10.1080/1331677X.2022.2094437

United Nations Conference on Trade and Development (UNCTAD) 2020, *UNCTADSTAT*, viewed 12 February 2022, <https://unctadstat.unctad.org/EN/>

World Bank 2020, *World development indicators database*, viewed 14 February 2022, <https://databank.worldbank.org/source/world-development-indicators>

Zenou, Y 2011, 'Rural–urban migration and unemployment: Theory and policy implications', *Journal of Regional Science*, vol. 51, no. 1, pp. 65–82. https://doi.org/10.1111/j.1467-9787.2010.00670.x

Chapter 6

Antonio, A & Tuffley, D 2014, 'The gender digital divide in developing countries', *Future Internet*, vol. 6, pp. 673–687. https://doi.org/10.3390/fi6040673

Bacchetta, V, Cerra, V, Piermartini, R & Smeets, M 2021, *Trade and inclusive growth*, IMF Working Paper no. 21/74, viewed 03 March 2022, <https://www.elibrary.imf.org/view/journals/001/2021/074/001.2021.issue-074-en.xml>

Banga, K & Te Velde, DW 2018, *Digitalisation and the future of manufacturing in Africa. Supporting Economic Transformation*, March 2018, viewed 20 February 2022, <https://set.odi.org/wp-content/uploads/2018/03/SET_Digitalisation-and-future-of-African-manufacturing_Final.pdf>

Cirera, X & Sabetti, L 2016, *The effects of innovation on employment in developing countries: Evidence from enterprise surveys*, World Bank Policy Research Working Paper no. 7775, viewed 19 August 2018, <https://openknowledge.worldbank.org/bitstream/handle/10986/24857/WPS7775.pdf?sequence=4&isAllowed=y>

De Berquin, L & Mbongo, E 2019, 'ICT diffusion and employment in Africa', *Economics Bulletin*, vol. 39, no. 1, pp. 521–532.

Fosu, AK 2017, 'Growth, inequality, and poverty reduction in developing countries: Recent global evidence', *Research in Economics*, vol. 79, no. 2, pp. 306–335. https://doi.org/10.1016/j.rie.2016.05.005

Friederici, N, Ojanperä, S & Graham, M 2017, 'The impact of connectivity in Africa: Grand visions and the mirage of inclusive digital development', *The Electronic Journal of Information Systems in Developing Countries*, vol. 79, no. 2, pp. 1–20. https://doi.org/10.1002/j.1681-4835.2017.tb00578.x

Friedrich Ebert Stiftung 2020, *What is digitalization? Opportunities and challenges in East Africa,* 20 April, viewed 01 May 2020, <http://library.fes.de/pdf-files/bueros/ruanda/16158.pdf>

Khan, S, Lilenstein, L, Oosthuizen, M & Rooney, C 2017, *Correlates of ICTs and employment in sub-Saharan Africa*, University of Cape Town Development Policy Research Unit Working Paper no. 201703, viewed 20 June 2021, <http://www.dpru.uct.ac.za/sites/default/files/image_tool/images/36/Publications/Working_Papers/DPRU%20WP201703.pdf>

Monga, C, Abebe, S & Andinet, W (eds.) 2019, *Creating decent jobs: Strategies, policies, and instruments*, African Development Bank Group, viewed 24 January 2022, <https://www.afdb.org/en/documents/creating-decent-jobs-strategies-policies-and-instruments>

Orkoh, E, Viviers, W & Jansen van Rensburg, SJ 2021, 'Can digital trade promote greater employment? Empirical evidence from sub-Saharan Africa', in W Viviers, A Parry & SJ Jansen van Rensburg (eds.), *Africa's digital future: From theory to action*, AOSIS Books, Cape Town, pp. 67–100. https://doi.org/10.4102/aosis.2021.BK199.03

Parry, A 2022, 'Determining the links between digital developments and inclusive growth: Implications for Africa', Unpublished Master's dissertation, North-West University.

Parry, A & Viviers, W 2023, 'Africa is going digital. Is this good or bad for employment?', ISS African Futures, 14 March, viewed 23 October 2023, <https://futures.issafrica.org/blog/2023/Africa-is-going-digital-Is-this-good-or-bad-for-employment.html>

Rodrik, D 2016, 'An African growth miracle?' *Journal of African Economies*, vol. 27, no. 1, pp. 1–18. https://doi.org/10.1093/jae/ejw027

Strydom, PDF 2021, 'Digital technologies, employment and labour-market polarisation in Africa', in W Viviers, A Parry & SJ Jansen van Rensburg (eds.), *Africa's digital future: From theory to action*, AOSIS Books, Cape Town, pp. 101–127. https://doi.org/10.4102/aosis.2021.BK199.04

Van Niekerk, AJ 2017, 'Towards inclusive growth in Africa', Paper presented at the Biennial Conference of the Economic Society of South Africa (ESSA), viewed 23 March 2018, <https://2017.essa.org.za/fullpaper/essa_3648.pdf>

Viviers, W, Parry, A & Jansen van Rensburg, A 2019, 'Are digital advances and inclusive growth compatible goals? Implications for trade policy in developing countries', Paper presented at the WTO Chairs Programme Annual Conference, Geneva, Switzerland, 02 July.

World Economic Forum (WEF) 2023, *The future of jobs report 2023*, viewed 31 May 2023, <https://www.weforum.org/reports/the-future-of-jobs-report-2023/>

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There is broad consensus in the literature that job creation and productive employment are critical for building a vibrant, inclusive economy. The digital era has the potential to expand employment by creating new professional pathways and market opportunities, particularly in Africa, which has high levels of unemployment and considerable room for enhanced economic activity. However, advancing digital technologies also pose risks and concerns – notably that machines will increasingly take over the jobs of humans. The effects of digital developments on employment therefore warrant thorough investigation.

This book delves into the effects of digital developments on employment in Africa, using both qualitative and quantitative research methods. An important premise in the book is that employment is a leading determinant of inclusive growth, which has become a policy imperative across the continent. Despite a wide range of views on digital developments and employment, there is no well-established, empirically determined relationship between these two phenomena in Africa, which makes policy-making difficult. The book addresses this research gap, giving specific attention to the fact that African countries are far from homogeneous, evidenced by their highly diverse economic activities and varying levels of development.

The book first sets the scene by probing the digital developments–employment nexus from a qualitative angle. It then provides an in-depth quantitative (regression) analysis of 33 African countries over a 20-year period, using a range of digital and employment indicators. An original feature of the empirical study is that it disaggregated the employment-related results according to sector (agriculture, industry and services) and gender (female and male). It also presented the results across country income groups (low-income, lower middle-income and upper middle-income) to reveal how the employment effects might differ according to countries' development status.

The book makes a particularly valuable contribution by comparing expected results, gleaned from the literature, with actual results from the empirical study. Some of the results were surprising, such as the resilience of industry and services sector employment in Africa, notwithstanding advancing digitalisation. Agricultural sector employment, by comparison, emerged as much more vulnerable, with serious implications for food security and intraregional trade on the continent.

By adopting a disaggregated approach, the study provided important insights on countries' relative digital preparedness and economic resilience, which constitute important foundation stones for policy-makers.

The book is essential reading for scholars in the development economics discipline who have an interest in policy studies and in gaining a holistic appreciation of the employment effects of digital developments in Africa. Such insights will go a long way towards shaping countries' economic and digital policies and putting the continent onto a steadier path towards its digital future.

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https://doi.org/10.4102/
aosis.2024.BK471

ISBN: 978-1-77995-317-9