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The future of international trade and development

Volume 1

AFRICA'S DIGITAL FUTURE

FROM THEORY TO ACTION

EDITED BY
Wilma Viviers, Ali Parry & Susara J. Jansen van Rensburg

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Research justification

The main thesis or thrust of this book is to examine whether Africa is in a position to enjoy the fruits of the digital age, particularly given the continent's development challenges and slow adoption of digital technologies. While there is substantial literature on the digital economy and the quickening pace of the Fourth Industrial Revolution (4IR) and how this is impacting countries' economic and trade performance, comparatively little research has been conducted on what the digital age means for Africa.

This book aims to close this research gap by presenting a cross-section of original research findings emanating from various academic (qualitative and quantitative) methodologies as well as perspectives on what Africa should be doing to capitalise on the benefits of digital developments, while also considering the impact of such developments on countries' inclusive growth and job-creation efforts.

The book's contribution lies in its coverage of a wide range of topics that will affect Africa's digital future – including industrialisation, global value chains, transport and logistics, trade facilitation, labour-market dynamics, employment and education – all of which are examined through a digital lens. Moreover, the theme of digital trade forms a backdrop to many of the chapters, along with references to the coronavirus disease 2019 (COVID-19) pandemic and all the complications it has brought in its wake.

The book recognises that although Africa should learn from best practices in other parts of the world, countries on the continent need to chart their own course according to their particular circumstances, and not attempt to clone other countries' digital policies, regulatory frameworks and educational paradigms. Furthermore, while Africa should be looking to the future and determining how digital technologies can become effective tools of sustainable development, the continent has a great deal of catching up to do. Hence, the fundamental building blocks of development cannot be overlooked.

Now more than ever, Africa needs to move beyond theory and take decisive action, or otherwise risk falling further behind in a world that is constantly changing. A collaborative approach is essential – not only among stakeholders within each country but also at the regional level. By adopting a digital mindset, countries should be able to diversify economically and extend their market reach across the continent.

The book has been written by researchers and the target audience of the book is fellow researchers and academics in Africa and other parts of the world.

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

Wilma Viviers, TRADE Research Entity, Faculty of Economic and Management Sciences, North-West University, Potchefstroom, South Africa.

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Abbreviations, figures and tables appearing in the text and notes

List of abbreviations

3D	three-dimensional
3G	third generation network standard
4G	fourth generation network standard
4IR	Fourth Industrial Revolution
5G	fifth generation network standard
ADFI	Africa Digital Financial Inclusion Facility
AEO	authorised economic operator
AfCFTA	African Continental Free Trade Area
AfDB	African Development Bank
AGOA	African Growth and Opportunity Act
AI	artificial intelligence
AIMS	African Institute for Mathematical Sciences
ALI	African Leapfrog Index
AR	augmented reality
ATAF	African Tax Administration Forum
AU	African Union
AUC	African Union Commission
B2B	business-to-business
B2C	business-to-consumer
B2G	business-to-government
BEPS	base erosion and profit shifting
BRICS	Brazil, Russia, India, China, South Africa

C2C	consumer-to-consumer
CAD	computer-aided design
CBEC	cross-border e-commerce
CBM	coordinated border management
CCL	cold-chain logistics
CEN-SAD	Community of Sahel-Saharan States
COMESA	Common Market for Eastern and Southern Africa
COVID-19	coronavirus disease 2019
CPC	customs procedure code
CPI	consumer price index
CPTPP	Comprehensive and Progressive Agreement for Trans-Pacific Partnership
DPD	dynamic panel data
DRC	Democratic Republic of the Congo
EAC	East African Community
ECIPE	European Centre for International Political Economy
ECOWAS	Economic Community of West African States
ePD	ePrivacy Directive
eSWS	electronic single-window system
EIU	Economic Intelligence Unit
EU	European Union
FAO	Food and Agriculture Organization
FDI	foreign direct investment
FGLS	feasible generalized least squares
FOD	forward orthogonal deviation
FTA	free trade area
G7	Group of 7 nations
G20	Group of 20 nations
G90	Group of 90 nations
GATS	General Agreement on Trade in Services

GATT	General Agreement on Tariffs and Trade
GDP	gross domestic product
GDPR	General Data Protection Regulation
GEPU Index	Global Economic Policy Uncertainty Index
GMM	generalized method of moments
GRD	Government Revenue Dataset
GST	goods and services tax
GVC	global value chain
HDI	Human Development Index
HS	Harmonized System
I6	rapidly industrialising 6
ICC	International Chamber of Commerce
ICD	intermodal container depot
ICT	information and communication technology
ICTD	International Centre for Tax and Development
IF	Inclusive Framework
ILO	International Labour Organization
IMF	International Monetary Fund
IoT	Internet of things
IP	intellectual property
IT	information technology
ITC	International Trade Centre
ITF	International Transport Forum
ITU	International Telecommunication Union
KISEDP	Kalobeyei Integrated Social and Economic Development Programme
LAC	Latin America and Caribbean
LDC	least-developed country
MIT	Massachusetts Institute of Technology
MNC	multinational corporation
MNE	multinational enterprise

MOOCs	massive open online courses
NPISHs	non-profit institutions serving households
NTB	non-tariff barrier
NTM	non-tariff measure
ODR	online dispute resolution
OECD	Organisation for Economic Cooperation and Development
OLS	ordinary least squares
OSBP	one-stop border post
PAD	pre-arrival declaration
PHEIC	public health emergency of international concern
PMD	post-manifest declaration
PPP	purchasing power parity
R&D	research and development
RBC	real business cycle
REC	regional economic community
REER	real expected exchange rate
RFID	radio frequency identification
RPA	robotic process automation
RTA	regional trade agreement
RVC	regional value chain
SAAFF	South African Association of Freight Forwarders
SACU	Southern African Customs Union
SADC	Southern African Development Community
SARS	severe acute respiratory syndrome
SARS	South African Revenue Service
SDGs	Sustainable Development Goals
SEZ	special economic zone
SLA	service-level agreement
SME	small and medium-sized enterprise

STEM	science, technology, engineering and mathematics
TFA	Trade Facilitation Agreement
TICTS	Tanzania International Container Terminal Services
TiVA	trade in value-added
TPP agreement	Trans-Pacific Partnership agreement
TPU	trade policy uncertainty
TPU Index	Trade Policy Uncertainty Index
TRA	Tanzania Revenue Authority
UIS	UNESCO Institute for Statistics
UK	United Kingdom
UN	United Nations
UNCTAD	United Nations Conference on Trade and Development
UNDESA	United Nations Department of Economic and Social Affairs
UNDP	United Nations Development Programme
UNECA	United Nations Economic Commission for Africa
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNHCR	United Nations High Commissioner for Refugees
UNU-WIDER	United Nations University World Institute for Development Economics Research
US	United States of America
VAT	value-added tax
VR	virtual reality
WCO	World Customs Organization
WDI	World Development Indicators
WEF	World Economic Forum

WHO	World Health Organization
WTO	World Trade Organization
WTU Index	World Trade Uncertainty Index

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In 2018, Biandri was awarded a three-month Tajudeen Abduraheem visiting fellowship, aimed at policy researchers, at the United Nations Economic Commission for Africa (UNECA) Institute for Economic Development and Planning (IDEP) in Dakar, Senegal. She regularly engages in academic discussions and consultations about WTO law and has a special interest in veterinary and agricultural law.

Preface

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Africa conjures up different images in people's minds. To some, it is a restless continent with rising expectations and huge, barely tapped potential – like a giant stirring after a long slumber. To others, it is a continent that has long trailed behind other regions in terms of economic development and trade – an indictment of weak policies (and/or implementation) and missed opportunities. Whichever view people subscribe to, Africa now finds itself, for better or worse, on the cusp of a new era – a technology- and data-driven future (referred to by many as the Fourth Industrial Revolution or 4IR) that will forever change how people interact, work, play and learn.

African countries have a choice: either leverage the power of digital technologies in order to improve their economic and trade performance and take decisive steps to eradicate their long-entrenched problems of poverty, unemployment and inequality or, alternatively, stay on the sidelines and watch as others ride the innovation wave, while simply allowing opportunities to pass them by. Surely, the right approach is to grasp the nettle and embrace the digital age, particularly in view of the immense development backlog on the continent and the need to make

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rapid progress to avoid being left behind in the gathering maelstrom.

Yet the adoption of digital technologies is not a panacea for accumulated development failures, poor planning, weak implementation and fractured societies. These problems cannot be magically airbrushed away, however transformative and revolutionary the unfolding digital era appears to be. Developed and developing countries, for example, are distinguishable from one another in how well they have planned, built, nurtured and preserved their economies and societies. History has frequently shown that the basic building blocks of development do not lend themselves well to quick fixes.

Is Africa in a position, therefore, to enjoy the fruits of the digital age? *Africa's digital future: From theory to action* attempts to answer this question. Featuring an interesting cross-section of views and research findings from various authors, the book explores what Africa can and should be doing to capitalise on the often-reported benefits of digital developments, while not overlooking the likely impact of such developments on economic growth, employment and the quest for inclusivity. While some African countries may aspire to be more like their investment and trading partners in other parts of the world, their circumstances are invariably different, and so it is ill-advised to try and clone other countries' digital policies, regulatory frameworks and educational paradigms. Each African country needs to respond to the digital age in its own way, while at the same time laying the foundations for greater continent-wide cooperation and collaboration in the areas of trade and investment, which have always been insignificant by global standards. Thus, Africa needs to look at and learn from the policies and best practices in other parts of the world but chart its own course for a more digitally responsive and sustainable future. In short, Africa must move beyond the theory and take action.

This book combines academic rigour with reflective policy-related commentary, keeping the spotlight firmly on Africa and

how it needs to realistically consider its future while not forgetting its past. The book covers a wide range of topics that are very pertinent to Africa – industrialisation, global value chains, transport and logistics, trade facilitation, labour-market dynamics, employment, education and more – all through a digital lens, with digital trade forming an overarching backdrop to many of the chapters, along with references to the coronavirus disease 2019 (COVID-19) pandemic and all its complications and uncertainties.

In a book of this nature, it is difficult to decide on the ideal sequence of chapters. While each chapter focuses on one or two main topics as they relate to Africa's digital experiences to date and future, there is inevitably some overlap in subject matter. We regard this not so much as repetition as helpful reinforcement of key concepts, which sometimes lend themselves to examination from different angles – such as technological leapfrogging, industrialisation, skills development and employment. Moreover, as many readers will undoubtedly opt for an 'à la carte' approach, selecting those chapters that are most relevant and appealing, the occasional overlap in subject matter should not be an intrusion.

Outlines of the book's 10 chapters are as follows.

Chapter 1, 'Headwinds and tailwinds in digital trade: Can Africa navigate the storm?', paints a picture of a turbulent world, rocked by geopolitical, geo-economic and technological forces that have conspired to polarise the world into three centres of power: China, the United States and Europe. Africa, the economically weakest of all world regions, is the least well-prepared for the gathering storm and will be buffeted from all sides unless it takes active steps to cope with the challenges ahead. This includes making sure that digital and digital trade policies are well informed and well executed.

Chapter 2, 'Economic development and industrialisation in the digital era: Where does Africa stand?', explores Africa's digital

development status, highlighting how – despite being at the forefront of a global 'mobile revolution' – the continent still has a pronounced digital divide, with millions lacking access to even basic Internet connectivity, let alone more sophisticated, productivity-enhancing digital tools. If African countries are to achieve their industrialisation goals, which are inevitably technology-dependent, they need to apply their minds to eliminating the digital divide, which includes ensuring reliable infrastructure and a skilled workforce.

Chapter 3, 'Can digital trade promote greater employment? Empirical evidence from Sub-Saharan Africa', is the first of two chapters focusing on employment in the digital age. It demonstrates, empirically, the relationship between digital trade, on the one hand, and employment (both the quantity and quality thereof), on the other. Among the (sometimes unexpected) findings is that the impact of digital trade is different, depending on the sector (agriculture, industry or services) and whether people live in urban or rural areas. The chapter also highlights the potential of agriculture as a source of higher-quality, more productive employment in Africa, which should alleviate the employment crisis on the continent.

Chapter 4, 'Digital technologies, employment and labour-market polarisation in Africa', also focuses on employment, but from a different angle to that in Chapter 3. It explains how the expansion of automation in developed countries has made many so-called 'middle-skilled' workers redundant. Yet this phenomenon is far less pronounced in Africa, which – because of its low levels of industrialisation – has far fewer industrial workers who risk being displaced. In fact, increased use of automation and other digital technologies could even improve job prospects in Africa if it is part of offshoring initiatives by developed countries, which encourage the shift from low-productivity to higher-productivity production and improve eligibility for participation in global value chains.

Chapter 5, 'Leveraging global value chains and digital technologies to strengthen Africa's industrial base', discusses how Africa's industrialisation efforts could be given a serious boost if countries concentrated their energy and resources on enabling businesses to participate in global and regional value chains as suppliers of 'niche', intermediate goods. It is by using appropriate, cost-saving digital technologies that businesses' competitiveness will be enhanced. The chapter also highlights how African value chains are still undeveloped, hampered by high trade costs and a lack of digital infrastructure and skills. Governments have a pivotal role to play in clearing many of the hurdles to global and regional value chain participation.

Chapter 6, 'Mobilising tax revenues in the digital era: Challenges for Sub-Saharan Africa?', examines the important topic of cross-border taxation of data flows and digital goods and services. Heightened tax revenues would provide a significant boost to depleted public finances, yet most African countries' tax-collection capacity is poor. In addition, there is currently a global moratorium on the imposition of duties on e-commerce goods and activities, allowing owners of large digital platforms such as Amazon, Google and Facebook to effectively escape tax liability in the many countries in which they operate. A key message that the chapter delivers is that African policymakers and tax authorities should worry less about the loss of potential revenue from taxing digital trade and focus more on how digital developments in general can spur more economic activity, thereby shoring up the tax base.

Chapter 7, 'Digital technologies: Benefits for transport and trade facilitation in Africa', looks at one of the continent's main constraints to competitiveness: high trade costs, and how digital technologies can be used to a far greater extent to streamline customs procedures and boost trade facilitation efforts on the continent. Of course, the use of such technologies to create 'smart borders' is hampered by various factors, including inadequate infrastructure, poor Internet connectivity, a dearth of

digital skills, a general fear of technology and corruption. Some countries are adopting technologies to improve border efficiency and the results look promising. However, for the most part, African countries still have a long way to go.

Chapter 8, 'Protecting Africa's digital future through effective regulation', explores the many ways in which effective regulation forms the bedrock of economic activity and trade, and how the digital age has precipitated the need for even greater protection against errant behaviour and illegal activities. There is a general concern that laws and regulations are unable to keep pace with digital developments, thus leaving regulatory gaps for opportunistic or unscrupulous operators to exploit. African governments are unanimous in their expressed desire to drive greater integration and forge stronger trade ties on the continent, yet from a legal and regulatory standpoint, such aspirations will be seriously tested in the years ahead.

Chapter 9, 'Rethinking Africa's education ecosystem: Why all economic sectors need to be digitally responsive', deals with one of the most important, yet challenging, topics of modern times: education. Africa's education attainment levels are the lowest in the world, which has ongoing, negative consequences for its developmental progress and prospects. However, as COVID-19 has demonstrated, education in the broadest sense of the word – which includes skills training, self-paced learning, mentoring, and other teaching and learning interventions – lends itself quite well to digitalisation. Whether Africa's massive education gap can be narrowed through creative 'leapfrogging', though, is debatable, especially where developmental basics (including a reliable energy supply, sound infrastructure and affordable Internet access) are not in place. Clearly, overhauling Africa's education system to make it more future-ready is not the responsibility of governments alone; a vibrant and effective education 'ecosystem' is needed in which knowledge and resources are shared and the interests of multiple actors (especially in the private sector) are promoted.

Chapter 10, 'Turning theory into action: The power is in Africa's hands', brings the book to a close, highlighting the main themes and interrelationships emerging from the different chapters. It poses several overarching questions for readers to reflect on and ends with the clear message that inaction will not make Africa's problems go away. With so much of the world being in a state of flux, Africa has a unique opportunity to fashion its own future. But it will take courage to make the right choices.

We hope you will find this book enjoyable and enlightening, and that it will leave you with a good feeling about Africa's digital future.

Chapter 1

Headwinds and tailwinds in digital trade: Can Africa navigate the storm?

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1.1. Introduction

Africa is like a ship sailing into a fast-approaching storm, buffeted by large, unpredictable swells and strong winds and hampered by poor visibility. The chances of the ship veering off course into even more dangerous waters and sustaining irreparable damage are very real. Yet storms are as natural as periods of calm, and sometimes just need to be confronted – not recklessly, but with knowledge, skill and determination.

Africa is not the only region experiencing turbulence, although economically it is the weakest. The whole world has been facing unprecedented levels of upheaval and uncertainty in recent years, with profound effects on economic, trade and investment activities, both at home and abroad. There have also been marked geopolitical shifts, with some major superpowers, notably the United States (US) and China, flexing their muscles in the face of a surge in strong-state politics. Trade uncertainty reached new heights when the US and China descended into their infamous trade war, which was exacerbated under the Trump administration. Moreover, the rise of the Asia–Pacific region has given global trade a different complexion and heightened competition.

In addition, economic slowdowns and volatility have been in evidence in different parts of the world for many years, along with hardening attitudes towards globalisation and a rising tide of protectionism. The coronavirus disease 2019 (COVID-19) pandemic then came like a bolt out of the blue, adding another layer of complexity to the unfolding drama. In today's uncertain global trade arena, questions are also being asked about the future of the World Trade Organization (WTO) as the global trade-governing body and the European Union (EU)-style regional integration model, to which many countries and regions used to aspire. All these factors are making the future of the global (and especially the multilateral) trading system increasingly unclear.

The composition of trade in recent years has been tilting more towards services trade and digital trade (a concept that will

reverberate through this book). Digital technologies, and the incredible pace at which they are being developed and applied in all imaginable industry sectors, are the source of both excitement and fear. Yet, like an approaching storm, the digital age is a natural evolutionary phase in the development of the world and needs to be accepted, understood and skilfully navigated. Where everyone is in agreement is that the digital age (sometimes broadly referred to as the Fourth Industrial Revolution or 4IR) is *disruptive* – more so, perhaps, than the other three industrial revolutions that some scholars refer to.

The digital disruption being witnessed is fundamentally changing how people, companies and countries trade. Trade is faster and more accessible, and also comes in more shapes and sizes than were ever imaginable – particularly the intangible variety. Not surprisingly, however, in a world that is still in many ways used to or bound by traditional trade rules and practices, the spread of digital technologies poses many new risks and challenges – from the need to prepare young and older people alike for a changing, more technologically powered workplace, to the importance of implementing digitally responsive policies and regulations that facilitate trade (including digital trade) and investment, while also helping to build more inclusive economies.

The following questions need to be asked: How does all this affect Africa? What must Africa do to successfully navigate the geopolitical, geo-economic and technological storm that is gathering momentum?

Keeping with the nautical theme, when a ship sails into a storm, it needs to be sturdy in its construction, have a good crew, reliable navigational instruments and an experienced captain. A clear course also needs to have been plotted that is not so foolhardy as to place the ship in danger, but also not so timid as to allow the ship to drift aimlessly until the storm hopefully passes. In the same way, African countries and economies need to be built to withstand external and

internal pressures. This includes having well-conceived and effective policies, regulations and business incentives; strong leadership; a clear sense of direction; the right kind of human capital; and the strategies and tools needed to endure difficult times but also embrace opportunities that pave the way for better times.

It appears that African countries are not leveraging the many opportunities presented by digital advances and digital trade to accelerate their development and create more sustainable livelihoods for their growing populations. By conventional measures, this may be so. However, Africa is different from other regions in terms of its history, demographics, geography, culture and political–economic character. While this arguably gives rise to immense challenges, Africa also has enormous potential, which needs to be tapped in ways that are appropriate for the continent.

While Africa's journey into a more digitally rich future is heavily dependent on well-informed and coherent policies and regulations, it is the implementation thereof – with all available hands on deck, so to speak – that will ensure that the continent gets where it wishes to go. In short, African countries need to turn all the good advice and theory into action, which is the motivation for this book.

Whereas in many other parts of the world, governments have been able to provide financial support to businesses and citizens to alleviate the devastation caused by COVID-19 lockdowns, few African countries have had the fiscal space to introduce stimulus packages. The best chance that Africa has in the short and longer term to bring about sustainable and balanced economic recovery is through stronger global and regional trade. This chapter provides an important backdrop for the rest of the book, highlighting the dynamics in the geopolitical and trade arenas and introducing the concept of digital trade and its potential to drive Africa's development.

1.2. Uncertainty in the global political economy

Political uncertainty has been on the rise in recent years and the contributing factors need to be understood. According to Woodley (2015), the world has been witnessing both geopolitical[1] insecurity *and* a geo-economic[2] transition, causing much uncertainty in the global political economy.[3] According to the World Economic Forum (WEF), in its 2019 *Global risk report*, both geopolitical and geo-economic tension 'represent *the* most urgent global risks at present' (WEF 2019a:6).

In recent years, geopolitics and geo-economics have become increasingly important in the context of trade because they have the potential to negatively affect both global trade volumes and the likelihood of free trade (Ignatyeva & Isaev 2019). In fact, they have already done so. According to Letzing (2019), the friction between the US and China in particular has forever changed the game for global trade. A report (see Damen & Igler 2019) produced by the European Parliament perfectly sums up the prevalence of geopolitical tensions and the threat that these pose to free trade. In that report, titled 'Free trade or geo-economics?', the EU accuses the US and China of not separating their economic interests from their geopolitical interests and the US of increasingly trying to gain a geopolitical advantage by using its economic might (Damen & Igler 2019). Although of

1. Global politics is the study of globalisation and transnational governance, whereas geopolitics is the study of conflict between competing regional blocs or 'great spaces' (Woodley 2015).

2. Political analyst Edward Luttwak was the first scholar to formulate the concept of 'geo-economics' (see Luttwak 1990). According to Scholvin and Wigell (2018:73), geo-economics refers to 'the application of economic means of power by states in order to realise strategic objectives'.

3. The global political economy is 'a field of study that deals with the interaction between political and economic forces' (Walzenbach 2016:87).

grave concern, this is not a new phenomenon, and other countries are guilty of it too.

Politics has always shaped international trade. Several studies have shown that international conflict can severely disrupt trade because it introduces risk (see Morrow, Siverson & Tabares 1998). For instance, the manner in which countries are dealing with the fallout from the COVID-19 pandemic (although not borne out of geopolitics or geo-economics) is a reflection of countries' political economy which, depending on the willingness of the countries' leadership to yield to certain interest groups, could negatively affect trade.

The geopolitical landscape in the late 20th century[4] was characterised by a unipolar world order dominated by the US and its Western allies (Harris 2019; Krauthammer 1990). At that time, Western liberal democratic norms and values held sway (WEF 2019b). The US and other Western economies dominated global trade, were largely responsible for defining the new rules of trade, and played an important role in the establishment of the WTO as the body mandated to oversee countries' adherence to global trade rules. They were also fierce proponents of free and fair trade (see Baru 2014).

It is widely accepted that the WTO's General Agreement on Tariffs and Trade (GATT) paved the way for unprecedented growth in trade among members (Sako 2019), the rapid spread of trade liberalisation and globalisation, and the integration of many more countries into the global economy and global politics.[5] Yet some emerging powers and developing countries have traditionally viewed the GATT, the WTO and trade liberalisation as Western (and primarily US) institutions and concepts and that the trade rules prevailing at the time increasingly favoured rich economies (see Kappel 2015; Narlikar 2010) and marginalised poorer

4. This refers to the period right after the end of the Cold War.

5. This was helped by political integration schemes, such as those initiated by the EU and intergovernmental organisations like the International Monetary Fund (IMF), the World Bank and the WTO Global Policy Forum (2019).

economies (WTO 2017), which enjoyed special trade privileges. In his paper, 'How trade became geopolitics', Laïdi (2008) points out that trade has become increasingly political, particularly since the establishment of the WTO in 1995, because the geopolitical context in which these exchanges take place has been altered.

Things began to change in the 1980s and 1990s when China started claiming to be the world's largest and fastest-growing economy (Congressional Research Service 2019). During that period, China's trade grew exponentially (see Fouquin & Hugot 2016) and the world witnessed China's rise as a global economic superpower. Moreover, becoming a member of the WTO in 2001 helped China secure its status as the world's largest factory and trading nation. The period also saw the growth in emerging economies' trade as a share of world trade, the rise of Asia as a formidable economic and trading region (Baru 2014), structural changes in cross-border flows of goods and services between developing countries, and an increase in South–South trade (see Hanson 2012; Scott 2016).

The rise of China and the wider Asian region resulted in a power shift from the West to the East (Nye 2010). This power shift not only altered global trade flows but also changed countries' negotiating power within the WTO (Baru 2014). According to Baru (2014) and Laïdi (2008), that period marked the end of the Euro–American duopoly in the WTO, while also creating a de facto multi-polarity in which trade and trade decision-making were dominated (and shared) by the US, the EU, the G20 and the G90.

In a speech delivered at Stanford University in 2013, secretary-general of the United Nations (UN), Ban Ki-moon, referred to this geo-economic transition as follows: 'As engines of growth and economic power continue to shift with the rise of the Asia–Pacific region … we move increasingly and irreversibly to a multi-polar world' (UN 2013). The previous year, Pascal Lamy, a former director-general of the WTO, said that 'the rising weight of influence of emerging economies has shifted the balance of

power' in the global trading system, leading to a 'redistribution of the geopolitical deck of cards on a global scale' (Lamy 2012). Clearly, this transition has placed increasing pressure on the more traditional, liberal trade order and its system of governance (Schwarzer 2017), while the declining power and influence of the US in a multi-polar world puts a question mark over the future of Western-led globalisation (Woodley 2015).

What does the geopolitical and geo-economic landscape look like today, and why is it important for trade and digital trade? Today, 21st-century geopolitics and geo-economics are described as 'not just multi-polar but multi-conceptual' (Derviş 2018). They remain multi-polar because multiple power centres (such as the US, EU, China, Russia and India) continue to dominate trade and geo-economic relations, but they are also part of a multi-conceptual order, where power is diffused and a diverse range of world views coexist (WEF 2019b).

Within this multi-polar, multi-conceptual order, various uncertainties and frictions exist, which threaten open or free trade and the multilateral institutions that promote and govern this ideal. According to the WEF (Derviş 2018), uncertainty is not uncommon during times of geopolitical turmoil and so, in order to improve security and certainty, the state is typically re-established as the main centre of power and legitimacy. Such a move, however, may result in the erosion of public trust and an intensification of nationalism (Bieber 2018; Postelnicescu 2016), strong-state politics (Derviş 2018) and right-wing populism (Greven 2016) – all of which signal anti-globalisation sentiments (Peters 2018).

Why has the world become so angry about globalisation, or rather globalism?[6] According to founder and executive chairman

6. According to Schwab (2018), a clear distinction should be (but is not always) made between globalisation and globalism. In Schwab's view, globalisation is 'a phenomenon driven by technology and the movement of ideas, people and goods', while globalism is an ideology that 'prioritises the neoliberal global order over national interests' (2018). Schwab asserts that we are undoubtedly living in a globalised world, yet whether our policies should be 'globalist' in nature is debatable.

of the WEF, Klaus Schwab (2018), large swathes of society have become disillusioned with the slow and uneven recovery of the world economy after various setbacks and, with insecurity and frustration on the rise, populism has become increasingly attractive. Another reason is that the 'industrialise-at-all-costs' approach of some East Asian countries (notably China) has created massive trade surpluses for these countries, encouraging trading partners to retaliate by way of increased protectionism (Carbaugh 2017).

Anti-globalisation sentiments have not been the only threat to free trade in recent years. While it is true that the US–China trade war is largely to blame for the unprecedented rise in tariffs and trade tensions in the past two to three years, growing trade protectionism over the past decade cannot be ignored (see, for instance, Aggarwal & Evenett 2013; Evenett & Fritz 2015; Trade Law Centre 2014). Much of this protectionism is evident in the use of non-tariff measures (NTMs) and non-tariff barriers (NTBs)[7] (see Kinzius, Sandkamp & Yalcin 2019; Niu et al. 2018), contributing to rising tensions between many major economies (United Nations Conference on Trade and Development [UNCTAD] 2018). This situation could worsen if one considers the proliferation of next-generation NTMs and the impact that they could have on digital trade specifically (see Pasadilla, Duval & Anukoonwattaka 2020).

The other uncertainties and frictions in this multi-polar and multi-conceptual order stem from fears surrounding the future of the multilateral trade order or the open global trading regime, as well as the future of the WTO as the governing body thereof (see Linn 2017; Mearsheimer 2019). Contributing factors to these

7. Non-tariff barriers have not been formally defined, but it is common to regard them as a subset of NTMs which are policy measures (excluding customs tariffs) that impact the quantities and/or prices of goods traded (UNCTAD 2019b). A key difference, however, is that NTBs generally have a negative impact on trade and have a 'protectionist or discriminatory intent' (International Trade Centre [ITC] 2019). Unlike tariffs, which are transparent and accessible via countries' customs authorities, NTBs are also often hidden and therefore difficult to detect and assess (Kinzius et al. 2019).

uncertainties and frictions are the longstanding stalemate in the WTO's Doha Development Round of negotiations, the inability of the developed and the developing world to see eye to eye on certain crucial trade issues (such as e-commerce), the proliferation of bilateral or regional trade agreements (RTAs) (Wu 2013) and the recent dispute-settlement and appellate body crisis in the WTO (see Pauwelyn 2019).

The above issues continue to stimulate much (often heated) debate. Some experts feel that the old multilateral institutions that were established when the US was the pre-eminent global political and economic power are no longer effective in addressing global challenges and that countries are looking to regional bodies and organisations to solve problems that call for collective responses (The Conversation Africa Inc. 2019). At the G20 meeting in Japan in 2019, some of the world's leading trade economists called for a 'reinvigoration of the WTO as a negotiating forum', citing the 'dysfunction of the WTO as a forum for trade liberalization and trade-related rule-making' because the 'WTO rules fail to reflect modern realities of a global economy characterized by globalization of value chains and digitization of trade' (Laborde et al. 2019:1–2). In contrast, many foreign policy and trade experts have provided compelling reasons why the existing world order and its multilateral institutions should be maintained.

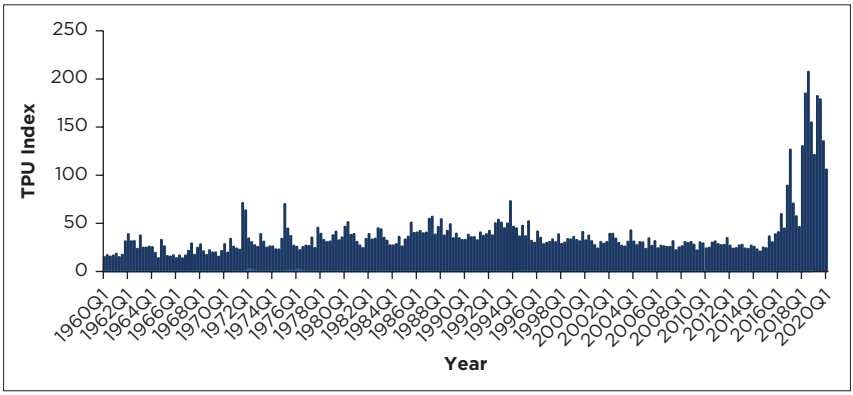
What is the significance of all this for Africa, digital trade on the continent and, in particular, digital trade policymaking? In his book, *The levelling: What's next after globalization?*, O'Sullivan (2019) mentions that the world has become polarised into distinct regions (i.e. China, the US and Europe) and that escalating trade tensions, technological advances and the regulation of technologies are among the key factors that have given rise to this polarisation. In China, the US and Europe, one finds extremely diverse views on how technology and cross-border information flows should be regulated, and how policies and trade agreements should be used to effectively address cross-border trade issues and digital protectionism (see Aaronson 2019). Africa's particular position is explored later in this chapter.

1.3. Uncertainty in the trade and trade policy arenas

In addition to turbulent geopolitics and geo-economics in the world, trade and trade policy-related uncertainly is at an all-time high.

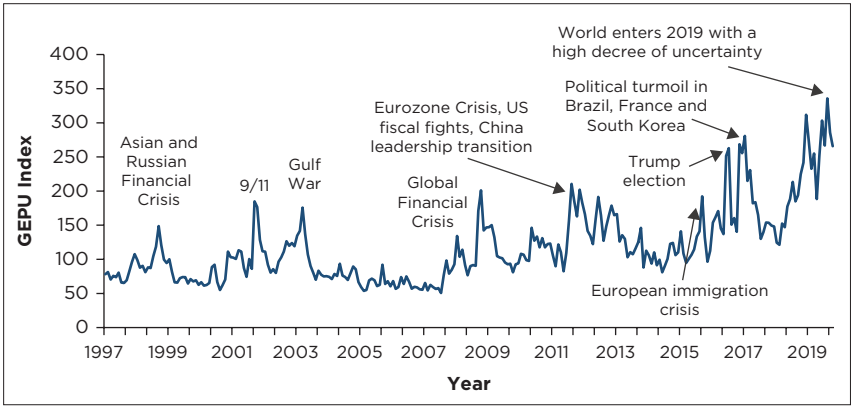
A great deal of literature is devoted to the effects of trade and trade policy uncertainty (TPU) on economic activity. The evidence suggests that both trade uncertainty and TPU impact global economic activity (see, for instance, Davis 2019). The TPU Index (Figure 1.1) and the Global Economic Policy Uncertainty (GEPU) Index (Figure 1.2) provide informative snapshots of the state of trade policy and the global economy and how uncertainty has been on a sharp, upward incline in recent years. Research by Caldara et al. (2019), who developed the TPU Index, has revealed that TPU is the worst it has ever been since 1960 (Figure 1.1).

The GEPU Index, which was developed by Baker, Bloom and Davis (2016), mirrors the rising uncertainty in the trade policy sphere and shows the main factors contributing to global economic uncertainty since 1997. In the last five years, such factors have



Source: Caldara et al. (2019).

FIGURE 1.1: Trade Policy Uncertainty Index, 1960–2020.



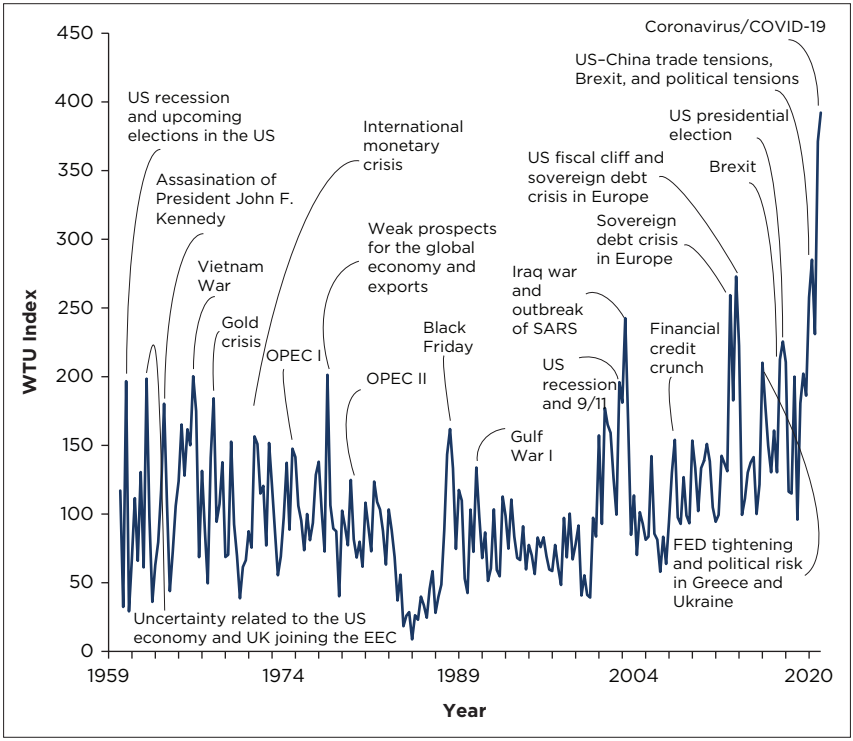
Source: Baker et al. (2016).
US, United States.

FIGURE 1.2: Global Economic Policy Uncertainty Index, 1997–2019.

included the European immigration crisis, the election of Donald Trump as US president, and political turmoil in Brazil, France and South Korea (Figure 1.2). One of the most important pieces of information on this index is that the world reached its highest level of economic uncertainty in 2019. What caused this?

Research conducted by Ahir, Bloom and Furceri (2018), who developed the World Trade Uncertainty (WTU) Index,[8] shows that Brexit (an acronym used to describe the United Kingdom's [UK] departure from the EU), trade and tariff tensions between the US and China, as well as COVID-19 have triggered the most recent spikes in world trade uncertainty (Figure 1.3).

8. The TPU Index is based on the frequency (per month) with which articles relating to trade policy uncertainty appear in seven leading newspapers in the US: the *Boston Globe*, *Chicago Tribune*, *Guardian*, *Los Angeles Times*, *New York Times*, *Wall Street Journal* and *Washington Post* (see https://www2.bc.edu/matteo-iacoviello/tpu.htm#overview). The WTU Index measures uncertainty in relation to trade in 143 countries, based on the frequency (each quarter) with which the *Economist Intelligence Unit (EIU)* cites the word 'uncertain' or 'uncertainty' in relation to trade (see https://www.policyuncertainty.com/wui_quarterly.html).



Source: Ahir et al. (2018).
EEC, European Economic Community; FED, Federal Reserve Bank; OPEC, Organization of the Petroleum Exporting Countries; SARS, severe acute respiratory syndrome; UK, United Kingdom; US, United States.

FIGURE 1.3: World Trade Uncertainty Index, 1959–2020.

1.4. Disintegration and retrogression: Threats to global trade

In recent years, global trade has been under growing threat from two different phenomena: *disintegration* and *retrogression*. Disintegration refers to the selective reduction in a country's level and scope of integration (see Schimmelfennig 2018), evidenced, for instance, in Brexit and the US's withdrawal from the Trans-Pacific Partnership (TPP) agreement – events that have both had significant consequences for regional trade. The TPP has been

superseded by the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP).

After more than four decades of integration with the EU, the UK formally withdrew from its alliance with its continental partners on 31 January 2020 with the passing of the UK's Brexit Bill. However, the deal setting out the terms of the new economic and trading relationship between the UK and Europe was only signed in December 2020 after many months of difficult negotiations.

Brexit has attracted a great deal of criticism in recent years from free-trade advocates because the EU model of integration remains a beacon of the multilateral trade order, trade liberalisation and regional integration, and Brexit threatened that ideal (see Luo 2017). As one commentator from the *Economic Times* put it: 'Brexit heralds not only Britain's exit from the EU, but the decline and maybe the fall of the twentieth century ideal of a liberal and globalised world' (Peters 2018:323). Although many reasons have been put forward for the UK's departure from the EU, the director of Harvard's School of Economics, Graig Calhoun, said that there was no dispute on the matter: Brexit can solely be attributed to 'English anger at globalisation and multiculturalism', with the EU serving as a convenient scapegoat (Calhoun 2016).

The US's withdrawal from the TPP agreement is another manifestation of disruption in global trade circles.[9] The TPP was described by US policymakers as 'the most ambitious and visionary Internet trade agreement ever attempted' (see Azmeh, Foster & Echavarri 2020:2), containing what many called ground-breaking digital trade provisions (see United States Trade Representative 2015). Although the remaining signatories to the

9. This is perhaps not an example of regional disintegration, because the TPP agreement was still being negotiated when the US withdrew. One can rather say it is an example of retrogression, which is the process of returning to an earlier state.

TPP (now CPTPP) agreement still hope to achieve their goal of being a model for global trade rule-making in the 21st century, friction at the negotiating table is hampering international relations, free trade and regionalism. It is also fuelling trade policy uncertainty and an anti-globalisation narrative. For countries to make strides in regional integration and trade, disintegration and retrogression must be avoided.

1.5. The US–China trade war

The US–China trade war is exacerbating global uncertainty. The trade war got into high gear in 2018 when President Donald Trump expressed his and his administration's dissatisfaction with China's 'unfair trade practices' and imposed a series of tariffs and other trade barriers against Chinese imports (Kwan 2019). These 'unfair trade practices' have contributed to the US's growing trade deficit with China over the past few years, which has negatively impacted the US economy, manufacturing, jobs, wages and living standards (Morrison 2019). Other areas of concern for the US are the 'theft' of US intellectual property by China and the 'questionable' business dealings of some Chinese companies (Kwan 2019). According to some scholars, the trade war was precipitated by the US to try and force China to change some of its economic and industrial policy approaches (Holland 2018) and to alter its trade practices (Kwan 2019).

Instead of capitulating, China has been engaged in a tit-for-tat tariff exchange with the US since 2018, resulting in the imposition of a series of punitive tariffs by both parties (Figure 1.3). This ongoing trade war has had severe consequences. By the end of 2019, the US had imposed tariffs on US$550 billion-worth of Chinese goods and China, in turn, had imposed tariffs on US$185bn-worth of American goods (Huang 2019). When these two figures are added together, it is equivalent to the total annual value of trade between the two countries before the trade war started. For example, in 2017, US imports from China were

valued at US$505bn, while Chinese imports from the US were valued at US$129bn, according to US figures (Huang 2019).

Many scholars and trade experts are of the opinion that the problem with the US–China trade war is not the sparring over tariffs, but rather (1) the effect that it has on the stability of the global economy and its future growth trajectory (UNCTAD 2019a), (2) the fact that it will further threaten trade liberalisation and the liberal trade order (Thoms 2019), which are already under pressure, and (3) the fact that it will erode global economic connectivity as time goes by (Lau 2019). Moreover, trade policy changes in one country often trigger trade policy changes elsewhere, which can result in a cascade of distortionary trade policies in the world (UNCTAD 2018).

Although the highest levels of trade uncertainty have been recorded in key US trading partners and countries geographically close to the US and China, other countries have also begun to be affected (Ahir et al. 2018). In Africa, the US–China trade war (because of its disruptive effects on Chinese demand) would have precipitated a 2.5% decrease in gross domestic product (GDP) in resource-intensive African countries and a 1.9% decrease in GDP in oil exporters by 2021 (Cazares 2019) – but this was before COVID-19 swept through the world.

1.6. The COVID-19 crisis

What took global uncertainty in 2020 to a whole new level was the rapid outbreak of the COVID-19 pandemic, which had its origins in Wuhan in China in late 2019. The virus rapidly spread to all corners of the world and, on 30 January 2020, the World Health Organization (WHO) declared COVID-19 a 'public health emergency of international concern (PHEIC)', with one of the WHO's greatest concerns being that the virus would 'spread to countries with weaker health systems and which are ill-prepared to deal with it' (Burki 2020:292). To try and contain the pandemic, countries around the world imposed a series of lockdown measures of varying degrees of intensity, in line with the ebbs and flows in infection

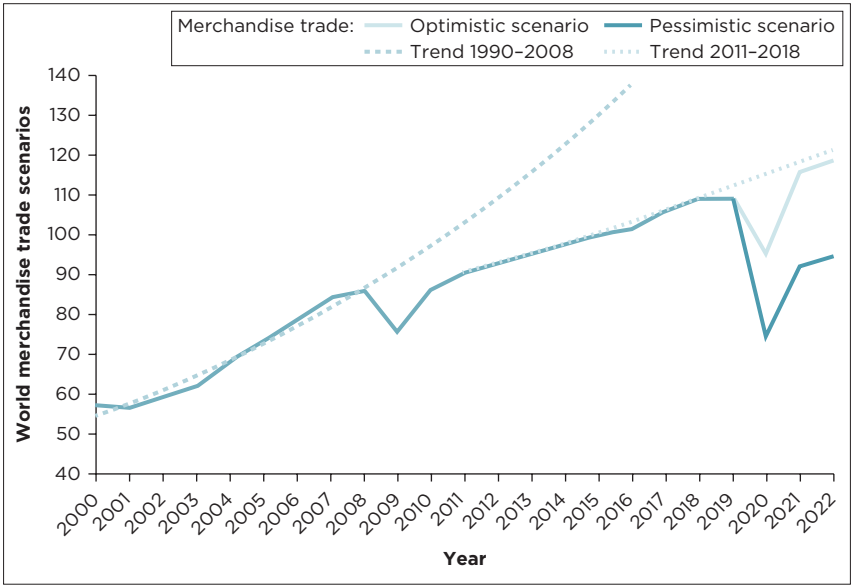
rates – from almost complete isolation at home, except for essential workers, to generally reduced contact and economic activity, combined with mandatory mask usage and social distancing.

While the spread of the virus has (at the time of writing) had an unprecedented impact on countries' health systems and caused the death of hundreds of thousands of people around the world, the broader economic consequences have also been devastating. Not surprisingly, it is vulnerable groups that have been the most severely affected by the various lockdown measures – including small businesses, informal traders and the poor. Whereas developed countries have been able to provide some measure of financial support to their populations in the form of stimulus packages or grants, most developing countries have lacked the resources to offer anything but paltry assistance to those most needy.

According to the IMF's *World economic outlook: The great lockdown* (IMF 2020:xiv), the COVID-19 crisis is like 'no other' and there is substantial uncertainty surrounding its ultimate impact. In the short term, initial estimates show that in the worst-case scenario,[10] the cumulative loss in global GDP in 2020/2021 could be around US$9 trillion. This means that global growth could contract by (minus) 3% in 2020, giving rise to 'the worst global recession since the Great Depression' and one that could be worse than that triggered by the global financial crisis of 2008–2009 (IMF 2020:xii).

World Trade Organization economists have predicted that the decline in global trade as a result of COVID-19 and associated lockdown measures might exceed the serious trade slump induced by the global financial crisis of 2008–2009 (Figure 1.4).

10. This was based on the assumption that the pandemic and associated containment measures would peak in the second quarter of 2020 for most countries and would recede in the second half of that year (IMF 2020). However, the emergence of a 'second wave' of the virus in many parts of the world and several new variants towards the end of 2020 could well render initial estimates inaccurate.



Source: WTO (2020).

FIGURE 1.4: The COVID-19 pandemic and the estimated decline in global trade.

How COVID-19 will affect Africa is of major concern to policymakers on the continent, in terms of countries' economic and trade performance both in the short and longer terms. Just as people the world over refer to a 'new normal' or an 'adjusted normal' in the post-COVID era, African leaders, policymakers and other stakeholders urgently need to determine how best to reinforce their economies against the possibility of future pandemics and other shocks. Some thoughts on the matter are shared in other chapters of this book.

1.7. The awakening of the digital economy and digital trade

It can be argued that the phenomenon that has had the greatest impact on global trade over the past 20 years is the awakening of the digital economy and digital trade. As these concepts tend to conjure up different images in people's minds, they deserve some explanation.

1.7.1. The digital economy

The digital economy has expanded beyond most people's imaginations. As Anderson and Wladawsky-Berger (2016) put it: 'Digital is not just part of the economy – it has become *the economy'*. Scholars agree that the digital economy has become so intertwined with the traditional economy that it is difficult to distinguish between the two. The digital economy can be defined as an 'economy that is made up of billions of everyday, online connections between people, businesses, devices, data and processes' (Deloitte 2020:n.p.). In this economy, 'data has overtaken oil as the world's most valuable commodity' (see Nersessian 2018:845).

There are many different views and predictions about the future of the digital economy. Critics often paint apocalyptic pictures of machines taking over the world and express concern about the power (and morality) of supercomputers, intelligent robots, self-driving cars, neuro-technological brain enhancements, human brain/cloud interface probabilities, and genetic editing. From an economic perspective, they are also anxious about the job losses that automation could bring about and whether or not the expanding digital economy will be able to provide enough replacement jobs or new opportunities for those who need them.

In contrast, those who are enjoying riding the wave of innovation, and who are profiting from new digital technologies and their multiple applications, remain adamant that the opportunities provided by the digital economy are as exciting as they are ground-breaking, such as 5G data networks (especially their ability to provide stable and fast Internet connections); 3D printing and its multiple applications; blockchain technology (especially its ability to safely govern financial transaction data); artificial intelligence (AI) (especially its ability to drive digital platform activity and digital service delivery); digital apps for personalised and predictive medicine; autonomous vehicle navigation/driving systems; and virtual and augmented reality

for entertainment and educational purposes, using special headsets or smartphone apps (see Marr 2020).

The reason for the digital economy having expanded at the rate that it has in recent years is that billions of people have, in the wake of the 4IR, become connected through digital devices with extraordinary processing power, storage capacity and access to information (Schwab 2016). The uptake and application of digital technologies in every economic sector have grown exponentially, thus fuelling the digital economy. In fact, it is estimated that by 2022, some 60% of global GDP will be the result of digitalisation, while an estimated 70% of all new economic value created globally will be through digitally enabled platforms (WEF 2020).

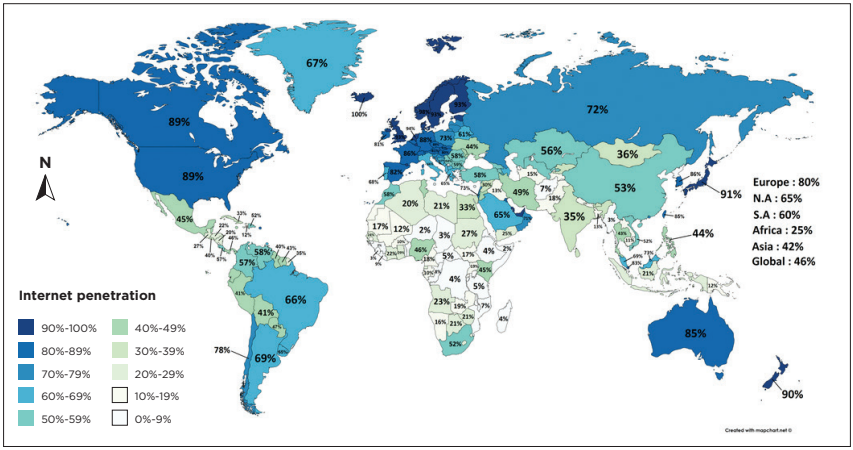
The digital economy consists of three main components: supporting infrastructure (including hardware and software), e-business (how business is transacted in a digital environment) and e-commerce (the marketing and procurement of goods and services in the digital marketplace) (see World Trade Centre Dublin 2016). In 2018, almost half of all households in the world had access to a computer. In developed countries, the share of households with a personal computer exceeded 80%, while in developing countries the share was just over 30% (Statista 2020). In addition, almost 4.57 billion people, or 59% of the world's population, had Internet access (Statista 2020), and there were almost 5 billion mobile phone subscribers globally – representing two-thirds of the estimated global population (Statista 2020).

According to UNCTAD's *Digital economy report 2019*, the digital economy represented US$11.5tn or 15.5% of global GDP in 2016, which equated to (on average) 18.4% of GDP in developed countries and 10% in developing countries (UNCTAD 2019b). Between 2000 and 2016, the digital economy almost doubled in size and grew 2.5 times faster than global GDP (UNCTAD 2019b). The leading contributors in this regard were the US (35%), China (13%), Japan (8%) and the EU, together with Iceland, Liechtenstein and Norway (25%) (UNCTAD 2019b).

Online shopping is one of the most popular commercial activities worldwide, with global e-commerce sales amounting to US$3.53tn in 2019. In the same year, China represented 54.7% of the global e-commerce market – nearly twice that of the US, UK, Japan and South Korea combined (Lipsman 2019). China will most likely continue to dominate the e-commerce landscape, especially seeing that the country is well under way to winning the digital currency issuing race (see Xu & Prud'homme 2020). Germany, France, Canada, India and Russia are also very active in e-commerce (Lipsman 2019). With reference to e-business, a study conducted by the Massachusetts Institute of Technology (MIT) found that companies that have embraced digital transformation are 26% more profitable than their non-digital peers (MIT 2013).

For all its impressive features and undeniable benefits, the digital economy continues to face many challenges. Currently, only about 50% of the world's population participate in the digital economy and Internet adoption is in fact slowing down (WEF 2020). The so-called 'digital divide' and 'digital poverty' remain major concerns. According to Heeks (2018), the digital divide[11] is a highly complex phenomenon and there are different types of divide. For instance, there is an availability divide (evidenced among those living beyond the range of a mobile signal), an affordability divide (evidenced among those who cannot afford a smartphone or other smart device) and an applicability divide (evidenced among those who lack the capability to use particular apps and other functions) (Heeks 2018). In Africa's case, all three types of divide are very much in evidence. Different countries and regions also display different levels of digital division (Figure 1.5).

11. The digital divide refers to the 'gap in access to information and communication technology (ICT), which threatens the well-being of ICT 'have-nots', whether they are individuals, groups or entire countries' (Organisation for Economic Cooperation and Development [OECD] 2001:5).

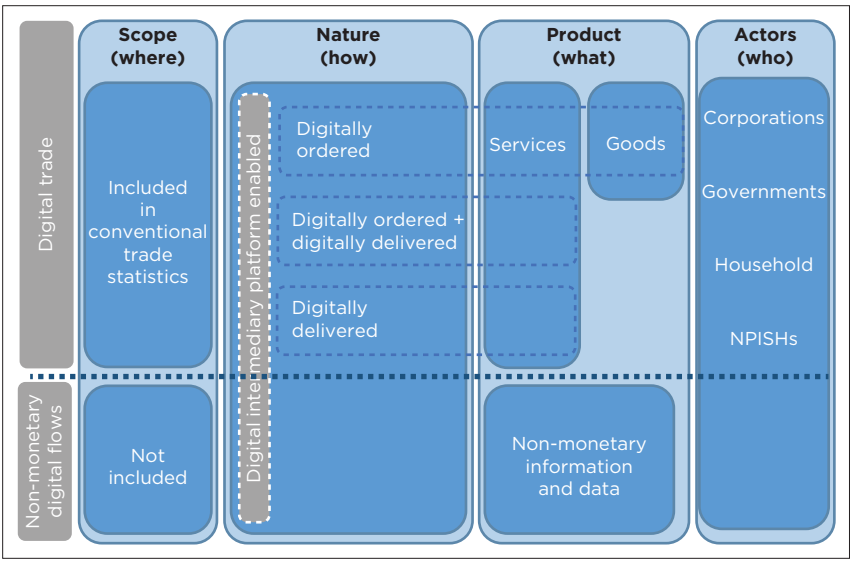


Source: Facebook (2020).
FIGURE 1.5: The global digital divide.

1.7.2. Digital trade

The *Handbook on measuring digital trade* (OECD, WTO & IMF 2020:11) defines digital trade as 'all trade that is digitally ordered and/or digitally delivered'. In this context, digitally ordered trade is 'the international sale or purchase of a good or service, conducted over computer networks by methods specifically designed for the purpose of receiving or placing orders'. Digitally delivered trade, in turn, is 'international transactions that are delivered remotely in an electronic format, using computer networks specifically designed for the purpose'. In addition, the handbook states that both digitally ordered and digitally delivered transactions cover orders and deliveries made over computer networks and should exclude any services not ordered or delivered via such means.

Figure 1.6 provides a conceptual framework for digital trade. It shows that digital trade consists of the exchange of goods, services and information that can be physically and/or digitally ordered and/or delivered, by and to, consumers, businesses and the government by means of data flows, using certain digital



Source: OECD, WTO and IMF (2020).
NPISHs, non-profit institutions serving households.

FIGURE 1.6: Conceptual framework for digital trade.

trade enablers that make the process easier (including digital infrastructure and the regulatory environment) (González & Jouanjean 2017:4). The movement of data or information across borders is a hallmark of the digital trade environment.

Even though various international organisations (such as the OECD, the WTO and the IMF), national statistics agencies and central banks should be commended for trying to define and measure digital trade, in many respects this kind of work is still 'very much in its infancy' and can best be described as 'embryonic' (OECD, WTO & IMF 2020). Much work still needs to be done to retrieve and compile coherent and comparable data on digital trade.

According to the United Nations Economic Commission for Africa (UNECA) (2020), digital trade has had a major impact on the global economy, with annual business-to-business

e-commerce transactions valued at more than US$15tn and business-to-customer e-commerce transactions valued at around US$1tn. Yet the way in which digital trade is and should be governed in different parts of the world is not clear cut. There are many questions about the efficacy and efficiency of current digital trade policies and how Africa should respond.

1.7.3. Digital trade policy

According to Aaronson (2019):

> A digital trade policy can be defined as any domestic, regional or international policy or rule designed to encourage or enable the cross-border flow of data or information, or products and services, in an online environment. (p. 4)

An effective digital trade policy should aim to promote and nurture digital trade by permitting and actively facilitating the movement of data across borders, while leaving sufficient scope to regulate digital activity in order to achieve legitimate public-policy objectives, such as enforcing national security or protecting public morals (see González & Jouanjean 2017).

Notwithstanding the need for regulation, countries should guard against 'digital protectionism' or any type of government effort to restrict or prevent information flows in order to deter competition (Aaronson 2019). Thus, countries may impose conditions or restrictions on the cross-border transfer of information, provided these measures are not discriminatory or a trade barrier in disguise (Aaronson 2019). However, it is difficult to determine what is protectionist and what constitutes a legitimate policy in the national interest.

While the absence of a common understanding of digital trade poses significant challenges for policymakers, the OECD (2016) is of the view that digital trade is complicating the notion of cross-border trade in services and also raising questions about how trade (and particularly services trade) should be measured. According to UNCTAD's *Digital economy report 2019*, the digital

economy remains – for most countries – uncharted territory, with policies and regulations lagging behind the rapid developments taking place in the digital arena, which are impacting countries' socioeconomic dynamics (UNCTAD 2019b:v). The report adds that there seem to be many more questions than clear answers as to how countries should approach the challenges of the digital economy, especially 'given the scarcity of empirical evidence and relevant statistics' (UNCTAD 2019b:v). This means that policy responses need to be constantly reassessed.

1.7.4. The evolution of trade and trade policy, and their digital equivalents

To understand the different dimensions of digital trade and the policy measures needed to effectively regulate such trade, one needs to be familiar with how international trade evolved and expanded. According to the renowned scholar Richard Baldwin, international trade and globalisation have gone through distinct stages, which can be broadly classified into old globalisation and new globalisation (Baldwin 2019a).

Old globalisation had two waves. Globalisation 1.0 began in 1820 and ended at the start of World War I, while globalisation 2.0 began after World War II and ended in about 1990 (Baldwin 2019b). Globalisation 1.0 witnessed a dramatic drop in trade costs with the advent of steam power and various types of mechanical power that made it possible to cost-effectively acquire and consume goods that were produced in far-off locations (Baldwin 2018). Globalisation 2.0 saw the emergence of institution-led, rules-based global governance, centralised in the UN, IMF, World Bank, GATT/WTO and various specialised agencies, including the Food and Agriculture Organization (FAO) and the International Labour Organization (ILO) (Baldwin 2018).

Globalisation 2.0 profoundly benefited the G7 countries (France, Germany, Italy, the UK, the US, Japan and Canada), which saw their share of world GDP soar from 20% in 1820 to

more than 60% in 1988 and their share of world trade surge to more than 50% (Baldwin 2019b). This resulted in huge differences in income between rich and poor nations (Baldwin 2019b). In contrast, developing countries' trade performance during this period was far less impressive.

Old globalisation (globalisation 1.0 and 2.0) was mainly characterised by physical goods crossing borders. Baldwin (2019a) refers to this period as the 'first unbundling' – the geographical separation of production and consumption. Trade policy during this era was largely concerned with market access (see González & Jouanjean 2017).

New globalisation (globalisation 3.0) took a giant leap forward at the end of the 20th century when information and communication technologies (ICTs) served to lower the cost of moving ideas across borders (Baldwin 2019a). Globalisation 3.0 can also be referred to as hyper-globalisation, the global value chain (GVC) revolution, or offshoring (Baldwin 2018). During globalisation 3.0, factories started crossing borders, along with (critically) the know-how of firms in G7 countries (Baldwin 2018). This gave rise to a new era of manufacturing where advanced technologies were combined with low wages (Baldwin 2018). The world witnessed a reduction in transport and coordination costs, which enabled businesses to 'fragment' production processes across national borders and to exploit comparative advantages geographically. Trade in intermediate products or tasks flourished and global production relocated to emerging economies that could produce goods more cheaply (Baldwin 2016). Baldwin refers to this period as the 'second unbundling' (see also ch. 4).

The effects of globalisation 3.0 on global GDP (income) and trade were very different from the effects of globalisation 2.0 on these phenomena. During the last two to three decades of the globalisation 3.0 period, the G7 countries lost their majority share of world manufacturing to China, South Korea, India, Poland, Indonesia and Thailand – called the 'rapidly industrialising 6' (or I6 for short). As a result, the G7 countries saw their share of global

GDP plummet to 50% and their share of global trade shrink to 32% (Baldwin 2019b). Trade policy during this period became increasingly complex, invariably involving trade facilitation and 'behind-the-border' issues aimed at reducing bottlenecks along global and regional value chains (González & Jouanjean 2017) (see also ch. 5 and ch. 7).

According to Baldwin (2018), globalisation 4.0 will commence when digital technologies allow the arbitrage of international wage differentials without the physical movement of workers. This is already evident in many parts of the world. Baldwin (2016) refers to this as the 'third unbundling'. While globalisation 1.0, 2.0 and 3.0 largely affected people who made things for a living (trade in products), globalisation 4.0 will mainly impact the services sector. When this happens, large numbers of workers in advanced economies will, for the first time, be exposed to low-wage, high-quality service competition from abroad. This, according to Baldwin (2018), will change the face of globalisation as the world once knew it. For example, AI-driven automation will begin to displace large numbers of workers, which will change the composition of the global workforce (see also ch. 4 and ch. 9).

González and Jouanjean (2017) state that trade in this new era is not just about digitally delivered trade, but also about digital connectivity (and thus expanded market access) to facilitate more traditional (physical) trade and GVC activity. Furthermore, digitalisation has changed not only *how* trade is conducted, but also *what* is traded. For instance, there has been growing international demand for small, low-value packages of physical goods, which helps to explain why online marketplaces like Alibaba and Amazon have become so successful. In addition, the demand for digital services is rising (surging numbers of Netflix subscribers, for instance, attest to this), while services are increasingly being bundled with physical goods.

In this complex climate, negotiating market access and behind-the-border measures continue to be priorities for trade

policymakers (González & Jouanjean 2017). However, additional trade policy considerations are emerging, such as those relating to digital connectivity and interoperability as well as the regulation of data flows (see González & Jouanjean 2017).

1.7.5. The future of digital trade policy

In today's deeply interconnected world, there has never been a greater need for strong institutions and well-informed policies and regulations to encourage fair economic activity. This will only increase in time as new technologies continue to appear and challenge people's views about governance and ethics, and how the latter should be addressed at an international level (WEF 2015). Currently, there are diverse opinions about the likely trajectory of digital trade in the future, how cross-border data flows should be governed to discourage both unfettered competition and protectionism, and how trade policies, agreements and other interventions should, accordingly, be structured and implemented (Aaronson 2019).

Jonathan E. Hillman, in his 2018 post titled 'The global battle for digital trade', highlights how global superpowers see the future of digital trade, including the optimal role of government in this domain (Hillman 2018). Similarly, Azmeh et al. (2020), in their paper, 'The international trade regime and the quest for free digital trade', offer varying views about digital trade, explaining how such a complex web of opinion will complicate the formulation and governance of digital trade rules in the future.

According to Hillman (2018), views on digital trade policy are currently polarised into three groups of countries: the 'liberalisers', led by the US; the 'regulators', largely comprising EU member countries; and the 'mercantilists', comprising China (the largest digital market in the world), Indonesia, Russia and a number of other emerging markets. Each group champions a different level and type of government intervention in the area of cross-border data flows.

The primary goals of the liberalisers are: a free and unrestricted Internet, unrestricted data flows across borders, and the removal or prevention of digital trade barriers and government-imposed restrictions on data flows (Hillman 2018). In pursuit of these goals, many liberalisers have begun to introduce digital trade provisions in RTAs. In 2017, Harvard law professor Mark Wu identified a significant number of WTO members who had agreed to include digital trade-related provisions in one or more of their RTAs (Wu 2017). A study undertaken by Monteiro and Teh (2017) revealed that e-commerce provisions had become increasingly detailed but remained largely heterogeneous. Of course, it should come as no surprise that the leading region for e-commerce, namely the Asia–Pacific region (Weber 2015), has some of the most elaborate and extensive provisions governing various digital trade-related issues in their RTAs (Wu 2017).

The regulators share most of the liberalisers' goals, such as unfettered data flows across borders, and the removal or prevention of digital trade barriers and customs duties on digital products, but they also have significant concerns about individual privacy (Hillman 2018). As a result, they advocate high levels of protection of personal data and government regulation to ensure data privacy. To this end, the EU has implemented the ePrivacy Directive (ePD) and the General Data Protection Regulation (GDPR), which together provide the legal framework for digital privacy in the bloc. These pieces of legislation ensure that personal data can be collected only under strict conditions and for legitimate reasons (see European Commission 2019).

The mercantilists prioritise the realisation of industrial policy objectives, with provision made for certain protectionist measures such as restrictions on cross-border data flows, as well as data-localisation, technology-transfer and source code-disclosure requirements (Hillman 2018). These measures, which are often justified on the grounds of industrial development imperatives or national security, have the effect of deterring foreign competition (Hillman 2018). China plans to roll out its own, fully fledged digital

currency (Xu & Prud'homme 2020), which could have grave implications for the future direction of the digital economy and digital trade, and the governance thereof in terms of policies and regulations.

1.8. Africa's digital trade policy landscape

Against the above background, one should ask: What position is Africa likely to take in the (as Hillman puts it) 'global battle for digital trade?' Can Africa's current digital trade policies offer a glimpse of what one might expect to see?

Chapter 2 provides an overview of Africa's digital economic and digital trade landscape. Suffice to say at this point that Africa has a great deal of potential in the digital trade arena. Internet usage and mobile phone penetration rates on the continent have risen dramatically in recent years. Africa also leads the world in the mobile money sector and can report many success stories relating to digital innovations and tech start-ups. What is noteworthy, too, is that many African governments acknowledge the essential, enabling role that digital technologies can play in enhancing economic growth and development at the country and regional levels. As a result, they have taken steps to make mobile phones and the Internet more accessible and provide the necessary supporting infrastructure.

Despite these efforts, however, various hurdles continue to impede African countries' active participation in the digital economy and digital trade. As countries in other parts of the world ramp up their efforts to take advantage of the practically limitless opportunities presented by the 4IR, Africa faces a widening digital divide (see, for instance, Fuchs & Horak 2008; Sarkar, Pick & Johnson 2015). This calls into question Africa's ability to arm itself in preparation for the 'global battle' referred to above.

So far, Africa has largely stayed on the sidelines while this digital trade battle has gathered momentum, mainly because

African policymakers are still grappling with the challenges of providing basic digital connectivity, with only a few having begun considering the broader implications of the digital economy and digitisation (Foster & Azmeh 2018). Policymakers' subdued response can be attributed to various factors. In particular, digital trade is a loosely defined term and is difficult to measure; thus, the role and implications of digital trade rules – and what a digital trade policy should look like – are not well understood (Foster & Azmeh 2018). What is encouraging, though, is that the African Union (AU) and most African regional economic communities (RECs) and individual countries have begun to view the digital economy as a priority and have begun to design various digital trade policy instruments for this purpose.

As members of the WTO, African countries are bound by the work programme on e-commerce[12] and the moratorium on e-commerce. The African Group, in their communiqué on e-commerce at the WTO's Ministerial Conference in 2017 (MC11), made it clear that it was 'entirely premature' to form any new multilateral rules on e-commerce (WTO 2017:3). They indicated that there were already enough multilateral rules on e-commerce and that new rules might constrain Africa's domestic (including industrial) policy space (WTO 2017). The African Group called on WTO members to preserve their right to regulate e-commerce and to adopt measures aimed at promoting digital industrial development at the national level. Such efforts, they asserted, needed to be supported through technical assistance, regulatory capacity-building and insights shared by more advanced economies (Hope & Sauli 2018). The group made it clear that 'the work we [Africa] undertake in multilateral trade and rule-making supports Africa's continental integration agenda' (WTO 2017:1).

12. At the multilateral level, the WTO Work Programme on E-Commerce is still the main (and only) platform for discussions on trade issues pertaining to e-commerce. It was established in 1998 to examine e-commerce in relation to trade in goods and services, intellectual property (IP) rights, and trade and development. In 2016, certain developed countries pushed for the prioritisation of an e-commerce agenda under the WTO but developing countries vetoed this call, arguing that the 'remaining Doha issues' first needed to be resolved.

At a continental level, Africa's digital trade policy agenda looks ambitious. One of the AU's integration and trade policy objectives is formulating a 'digital transformation strategy for Africa' which aims to 'prioritize and accelerate digital transformation in Africa' through the creation of a 'digital single market' (AU 2019). This digital single market would build on all existing initiatives and frameworks in member states and harmonise policies to create a more effective digital marketplace (AU 2019). In 2020, e-commerce was included in the African Continental Free Trade Area (AfCFTA) agreement on the basis of a decision taken by the AU Bureau of Heads of State and Government (tralac 2020a). This was a significant step, considering that many scholars and organisations had been calling for policymakers to leverage the AfCFTA to drive digital trade on the continent. The AfCFTA now offers a platform for rules on digital trade (including e-commerce) to be negotiated, with such rules incorporated into the free trade area (FTA) agreement as a standalone chapter or protocol, or as an embellishment to existing AU instruments (see ITC & WEF 2019).

The United Nations Economic Commission for Africa has invested heavily in digital identity determination in Africa (the process of authenticating individuals' identity both online and offline) because this is an important catalyst for various development initiatives, including trade, governance, social protection, financial inclusion and domestic resource mobilisation (UNECA 2020). In addition, the African Development Bank (AfDB) operates its Africa Digital Financial Inclusion Facility (ADFI), which is a financing vehicle designed to accelerate digital financial inclusion across Africa (AfDB 2020).

Various RECs in Africa have adopted e-commerce policies and initiatives with a view to encouraging greater digital adoption in regional trade and integration initiatives. These include: the Common Market for Eastern and Southern Africa (COMESA) digital FTA, the Southern African Development Community (SADC) e-Commerce Strategy, the Economic Community of

West African States (ECOWAS) Digital ECOWAS initiative and the East African Community (EAC) Single Digital Market. Some RECs such as the Community of Sahel-Saharan States (CEN-SAD) do not have any overarching digital strategies in place, but member countries of CEN-SAD such as Tunisia and Senegal have formulated their own national strategies, such as Digital Tunisia 2020 and Digital Senegal 2025.

Several African countries have developed policies and strategies aimed at expanding and strengthening the digital economy at a national level and advancing their digital industrialisation agendas. South Africa, for instance, has drafted a national e-Strategy, which aims to position the country as a significant player in the development of ICTs in various technology-driven value chains and to accelerate the uptake of ICTs in a range of economic sectors in South Africa (South Africa 2020). Kenya has developed a Digital Economy Blueprint, which provides a conceptual framework aimed at creating a dynamic and sustainable digital economy, focusing on priority areas such as digital government, digital business, infrastructure, innovation-driven entrepreneurship, and digital skills and values (Republic of Kenya 2019).

Egypt's Digital Egypt strategy aims to transform Egypt into a thriving digital economy, with one of its first objectives being to digitise and thus transform Port Said (a strategic and cosmopolitan city) into a smart city (Egypt Today 2020). Nigeria's Digital Transformation plan, in turn, focuses on introducing regulations to level the digital playing field and remove obstacles to doing business, build capacity to turn Nigeria into a knowledge economy, promote home-grown technology solutions and digital jobs, and strengthen cyber security (This Day Live 2020). A number of international governmental organisations also have various initiatives in place to advance Africa's digital economy. For instance, the EU–AU Digital Economy Taskforce is a high-level, cooperative forum that focuses on Internet connectivity, e-Skills, digital entrepreneurship and e-Services (European Commission 2020).

E-commerce and related issues have been incorporated as provisions or chapters into various RTAs, covering topics such as data localisation, cross-border data flows, information and consumer protection, customs duty bans, and the promotion of e-commerce, among others (tralac 2020b). Typically, these provisions are grouped into four categories: market access (e.g. customs duties on digital products); rules and regulations (e.g. consumer and personal information protection); facilitation (e.g. paperless trade administration) and enabling issues (e.g. technology infrastructure and related matters) (see tralac 2020b). To date, no country in Sub-Saharan Africa has become a signatory to an RTA with a standalone e-commerce chapter (see Wu 2017).

Regarding which position Africa is likely to take in the 'global battle', a few things seem clear. At the multilateral level, Africa's stance seems to be in line with that of the mercantilist group, considering Africa's concerns about having enough domestic policy space to support its industrialisation efforts. However, from a continental and regional standpoint – where the focus is on promoting and removing the barriers to digital trade – Africa's position is more closely aligned with the liberaliser group, *except* that the preferred liberal approach to digital trade should be confined to the continent (at least for now). How African countries will handle their digital trade activities with countries beyond Africa's borders is unclear at this stage, particularly as no country in Sub-Saharan Africa has signed an RTA with a standalone e-commerce chapter. Another complicating factor in this regard is that the continent has not yet reached the desired level of regional integration (encapsulated in the Abuja Treaty or the proposed digital single market concept) and therefore cannot, as a bloc, negotiate trade rules and protocols. How (and what) will Africa negotiate in the interim? Even if Africa achieves the requisite level of economic integration, its ability to negotiate as a bloc would depend on countries' trade policies being harmonised, which they are not.

A final question to ask is: Will Africa's various digital trade policy instruments be effective and produce their intended results? However well-crafted they may be and however enthusiastically they may be adopted, policy instruments will only make a difference on the ground if they are accompanied by inclusive, enabling regulations; strong ties with trade and investment partners; sound ICT infrastructure; widely accessible digital services; efficient trade logistics; and skills and capacity in all the right places. Subsequent chapters will look at some of these imperatives in more detail.

1.9. Conclusion

The many digital economy and trade initiatives that African countries are involved in are laudable. Yet their value lies in the detailed plans that flow from them, which must be effectively implemented – something for which Africa is not well known. Regulations are critical tools for ensuring that commitments are upheld and policies and plans are followed. Yet digital trade is about so much more than compliance. It is about investment, creativity, innovation, learning and sharing. It is also about taking stock of the present in order to look realistically into the future. Digital trade policy therefore needs to unlock the doors to these creative and cooperative forces, while seriously addressing current impediments and, importantly, putting appropriate structures in place to monitor and measure outcomes.

Africa stands at the digital crossroads. While the fast-changing digital landscape, like an advancing storm, appears daunting, it also provides an untold number of opportunities to rise to the challenge and do things differently and better – in ways that are right for Africa.

American entrepreneur Jim Rohn said: 'It is the set of the sails – not the direction of the wind – that will determine which way we will go' (Patton 2014). Seafarers know that the wind is not something that they can control, but they *can* determine

the route and how they 'set the sails'. Sometimes, they are fortunate enough to get a tailwind, but headwinds are all-too-frequent occurrences. It is tempting to wait for a more favourable wind when things get choppy, but this means that they will forfeit the opportunity to become better sailors.

Returning to the metaphor of Africa as a ship sailing into a storm, it is inevitable that, as the continent contemplates its digital future, many uncertainties and difficulties will lie in its path. This is, after all, one of the most uncertain times in the world's history. Moreover, even though countries have control over their proverbial sails, the wind is always changing, which means that sails need frequent adjustments. The remaining chapters in this book will show, in their own way, how Africa can weather the approaching and more distant storms by skilfully plotting and staying on course, both domestically and further afield.

1.10. Key takeaways from this chapter

- The world has been experiencing much upheaval and uncertainty in recent years – geopolitically, geo-economically and technologically – and traditional trade rules and alliances are in a state of flux. The unexpected arrival of COVID-19 has added to the turmoil.
- The world is seeing increasing polarisation around three main centres of power – China, the US and Europe – with the changing technological landscape also helping to fuel ideological and socioeconomic divisions in the world.
- The digital age or 4IR presents both opportunities and challenges to developed and developing countries alike. In many ways, it is like an advancing storm – powerful, disruptive and unpredictable. It cannot be avoided, but it can be skilfully navigated and, in the process, valuable lessons can be learnt.
- Digital trade refers to all trade that is digitally ordered and digitally delivered across borders, and therefore covers a wide

range of goods, services and information (data). If countries are to succeed in their digital trade endeavours, they need digital trade policies that effectively regulate cross-border activity but still encourage innovation and competition. Key considerations include how liberalised digital trade and cross-border data flows should be, and how to protect data privacy and fight cybercrime.

- Digitalisation is changing both *how* people trade and also *what* people trade, evidenced in the rising demand for small, low-value parcels of goods (such as from Amazon and Alibaba) and digital services (such as from Netflix). Policymakers and regulators are therefore under pressure to keep pace with changing industry and market trends.
- Of all regions, Africa appears to be the least well-prepared for the 4IR, given its historically slow pace of economic development and its widening 'digital divide'. However, it has a rapidly expanding mobile culture, a potential youth dividend and many entrepreneurial success stories. Given the right policy and business environments, the enormous potential of the 4IR could be unlocked on the continent.
- Encouragingly, many African countries have been formulating digital policies and strategies, both nationally and at the regional level. In time, the AfCFTA could take digital cooperation and trade to a whole new level on the continent.
- Much work, however, needs to be done for African countries to be 4IR-ready, which includes expanding and enhancing ICT infrastructure and services, overcoming trade logistics hurdles, and building digital skills and capacity. Policies provide crucial direction, but they need committed action from relevant stakeholders if they are to deliver the intended results.

Chapter 2

Economic development and industrialisation in the digital era: Where does Africa stand?

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2.1. Introduction

An overarching consideration in this book is how Africa can move to a new level of digital adoption and leverage the innumerable opportunities presented by the fast-accelerating digital era, which some people refer to as the 4IR. The fact that many developing countries have a glaring 'digital divide' is well known and documented – a phenomenon that is particularly acute in Africa. As many countries proceed to digitalise their economies and pave the way for increased digital trade, African countries' efforts in turn appear to be comparatively timid. The main reasons for this are briefly discussed in this chapter.

Against the backdrop of Africa's relatively slow technological uptake, which has hampered industrialisation efforts and dimmed the prospects of job-rich growth in many countries, there are nevertheless interesting things happening on the continent. If combined with better policy and business environments, they could provide the fuel for a digital turnaround. The fact that Sub-Saharan Africa has been called 'the enduring epicentre of mobile money' (Kazeem 2020) is an example of how the region is a global leader in an important area of the digital economy, driven largely by an exponential rise in the mobile penetration rate in recent years (UNECA 2020).

Whether Africa's so-called mobile revolution is a sign that the continent is waking up to the digital possibilities that the 4IR has unleashed is debatable. One could also argue that waking up to the digital era is not the same as responding to it. The former is a relatively organic process with an unclear trajectory, which runs the risk of producing uneven results, while the latter is a more informed, orchestrated process

underpinned by specific goals. Digital responsiveness is dependent on many factors – from having effective policies and regulations in place to having access to the right information, skills and technologies. How Africa is faring in terms of digital responsiveness and how it could enhance its performance are explored in this and subsequent chapters.

2.2. Africa's digital landscape

Africa's digital potential is not difficult to see. At the end of 2019, there were more than 529 million Internet users on the continent, which equates to almost 40% of Africa's population. This represented 11.5% of all Internet users globally (Internet World Stats 2020). Furthermore, over the past 20 years, Africa has seen its Internet penetration rate grow by 11.5% (Internet World Stats 2020). The continent is also home to some of the fastest-growing Internet-user populations in the world (ITC & WEF 2019).

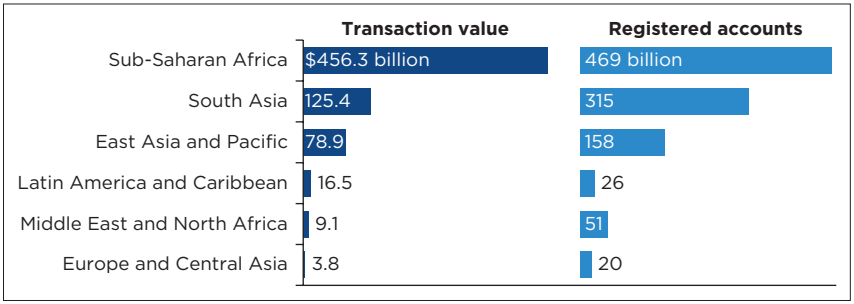
Complementing its steady expansion in Internet connectivity, Africa has a huge mobile economy. Modern mobile phones are powerful digital devices that are able to process a host of high-tech applications. In 2018, Africa had 456 million mobile phone subscribers (44% of the African population), with 239 million people (23% of the African population) using mobile devices to access the Internet on a regular basis (GSM Association 2019). Sub-Saharan Africa has remained one of the fastest-growing regions for mobile phone subscriptions, with an expected compound annual growth rate of 4.6% in the period 2018–2025. If this momentum is maintained, Africa will have 600 million subscribers by 2025, representing around half the African population (GSM Association 2019). As indicated by Gillwald and Mothobi (2019), Internet usage is directly related to smartphone ownership. This, in turn, is highly correlated with income per capita and the youthfulness of the owners of phones.

Also in 2018, mobile technologies and services generated almost 9% of Sub-Saharan Africa's GDP or nearly US$144bn in

value-added economic activity (GSM Association 2019). Mobile networks in turn supported nearly 3.5 million direct and indirect jobs. A large proportion of the (around 1.2 million of the 1.7 million) people in the mobile ecosystem in Sub-Saharan Africa are informally employed, distributing and retailing mobile services (GSM Association 2019). E-commerce holds particular promise for Africa and is set to generate around 3 million jobs by 2025, according to the ITC and WEF (2019).

In 2019, Africa dominated the global mobile money industry and was responsible for 60% of mobile money transactions (valued at US$690 million) that year (Figure 2.1). Well-known mobile money platforms in Africa include M-Pesa, Airtel Money and Orange Money. Many telecommunications companies are providing products and services that were once only provided by traditional banks (WEF 2019b). M-Pesa, the best known of these mobile platforms, has flourished in countries whose banking facilities are relatively undeveloped, such as Kenya, Ghana, Tanzania and Uganda. M-Pesa and other mobile banking services have not gained much traction in South Africa, however, owing to the country's well-developed financial sector (Gillwald & Mothobi 2019).

Africa has many success stories in the area of digitally driven innovation, evidenced in the establishment of an interesting cross-section of tech start-up companies. For example, Jumia



Source: Kazeem (2019).

FIGURE 2.1: The global mobile money industry.

(an online marketplace) boasts more than 4 million clients in 14 different African countries, and its US$1bn listing on the New York Stock Exchange made it Africa's first-ever technology unicorn[13] (Leke & Sibanda 2019a). Another digital start-up, Interswitch, enables Nigerian consumers and businesses to use its digital channels to buy groceries, airtime, electricity, water, and other goods and services. This is another digital behemoth in the making, processing over 300 million digital transactions per month (Leke & Sibanda 2019b). Africa is also seeing the rapid establishment of technology incubators (Kazeem 2019). For example, Andela, a software development incubator, recruits African software developers and engineers, trains them and assigns teams of recruits to companies around the world. Over the past four years, Andela has hired 1200 software developers/engineers and sent them to work in 200 different companies. Valued at some US$700m, this company also looks set to achieve unicorn status (Leke & Sibanda 2019a).

The number of new tech start-ups in Africa rose by 61% in 2019, with investments channelled to various sectors, including fintech, logistics, e-commerce, agri-tech and e-health (Jackson 2019). Kenya and Nigeria were Africa's leading tech start-up investment destinations in 2019, together securing some US$270m in deals and funding (Appsafrica Advisory 2019). South Africa, Rwanda and Egypt are, in turn, becoming notable tech hubs on the continent (Briter Bridges n.d.) and leading the way where tech start-ups are concerned.

While the digital strides that are being made in various quarters are impressive, they are not evenly spread across the continent, nor are they expansive enough to deal decisively with Africa's significant (and growing) digital divide (Fuchs & Horak 2008; Sarkar, Pick & Johnson 2015). It is of great concern, for example, that countries such as the Seychelles and South Africa have Internet penetration rates in excess of 50%, while in several other

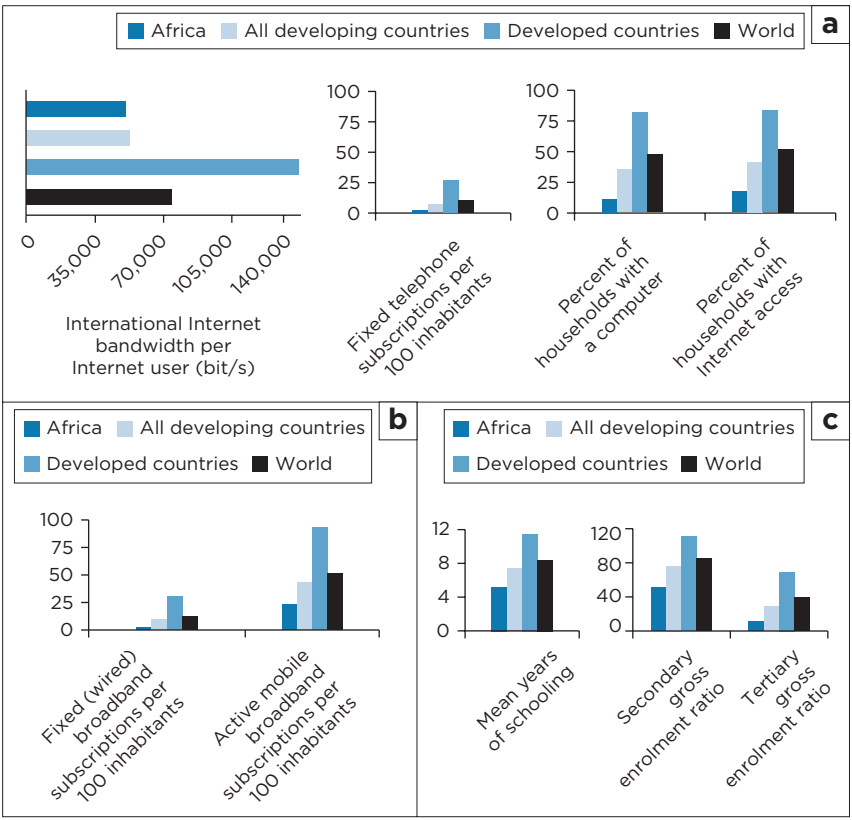
13. When a privately owned start-up company is valued at more than US$1bn, it acquires 'unicorn' status.

countries Internet usage is negligible (see Curran 2017; Gillwald & Mothobi 2019). Rwanda's Internet penetration rate is only 9% (Gillwald & Mothobi 2019). Moreover, Africa's mobile phone penetration and Internet (and broadband) connectivity rates are, on average, very low by world standards and trail behind those of developed countries.

Gillwald and Mothobi (2019) are of the view that income and level of education, particularly tertiary education, are two important determinants of Internet usage. In Africa, the cost of both devices and connectivity exclude many low-income earners from Internet usage. What is concerning, too, is that most Africans with access to the Internet use such access (largely via mobile devices) for the purposes of surfing or communicating on social media channels. The authors report that only about 21% of people in Africa use the Internet for educational purposes, while 15% use it for work purposes (Gillwald & Mothobi 2019).

Unlike several developed countries with ageing, shrinking populations, Africa has a 'youth dividend' which should constitute a rich reservoir of young people with the potential to embrace the opportunities and challenges presented by the digital era. Approximately 62% of the population in Sub-Saharan Africa are under the age of 25 who, if they had the benefit of high-quality and relevant education and training, would constitute a sustainable source of labour (United Nations Department of Economic and Social Affairs [UNDESA] 2019; WEF 2017b). Unfortunately, Africa's low average education and skills levels are well-known, with many African countries (including South Africa) consistently at the bottom of various global scales that rank countries on their education and skills attainment levels. Particular problem areas are mathematics and science proficiency, but also simple literacy.

Ndung'u and Signé (2020:61), citing the Brookings Institute, assert that 'Africa still lags behind in several indicators essential for a successful digital revolution', especially in infrastructure, technology access, and education' (Figure 2.2). For example, the



Source: Ndung'u and Signé (2020).
ICT, information and communication technology.

FIGURE 2.2: Africa's information and communication technology development indicators, in terms of (a) technology access, (b) technology use, and (c) technology preparedness.

fact that the mobile phone has become ubiquitous on the continent does not necessarily translate into knowledge of digital applications that could assist learning, spark new business ideas, and facilitate domestic and international trade.

According to Darsinouei (2017), narrowing the digital divide requires that a wide range of barriers be addressed. These barriers include:

- inadequate ICT infrastructure (both hardware and software) because of insufficient investment
- the high cost of ICT networks, equipment and services
- logistical hurdles, which complicate or impede procurement and distribution activities and impact e-commerce and cross-border trade in tangible goods
- a lack of data security and low levels of trust in online payment and other services
- inadequate knowledge of ICT systems and their multiple applications.

An empirical study conducted by Sarkar et al. (2015), which examined the differences in ICT utilisation among various African countries, found that the most critical barriers to overcome when seeking to bridge the digital divide are inadequate ICT-related polices and laws and institutional weaknesses (particularly in government). According to Sarkar et al. (2015), earlier studies support this finding. The authors stress that national governments in Africa must:

> [*P*]lay a more prominent role to shape economic and telecommunications policies for public and private sector investments in ICT to build infrastructure, deregulate telecom markets to encourage competition, simplify licensing regimes, and encourage adoption of ICTs among individuals and organizations in education, government and business. (p. 19)

Many African governments do indeed recognise the valuable, enabling role that digital technologies could play in stimulating economic growth, reversing high unemployment rates and laying the foundation for more cost-effective regional and international trade.

Yet failure to shift the many obstacles that are preventing countries from realising their digital potential will result in Africa falling further and further behind on the development curve, making it increasingly difficult to put up defences against unanticipated crises such as COVID-19 and withstand other, more regular occurrences such as commodity cycle downturns, drought and famine (International Telecommunication Union

[ITU] 2018). It will also make it difficult to realise the vision of an integrated continent characterised by robust intraregional trade, for which the AfCFTA is intended to pave the way.

2.3. Africa's digital divide: Is leapfrogging a solution?

Much has been said in recent years about the need for greater inclusiveness – particularly in developing countries whose populations are often deeply divided in terms of income, education and skills levels, employment opportunities and quality of jobs. Women are a particularly marginalised group. For example, in 35 out of 75 countries in Sub-Saharan Africa, 25% of the poorest young women are not literate (United Nations Educational, Scientific and Cultural Organization [UNESCO] 2020). Equally disturbing is the fact that more than 400 million of the world's extreme poor are in Sub-Saharan Africa, living in 10 of the 19 most unequal countries in the world (World Bank 2015). A few years ago, the World Bank estimated that if growth and poverty reduction measures were not actively pursued, Africa would become home to 90% of the world's poor by 2030 (World Bank 2015).

Divisions invariably extend into the digital domain as well, with many people unable to access or afford mobile devices or Internet services, thus leaving them ill-prepared to acquire ICT-related skills and participate in the digital economy. For example, rolling out ICT infrastructure to rural communities far removed from main urban centres is a very expensive and logistically difficult undertaking. Fixed-line and wired networks are often beyond communities' reach. The urban–rural disparity in Internet usage is particularly pronounced in African countries such as Mozambique and Tanzania, standing at 87% and 84%, respectively. The equivalent figure for South Africa is 36% (Gillwald & Mothobi 2019). As the 4IR gains momentum, the digital divide will simply widen in the most seriously affected countries. According to the ITU (n.d.), digital inclusion means that everyone has an equal

opportunity to take advantage of and be enriched by ICTs and to participate in the digital world. Consequently, ICTs should be accessible to all.

COVID-19 has thrown into sharp relief the adverse effects of an economically and digitally divided world. Although many report that the pandemic has forced governments, businesses and individuals to quickly adapt to more remote and flexible learning and working styles – thus boosting productivity and bringing about significant cost savings – the advantages presented by the swift move to digital platforms for everyday communication and commercial trading are only really experienced by those who have regular and affordable access to online services. That is why, despite online education (particularly in the wake of COVID-19) being hailed as a modern, cost-effective solution to the problem of traditional educational exclusion, poor and digitally excluded societies have not been able to realise the benefits of this technological transition (see also ch. 9).

COVID-19 has also highlighted the impact of the digital divide in the health sector. For example, with so many people in Africa still lacking access to the Internet and digital apps, efforts to educate people about the virus, contain its spread (through testing, tracking and tracing) and roll out treatment programmes on the basis of collected data have been seriously hampered (Ghanem 2020; World Wide Web Foundation 2020).

Africa can least afford the ravages of COVID-19 (and the lockdowns in particular), given many countries' relatively fragile economic state. According to the World Bank (2019a), Sub-Saharan Africa will sustain COVID-induced output losses of between US$37bn and US$79bn in 2020 for reasons:

> [*T*]hat include trade and value chain disruption [...]; reduced foreign [...] remittances, tourism, foreign direct investment, foreign aid combined with capital flight; and through direct impacts on health systems, and disruptions caused by containment measures and the public response.

The IMF (2020) indicates that the countries most affected by the pandemic and its associated lockdown measures are likely to be those that are tourism-dependent, resource-intensive, oil exporters and frontier-market economies.

While many other countries will bounce back economically once vaccines are rolled out and economic activity returns to pre-pandemic levels – which is good for Africa's international trade prospects – COVID-19 has laid bare the dangers of eschewing knowledge- and productivity-enhancing innovation. After all, ongoing geopolitical tensions, climate change, economic volatility and possible future pandemics will continue to create uncertainty in the world, and countries need strong and diverse economies to weather the storms.

With the digital divide showing no signs of abating in many parts of the world, 'leapfrogging' is often touted as a partial solution. This broadly refers to a process of harnessing the power of innovation and appropriate technologies to make rapid, non-linear progress in areas in which countries or industries are lagging behind (Winthrop & Ziegler 2019). It suggests that developing countries, for instance, could adopt a more rapid, technology-fuelled approach to economic development instead of trying to emulate the traditional phases pursued by the developed countries (AfDB 2020; Shaikh et al. 2019; White & Rees 2019; WEF 2019a).

For example, many African countries have bypassed the fixed-line telephony phase in favour of more versatile mobile options. Digital platforms now make it possible to perform all sorts of financial transactions using mobile devices – from effecting payments to sourcing loans and credit – where previously these processes needed the involvement of the formal banking sector. There are many other African examples – from life-saving medicines being delivered by drone to remote villages cut off by poor roads to crowdfunding of farmers who do not qualify for financial assistance through more conventional channels (World Bank 2017).

Electricity supply problems have long been a key stumbling block to Africa's growth and development. To address the lack of a reliable power supply in certain African countries, M-Pesa has branched out into solar energy with the establishment of Kopa Solar. Combining solar-power generation and low-energy lights with mobile payments and the Internet of things (IoT) technology (in this instance, SIM cards embedded in solar energy devices), M-Pesa is giving people access to solar energy products at affordable prices, using its popular mobile payment infrastructure. One of the reasons why mobile communication has grown exponentially in Africa is that it uses satellite technology. However, satellite connectivity is supplied by private-sector service providers that focus primarily on urban areas, with unprofitable rural areas that do not produce scale effects often falling outside the coverage loop.

Leapfrogging is also sometimes spoken about in the context of education, with the rapid move to online learning models in the wake of the COVID-19 pandemic being a good example. According to Winthrop and Ziegler (2019), it would take up to 100 years for those furthest behind in terms of educational achievement to catch up to those at the top end of the educational achievement scale if traditional teaching and learning methods were followed. The application of digital technologies can (and must) dramatically fast-track the process (see also ch. 9).

Yet, one must refrain from seeing leapfrogging as a way of using technology to compensate for long-term developmental failures and as a substitute for critical (but often neglected) phases in a country's industrial development, such as developing a manufacturing capability. Leapfrogging is less about using technology to catapult a country (which may, for example, be agriculture-dependent) into the digitally enhanced services arena, and more about using technology to gain a competitive advantage and accelerate the transition into, say, agro-processing and other value-added economic activities.

Africa's status as the world's mobile money hub is indeed impressive. However, this does not necessarily mean that African countries can become masters of fintech or medical diagnostics or e-commerce. Many other essential building blocks need to be in place for countries to successfully transition into new areas of economic activity and to develop competitive and other trade-related advantages. These building blocks include such basic requirements as accessible and affordable electricity, water and Internet connectivity; efficient physical and ICT infrastructure; a sound education system (whether digitally delivered or otherwise); and transparent rules and regulations.

Where countries' economic development is concerned, the fundamentals cannot be downplayed or averted. Digital technologies may provide some short cuts into the future, but their value mainly lies in their ability to drive higher levels of productivity and competitiveness; they are not a miracle cure in themselves. In short, it would be unrealistic to think that Africa can leapfrog into a digital future without also giving attention to building a sound industrial base.

2.4. Industrialisation in Africa

Sustainable Development Goal 9 in the UN Sustainable Development Goals (SDGs) (see UN 2021), which have a time horizon up to 2030, is: 'Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation'. Clearly, innovation, inclusion and industrialisation are interlinked.

2.4.1. Pathways to industrialisation

Broadly, industrialisation refers to the process of moving an economy from a low-productivity, factor-driven stage to a more efficient, innovation-driven stage. Low-productivity economies are the least developed and typically rely on subsistence agriculture and mining, as well as large numbers of unskilled workers. Innovation-driven economies are the most developed,

with rising numbers of knowledge-intensive businesses and an expanding services sector (WEF 2017a). Of course, there are many variations in between.

In Africa, most economies are still largely at the low-productivity, factor-driven stage and so countries' industrialisation efforts should be geared towards making the transition from a commodity-dependent path to a more knowledge-driven, value-added and innovative path. Given its many socioeconomic challenges – not least of which are high levels of unemployment and poverty, and the encroaching effects of climate change – industrialisation in Africa is an imperative. It also offers a route towards less dependence on foreign aid, which rarely leads to productive development. Unfortunately, a narrative that has been circulating is that Africa has been de-industrialising, with questions being asked about whether Africa has the potential even to take its industrialisation plans forward.

According to renowned historian Yuval Noah Harari, conventional views on industrialisation need to change (see Harari 2020). He believes that, as time goes by, land and physical capital will lose their significance as key drivers of competitiveness. They will be replaced by data and information, digital technologies, ICT skills and progressively more fluid, decentralised decision-making. According to Naudé (2019), Africa has definite industrialisation potential but there is no single, 'one-size-fits-all' strategy to prepare for a more digitalised industrial future; nor is inclusiveness something that can be achieved overnight. Each country's pathway and time frame will be different.

Naudé (2019) refers to three types of industrialisation. The first involves building or acquiring traditional manufacturing capabilities. This would suit those countries and sectors that – because they are well behind the technology curve – should continue to pursue labour-intensive manufacturing, while at the same time investing in new, complementary technologies that will in time help to modernise existing systems. The second involves developing services sectors to take over the role of the

once-dominant manufacturing sector. For example, ICT, tourism, transport, financial services and even agricultural services could all lead to productive development if or when manufacturing starts to wane. The third involves high-tech manufacturing, using automation, AI, 3D printing, the IoT, cloud computing and other applications.

Ultimately, each country's industrialisation path needs to reflect a unique combination of the three types of industrialisation described above. For example, Kenya is seeing the 'simultaneous development of high-tech financial services alongside growth in traditional food processing and textiles' (Oxford Business Group 2021). However, a common theme is that each country must – in its industrialisation efforts – consider the impact of new technologies, especially digitalisation, on manufacturing (Naudé 2019). If it does not, the risk of sectors and whole countries being 'left behind' will only intensify.

2.4.2. The role of industrial policy in the digital era

Industrialisation does not happen automatically. A well-informed and effective industrial policy needs to drive the process. In simple terms, an industrial policy is a collection of measures aimed at improving a country's productive capacity. This includes addressing the constraints that impede a country's transition from low- to higher-productivity economic activities (Mureverwi 2016; Newman et al. 2016; Rodrik 2004, 2018; Strydom, Viviers & Parry 2018; Weiss 2018; World Bank 2020).

A country's industrial policy also needs to go hand in hand with its trade promotion efforts, as productive domestic industries help to drive both export and import activity. It also paves the way for more active participation in global and regional value chains (see also ch. 5) and the transfer of technology to domestic firms, with broad economic development benefits. One of the challenges, though, of using trade (and particularly more liberalised trade) as

an industrialisation lever is that large volumes of imported foreign goods and services could overwhelm domestic industries and prove counterproductive to industrialisation efforts.

The thinking on industrial policies and industrial policy instruments has changed significantly over the years (Rodrik 2005; Strydom et al. 2018). Conventional industrial policies can be described as partial equilibrium policies, meaning that they consider the effects of policy actions only on those sectors/markets that are directly affected by them and often overlook the interdependence of economic activities. Conventional policies typically concentrate on a single or narrow range of policy interventions, such as import substitution, export promotion or special economic zones, with scant regard for how these may affect other sectors or a country's long-term development prospects.[14] They also fail to take into account the highly integrated nature of the global economy. Another hallmark of conventional industrial policies is the selection (by government) of 'winners', which are then given various forms of assistance to bolster their performance, particularly in terms of exports and job creation. However, given the fluidity of global economic conditions and relationships, winners today could become tomorrow's 'losers' which continue to enjoy government support despite waning competitiveness.

Fundamentally, conventional industrial policies also tend to focus on physical products and fabrication, and largely ignore the activities and opportunities in the pre- and post-fabrication stages of the value chain. As argued by Baldwin (2013), the pre- and post-fabrication stages carry higher value-added features than the fabrication stage, which refers to final assembly. Broadly, pre-fabrication is associated with research and product development, while post-fabrication concentrates on marketing and business support services. The advantage of the value chain model is that it creates opportunities for niche or specialised

14. A special economic zone (SEZ) is a demarcated area in a country where regulatory restrictions are more lenient than the prevailing national requirements in respect of tariffs and taxation (see UNCTAD 2019).

production across different countries and regions. Whereas physical products still feature heavily in production and distribution networks around the world, services and data traffic are the core features of many countries' industrial (and digital industrial) policies and strategies.

In the light of the above, the partial equilibrium approach should give way to a more holistic policy framework that focuses on the many interdependent factors that shape the industrialisation process, including infrastructure development, human capital development, labour market flexibility, financial market efficiency, integrated transport corridors and GVCs, property (including intellectual property) rights protection and policy certainty. It should also take into account new opportunities associated with digitalisation.

In implementing industrial policies, different countries and regions have produced very mixed results. For example, East Asian countries' industrialisation efforts have largely produced positive results, while African countries' efforts have generally been disappointing. Ill-conceived industrial policies have been partly to blame. As explained by Rodrik (2018), African policymakers have often blamed financial constraints for not adopting a more rigorous approach to industrialisation – evidenced, for example, in the BRICS New Development Bank's mandate to engage mainly in short-term financial intermediation. This, however, signals a misunderstanding of the complex and long-term nature of economic development (Rodrik 2018). (BRICS refers to a group of informally linked trading partners with strategically important financial and trade links with African countries, namely Brazil, Russia, India, China and South Africa).

Newman et al. (2016) speak of the general short-sightedness and failure of top-down interventionist actions by governments aimed at inducing import substitution (or inward industrialisation). Special economic zones have had an uneven success record in different parts of the world, according to the World Bank (2020). East Asian countries such as China and South Korea used SEZs

as one of the pillars of their economic transition. In Africa, however, only Mauritius has used SEZs successfully to diversify beyond its concentrated sugar production into more digitally enhanced economic sectors (World Bank 2020).

In addition, African countries have often failed to leverage the opportunities arising from digitally driven industrialisation because they have been excessively preoccupied with labour-intensive growth and development strategies. However, in a world increasingly driven by digital technologies, the distinction between 'labour' and 'capital' has become blurred as new, digitally oriented occupations are increasingly characterised by their skills requirements rather than their labour or capital intensity (see also ch. 9).

2.4.3. Making the transition

Making the transition from low-productivity to higher-productivity, value-added economic activity is complex and costly. As a result, many African countries are locked into low points in the value chain, producing raw materials for export, with limited industrial activity or widespread economic benefit.

Diversification is particularly difficult in mining-dependent economies as, when mining stops being profitable, the mining companies invariably look elsewhere for opportunities rather than assume the risk and expense of diversifying into new, related industries. However, agro-processing, renewable energy, telecommunications and business support services are among the sectors in Africa that are receiving high levels of foreign direct investment (FDI) – a trend that is likely to continue given their digitalisation potential. In general, too, a thriving services sector is essential if African manufacturing businesses are to attract investment because it allows local sourcing of critical support services, such as transport and logistics, telecommunications and financial services (UNECA 2017).

African countries need to rethink their industrialisation efforts and industrial policy frameworks, while not overlooking a number

of priorities that could be classified as 'getting the basics right' (Newman et al. 2016).

2.4.3.1. Reliable and affordable electricity

The World Bank (2019b) draws attention to the fact that access to digital technologies in Africa – as the basis for a new-look industrialisation drive – is often hampered by electricity supply problems. In Sub-Saharan Africa, for example, only 43% of people on average have access to electricity, compared with the global average of 87%. Moreover, in the rural areas, the figure is only 25%. Among the constraints to electricity uptake are low household incomes and the high price of electricity.

According to the World Bank (2019b), the average price of electricity in Africa is more than double that in high-income countries. As African electricity-generating utilities are generally under financial stress, they tend to charge high prices, thus inhibiting consumption. Expensive and often unreliable electricity supply is a major deterrent to investment in Africa (particularly for infrastructure upgrades and expansion), which is critical for countries' industrial development and participation in GVCs (see also ch. 5).

In failing to supply affordable and reliable electricity across the continent, Africa missed the so-called 'first unbundling' period (Baldwin 2019) and continued to pursue protectionist industrial and trade policies as many other countries and regions embraced the concept of fragmented global production.

2.4.3.2. High-speed broadband connectivity

Many African countries have made significant strides in developing their mobile sectors. Yet high-speed broadband is required for efficient Internet access and e-commerce, and to collect and disseminate the big data needed for AI, cloud technology, the IoT and other applications.

The 'second unbundling' period (Baldwin 2016) – with ICT-related advances constituting a key driver – offers African

countries an excellent opportunity to ramp up their industrialisation efforts and play a more prominent role in global and regional value chains (see also ch. 1 and ch. 5). However, there is a risk that Africa could miss this opportunity by delaying the rollout of affordable and reliable broadband connectivity.

To date, African governments have been slow to license the required international mobile telecommunications spectrum for high-speed Internet connectivity (which would have the added benefit of bolstering the fiscus), and so global and regional value chain participation has suffered as a result. It has also made it difficult for countries and communities to adapt to the need for higher levels of online activity in the wake of COVID-19 and the changing (and more remote) nature of business, shopping and personal interactions. For the most part, 3G[15] still forms the basis of most African networks, with 4G still being relatively uncommon. In other parts of the world, 5G is showing rapid uptake.

More powerful broadband networks will also enable African countries to leverage the power of AI and cloud technology in different fields, including financial services, medical diagnostics and healthcare. Research conducted by the AfDB, OECD and United Nations Development Programme (UNDP) revealed that of all economic sectors in Africa, financial services had the highest share of value-added inputs from other African countries, which signals strong value-chain participation through backward integration (also see ch. 5) (AfDB, OECD & UNDP 2014). The regional importance of the financial services sector enhances Africa's potential as a financial services hub, although – as established by Gillwald and Mothobi (2019) – the realisation of this vision is dependent on there being an extensive regional presence of financial institutions.

Gillwald and Mothobi (2019) explain that communication networks, and particularly broadband, have positive spillover effects or economic externalities. These include higher productivity,

15. The 'G' refers to 'generation' and relates to a particular network standard, which controls data transmission speeds.

economic growth and job creation. Network externalities arise after a particular Internet coverage threshold has been reached. For broadband, this is 20% of the population (Gillwald & Mothobi 2019). A country like South Africa (with a 50%+ Internet penetration rate) is well placed to benefit broadly from these spillover effects. Interestingly, Internet access in Nigeria, South Africa and Lesotho is much higher than in Asian countries like India, Pakistan and Bangladesh (Gillwald & Mothobi 2019).

☐ 2.4.3.3. Investment in physical and ICT infrastructure

Transport and logistics are critical components of efficient production and distribution. Even where industrialisation is geared towards digitalisation and service delivery, it still relies on roads, ports and airports for the movement of inputs and outputs, as well as various forms of visible ICT infrastructure – all of which call for substantial and recurring investment. Industrialisation cannot thrive in a completely virtual world or a vacuum. Towards the end of 2019, the company ArcelorMittal SA closed its steel plant at Saldanha Bay on South Africa's west coast, citing a loss of international competitiveness in the face of excessive (government-regulated) prices for electricity, rail and port usage. This dealt a serious blow to the country's industrialisation drive, with negative ripple effects for the manufacturing sector as a whole (Stoddard 2019).

☐ 2.4.3.4. Human capital development and labour market reform

Throughout Africa, large gaps can be seen between education and training efforts and outcomes, on the one hand, and the skills required for well-functioning economies, on the other (see also ch. 9). Furthermore, wages are often too high given labour productivity measures. Rodrik (2018) speaks of a common phenomenon in Sub-Saharan African countries where educational standards and proficiency levels are declining, but expectations

of decent jobs or high wages, or both, are on the rise. This can lead to wage-related disputes and damaging work stoppages. In a study conducted by Gelb et al. (2017), a key finding was that wages paid by manufacturing firms in Africa are too high in relation to what economies are able to produce in terms of GDP per capita. Similarly, in a World Bank (2020) study, it was reported that in Ethiopia, Kenya, Senegal and Tanzania, the average annual labour cost per manufacturing worker was approximately double the value of GDP per capita output.

The World Bank (2017) asserts that competitive labour costs, measured in terms of average manufacturing wages as GDP per capita, are a far better measure of a country's competitive situation than simply how low its wages are. Industry sectors or companies may have low unit labour costs (making them good candidates for global value-chain participation) but not necessarily low wages. This means that their trade competitiveness is productivity-driven rather than wage-driven (thus echoing David Ricardo's theory of comparative advantage). African countries are often associated with rigid labour markets, such as South Africa's insider–outsider labour model[16] with its complicated hiring and disposal procedures. Rigid or dysfunctional labour markets disrupt production and trade by adding high labour costs (which cannot be compensated for in productivity terms at the firm level) to trade costs.

Chapter 9 explores how the 4IR is transforming the workplace and the knowledge and skills required for individuals to remain employable and also for companies to remain competitive in an increasingly online and technology-infused world. Building wide-ranging knowledge, skills and experience should be at the heart of

16. This describes a labour market that distinguishes between those with jobs and those without, where those with jobs have an inherent advantage over the unemployed or 'outsiders'. Where the labour market is rigid and highly regulated, as it is in South Africa, insiders develop highly protective positions that bar outsiders from being employed. A well-known technique for achieving this is by introducing complicated and expensive employment and dismissal procedures. Rigid labour markets inflate labour costs, encourage labour-market inefficiencies and result in high rates of unemployment (see Leslie 1993).

African countries' industrialisation drives in the digital era, aimed at narrowing the significant gaps between wages and productivity.

Closing the deep wealth, opportunity and development gaps that characterise many African countries may appear to be a practically impossible undertaking. Yet the digital era – with its disruptive character and acknowledged propensity to deprive people of their traditional livelihoods – has the potential, somewhat paradoxically, to provide the pathway towards economic activity that is more inclusive and sustainable.

2.4.4. The link between industrial policy and trade policy

There are different views on how industrial policy aligns with a county's trade policy. According to UNECA (2017), industrial policy should be a core objective of trade policy. Others see trade policy as subordinate to industrial policy. There is no hard-and-fast rule in this regard, but it is clear that a country's industrial policy needs to cater to the broad aims of economic growth and digital inclusion. Furthermore, industrial policy cannot be the preserve of one national department. Rather, it should be integrated across all pillars of government and refreshed from time to time as the external environment changes and the 4IR picks up speed. It also needs to constitute a key area of focus in regional and international trade agreements and public–private sector initiatives as conventional borders and restrictions to doing business continue to fall away.

The prospects of African countries experiencing trade-led growth and development will depend on how well they absorb digital technologies and apply them in their existing and evolving industrial environments. According to Sampath (2017), being trade-ready in the digital economy requires two types of capability: the first comprises routine skills, know-how and competencies that are essential for producing goods and services, and knowing how to effectively blend the two; the

second comprises more specialised knowledge, skills and technical expertise linked to 4IR applications. Thus, hybrid production systems will invariably be required (to retain jobs today while also looking to the workplace of tomorrow), although over time all industrialisation processes will face growing pressure to become digitalised (Sampath 2017).

The digital era is a shared, global phenomenon, which calls not only for international collaboration but also for multi-disciplinary and multi-stakeholder responses to ensure that the interests of all countries are catered for. In the digital economy, trade, development and privacy have become deeply intertwined (Sampath 2017). Yet in the absence of multilateral negotiations on e-commerce, there is the risk that decisions taken at the national level (especially those surrounding cross-border data flows) will impede the development of those sectors that rely on data flows. As a result, countries may look to bilateral and regional free trade agreements to guide their digital industrialisation efforts, which – while perhaps a good place to start – may not cover the full spectrum of global concerns about digitalisation, such as data privacy and consumer protection, encryption technology, electronic contracts, secure payment systems, cyber security and digital taxation.

Trade officials and their development partners need to strike a careful balance between pursuing public policy objectives without unnecessarily restricting trade, and ensuring that the cost-related advantages of digital applications benefit industry sectors, firms and individuals.

2.5. Conclusion

It is evident that, while Africa has experienced a mobile revolution in recent years, it has not felt the full force of the 4IR, which – unless planned for and embraced – will ultimately be to the continent's detriment in the years to come. Committed action needs to be taken to narrow the deep economic and digital divide that robs so many people of the opportunity to get ahead – particularly the youth who often have an ample supply of good

ideas, talent, stamina and hope. While the digital age is pulling more and more countries into the future, Africa is to some extent still chained to its past, with unresolved problems of poor or out-of-touch education systems, weak infrastructure, high levels of poverty and unemployment, and a dubious policy implementation record. Pockets of technological excellence certainly exist, which should be harnessed, but they need to be scaled up if they are to make a significant difference to most African societies.

Although some believe that Africa can escape many of its problems by leapfrogging away from them into a more rosy-looking future, countries still need to follow a rigorous industrialisation path, which means ensuring that the essential building blocks are (and always will be) in place. The need for reliable and affordable energy and Internet connectivity, for example, is a common refrain in the African context and will continue to be heard until these problems are decisively addressed. Moreover, industrialisation depends on moving from low-productivity to higher-productivity economic activities, together with the innovative blending of tangible and intangible elements. While access to technology is important, how one uses it and turns it into a competitive advantage is crucial for a successful industrialisation project. For this, new mindsets and skill sets are required.

Industrial policy is sometimes mistaken for what goes on at the domestic level, while trade policy is concerned with export and import activities. Yet, the two are inextricably linked, each providing the rationale for and support to the other in a symbiotic, albeit complex, relationship. When a digital dimension is thrown into the mix, things become even more complicated. That is why Africa's digital future must be a shared one.

2.6. Key takeaways from this chapter

- Africa has been slow to embrace digital technologies, and this has hampered industrialisation efforts on the continent. The fact that Africa has seen unprecedented growth in its mobile

penetration rates and is considered a global leader in the mobile money arena are encouraging signs. Yet to be digitally responsive, Africa needs to have the right policies and regulations in place, along with appropriate technologies and skills.

- There are many stories of African digital start-ups having become profitable companies with extensive market reach. However, such innovative endeavours are far from evenly spread across the continent. In many African countries, only a small proportion of the population has access to the Internet and there is a pronounced 'digital divide'. Contributing factors include inadequate ICT infrastructure and expensive connectivity (often the product of a poor policy environment) as well as generally low educational standards and widespread poverty. The impact of COVID-19 has proved to be an additional burden.
- While the concept of 'leapfrogging' has many proponents, it should not be seen as a panacea for Africa's development failures. In other words, leapfrogging should not be viewed as an opportunity for a country to simply skip a critical phase in its development, such as attempting to transition from subsistence farming directly to high-level service delivery in a field like fintech. Leapfrogging is more about using technology to gain a competitive advantage in specific, high-opportunity sectors, with government support.
- Industrialisation is the process of moving an economy from a low-productivity, factor-driven stage to a more efficient, innovative stage. In Africa, most economies are still at the former stage, and so countries' industrialisation efforts should be geared towards making the transition from commodity dependency to more knowledge-driven, value-added economic activity.
- With its emphasis on productivity improvement and cost-cutting, an industrialisation strategy can inadvertently deprive some people of their livelihoods. The challenge for policymakers is promoting productivity and value addition while also

improving people's employment prospects – especially through education and (re)training.

- There is no single industrialisation formula; each African country needs to adopt an optimal approach, which could be a hybrid of low- and higher-level manufacturing, service delivery and advanced digital adoption. Moreover, industrial policy needs to go hand in hand with trade policy – particularly as, in the digital era, much cross-border activity is virtual.
- A digitally powered industrialisation strategy will not succeed unless countries have the right foundation stones in place. In the African context, these include reliable and affordable electricity, high-speed broadband connectivity, efficient physical and ICT infrastructure, and an educated and productive workforce.

Chapter 3

Can digital trade promote greater employment? Empirical evidence from Sub-Saharan Africa

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3.1. Introduction

Unemployment is a major problem in Africa. Youth unemployment, for example, is sitting very uncomfortably at 60% and as many as 70% of African workers constitute the 'working poor' (Marwala 2020). These statistics paint a grim picture of the dilemma that Africa finds itself in and the fact that it faces the dual challenge of addressing both the quantity and quality of jobs on the continent. Digital advances are unleashing new economic opportunities in many parts of the world and could offer welcome relief to Africa in the face of its unemployment (and underemployment) crisis. However, the African job market is dominated by basic occupations as well as more skilled work in the agricultural, forestry and fisheries sectors, which together are projected to account for 57% of employment on the continent by 2023 (ILO 2019a). The question that must then be asked is: to what extent will the unskilled or manual workforce in Africa benefit from digital advances in general and digital trade in particular?

The employment effect of trade in goods and services is fairly well established in the literature, although the conclusions drawn from different studies have been mixed (Bella & Quintieri 2000; Hoekman & Winters 2005; Márquez 1998). Some attempts have been made to quantify the employment effect of electronic commerce (e-commerce), but the focus so far has largely been on developed countries (Biagi & Falk 2017; Terzi 2011). Other studies have provided evidence of the employment effect of access to ICT in both developed and developing countries (Goaied & Sassi 2019; Ju 2014; Mbiti & Weil 2015). However, academic and policy-related research on the effect of digital trade[17] on employment quantity (job numbers) and quality,

17. Whether or not e-commerce should be included in the definition of digital trade has been the subject of some debate. Benson (2019) describes e-commerce as 'physical goods bought via digital platforms that are then shipped/transported overseas and customs-cleared into foreign markets, and digital trade as the transfer of data, products or services by electronic means – usually through the internet'. Lopez Gonzalez and Jouanjean (2017) assert that

especially in developing countries, remains limited, largely because little empirical and internationally comparable information currently exists (Fayyaz 2018).

Drawing on the Post-Keynesian theory of structural change, this chapter contributes to addressing this gap – albeit from a Sub-Saharan African perspective. Proponents of the structural change theory postulate that for both domestic and foreign demand to increase, technological innovation is needed to produce new products that will eventually lead to the creation of new economic activities, while some existing jobs will be sacrificed. Which jobs fall away will depend on the country's sectoral/economic structure and the types of innovations introduced (Pianta 2018).

The relationship between employment and digital trade is complex and dependent on institutional, structural and other regional or country-specific factors (Terzi 2011). In developing countries, the rapid development of digital technologies presents both opportunities and challenges in terms of employment. There has been a growing sense of optimism over how developing countries could use digital advances as a lever to lift millions of people out of poverty, create sustainable livelihoods and promote economic inclusion for all (OECD 2018).

Digital developments have the potential to propel developing countries into new, fast-growing sectors that will enable them to

(footnote 17 continues ...)
digital trade refers not only to digitally delivered products and services but also to increased trade in traditional goods and services through greater digital connectivity. The OECD, WTO and IMF's *Handbook on measuring digital trade* (2020:11) distinguishes between digitally ordered trade (which is identical to the OECD's definition of e-commerce) and digitally delivered trade. While 'digitally ordered trade' is defined as 'the international sale or purchase of a good or a service, conducted over computer networks by methods specifically designed for the purpose of receiving or placing orders', 'digitally delivered trade' is defined as 'the international transactions that are performed remotely in an electronic format, using computer networks specifically designed for that purpose' (OECD, WTO & IMF 2020:11). For instance, if someone orders a book on eBay or Amazon, uses an Uber service while travelling internationally or makes a booking through Airbnb for accommodation in another country, they would be engaging in digital trade. On the basis of the above, this chapter (and the book as a whole) has adopted the stance that e-commerce is a part of digital trade.

catch up with more advanced economies (ILO 2018a). For instance, a study on digitalisation of three economic sectors (library services, security and entertainment) in African countries found that it is at least feasible to anticipate that the digital economy will have an effect on employment in the entertainment sector of Nigeria and the Democratic Republic of Congo (Bellucci & Otenyo 2019). However, it is important (especially in an African context) for all sectors to embrace the digital economy if countries are to realise sustainable economic growth (see Gillwald, Mothobi & Rademan 2018).

Despite rapid advances in digital technologies, the broader developmental benefits from using these technologies have been slower to manifest in developing countries than in developed countries (World Bank 2019a). In the labour market, concerns have been expressed about the potentially negative repercussions of increased digitalisation and automation for both the quality and quantity of jobs. For example, new types of jobs and fields of employment are transforming the nature and conditions of work by changing skills requirements and displacing traditional patterns of production and sources of income (ILO 2018a). Widespread digital advances in the form of automation/robotics, AI, the IoT and 3D printing threaten the quantity and quality of jobs, which are critical measures of the extent to which economic growth can be translated into inclusive and sustainable development (Parry et al. 2021; Wisskirchen et al. 2017).

While estimates of the extent to which digitalisation could disrupt global labour markets vary widely, from less than 10% to more than 60% of all jobs, evidence suggests that by 2030, no less than one-third of the constituent activities of 60% of occupations could be automated. Although this impact may differ across countries, the full-time equivalent of work potentially being displaced by automation is estimated at around 15%. This would mean that between 3% and 14% of the global workforce would have to switch occupational categories (move to newly created jobs) (ILO 2018a).

As policymakers in (mostly) developing countries contemplate how to effectively manage this transition, the COVID-19 pandemic has added another layer of complexity to an already challenging process. The spread of the disease and the phased national lockdown strategies have brought huge economic disruption, losses and uncertainty to countries and communities all over the world. Initial estimates suggested a significant rise in unemployment, underemployment and working poverty in the wake of COVID-19. Owing to a substantial decline in economic activity and restrictions on people's movements, the global unemployment figure in 2020 was expected to rise by between 5.3 million and 24.7 million (although this estimate is probably conservative), from a base level of 188 million in 2019 (ILO 2020). The economic impact of COVID-19 is being felt most acutely by poor and economically vulnerable people whose survival is often dependent on their daily participation in some form of economic activity (OECD 2020a).

In Africa, 2018 estimates indicate that approximately 33% (almost one-third) of all workers are living in extreme poverty.[18] This represents more than half (56%) of the world's working poor (ILO 2019c). On a continent where there is a high level of informality and workers have low levels of social protection, COVID-19 will have both short- and long-term effects on labour-market outcomes and income distribution (ILO 2019b). In the short term, travel bans, border closures and quarantine measures – which have affected many workers' movements to and from their places of work and their ability to perform their jobs – are having knock-on effects on incomes, particularly among informal and casual workers (ILO 2020). In the long term, companies' increased adaptation to online work will precipitate the occupational transition earlier than policymakers originally anticipated. This will widen the employment and livelihood gap between the digitally literate and illiterate.

18. The extreme poor are defined as 'those individuals earning less than US$1.25 a day' (De La O Campos et al. 2018:3).

This chapter adds to the literature by assessing the association between selected digital trade indicators (ICT goods[19] as a share of total merchandise trade and digitally delivered services as a share of total services trade) and employment indicators (employment as a share of total population, vulnerable employment as a share of total employment[20] and working poverty as a share of total employment[21]), using panel data for 24 Sub-Saharan African countries. The specific objective of this chapter is to explore the differential employment (quantity and quality) effect of the trade in ICT goods and services in the region. For the analysis, the effect of digital trade on sectoral-level employment is disaggregated to account for sector-specific characteristics that affect employment in the countries being studied.

In the current era, when trade practitioners are grappling with the complexities of determining the impact of digital transformation on economic activity and trade, this chapter is particularly relevant and timely. It also resonates with UN SDG8.[22]

19. According to the OECD (2020b:n.p.), ICT goods can be defined as 'products intended to fulfil the function of information processing and communication by electronic means, including transmission and display, or the use of electronic processing to detect, measure and record physical phenomena or to control a physical process'. This indicator is measured in US dollars (millions). More information can be accessed at: https://data.oecd.org/ict/ict-goods-exports.htm

20. Vulnerable employment is the 'sum of own-account workers and contributing family workers' (in a self-employed capacity) (ILO 2010:18). Vulnerable employees are 'less likely to be involved in formal work arrangements and are more likely to lack adequate social security and a "voice" through effective representation by trade unions and similar bodies' (ILO 2010:18). They are also 'often faced with inadequate earnings and difficult working conditions, which undermine workers' fundamental rights, and are typically associated with low productivity' (ILO 2010:18).

21. The working poor refer to those who, while employed, fall under the recognised poverty threshold (ILO 2020).

22. Sustainable Development Goal 8 is to realise inclusive and sustainable economic growth, full and productive employment, and decent work for all women and men by 2030 (UN 2020).

3.2. Data and measurement of variables

Currently, there is no single, accepted definition of digital trade in the literature. However, there is a growing consensus that digital trade comprises all trade that is digitally ordered and digitally delivered. It also involves consumers, firms and governments (Lopez González & Jouanjean 2017). In the analysis presented in this chapter, two indicators were used as proxies for digital trade: (1) the international trade in ICT[23] goods as a percentage or share of total merchandise trade, and (2) the international trade in digitally delivered services as a percentage or share of total services trade. The choice of these two indicators as proxies was based on the OECD's typology of digital trade which considers the mode of delivery (physically or digitally delivered), the object of the flow or transaction (goods or services) and the actors involved (Lopez González & Jouanjean 2017). Data on these two indicators were extracted from the UNCTADSTAT database for the period 2005–2017. However, for some of the countries in the analysis, information for the year 2017 was unavailable, and therefore omitted.

The employment indicators ([formal] employment as a share of total population, vulnerable employment as a share of total employment, working poverty as a share of total employment and industry sectors as shares of total employment) and the other explanatory variables were obtained from the World Development Indicators (WDI) of the World Bank (2020). Aside from working poverty, the scope of data available for the rest of the variables was higher than in the 2005–2016 period. Nevertheless, the analysis was restricted to the period 2005–2016 to ensure consistent observation of all the variables included in the analysis.

23. More information on the constituents, classification and method of computing ICT goods as a share of total merchandise trade and digitally delivered services as a share of total services trade, respectively, can be found in UNCTAD (2018) and UNCTAD (2015).

The World Bank measures the employment-to-population ratio as the proportion of a country's population who are employed. Employment was captured as (Pietschmann et al. 2016):

> [*P*]ersons of working age who, during a short reference period, were engaged in any activity to produce goods or provide services for pay or profit, whether at work during the reference period (that is, they worked in a job for at least one hour) or not at work due to a temporary absence from the job or other, applicable working-time arrangements. (p. 13)

Similar to the employment-to-population ratio, vulnerable employment is measured as the number of individuals who are own-account workers and contributing family workers as a percentage of total employment (World Bank 2017, 2020). According to the ILO, persons engaged in vulnerable employment are more likely to be involved in informal work, and less likely to have social security coverage or to benefit from social negotiation (ILO 2018b). The data on working poverty were obtained from the Human Development Index (HDI) database of the UNDP for the period 2010–2017. Working poverty is measured as the percentage of the employed population aged 15 years and older, with purchasing power parity (PPP) of US$3.20 used as the basis (UNDP 2015).

Apart from these variables of interest, other explanatory variables that were included in the analysis were government expenditure, inflation, the share of urban population to total population, FDI net inflows, the human capital index (used as a proxy for education), and expenditure on water and electricity infrastructure.[24] Data on water and electricity infrastructure were

24. This was an instrumental variable analysis, implying that digital trade indicators were not entirely predetermined (exogenous) and were influenced by other factors as well. This was accounted for in the analysis. ICT infrastructure, for example, was used as an instrument to moderate the potential exogenous relationship between the digital trade and employment indicators. Detailed explanations of the measurement of each of these variables can be accessed from the WDI website of the World Bank at: https://databank.worldbank.org/source/world-development-indicators.

TABLE 3.1: List of variables included in the analysis.

Variable	Obs. (*N*)	Mean	Std Dev.	Min.	Max.
Employment	288	65.8	13.4	38.5	87.8
Lagged employment	264	65.7	13.7	38.5	87.8
Agricultural sector employment	264	53.7	23.9	4.6	91.8
Lagged agricultural sector employment	288	52.2	24.2	4.6	91.8
Industry sector employment	264	12.0	7.0	2.4	32.5
Lagged industry sector employment	264	12.4	7.1	2.4	32.5
Services sector employment	288	34.3	18.2	5.6	71.9
Lagged service sector employment	264	35.4	18.5	5.6	71.9
Vulnerable employment	288	67.1	25.3	8.8	93.3
Lagged vulnerable employment	264	66.6	25.7	8.8	93.3
Working poor	175	57.6	25.1	0.7	91.1
Lagged working poor	168	58.1	25.5	0.7	91.1
ICT goods as a share of total merchandise trade	288	4.5	3.3	1.0	23.6
Digitally delivered services as a share of total services trade	288	50.6	22.3	0.0	130.4
General government expenditure	288	14.9	4.6	4.5	26.5
Inflation (CPI)	288	7.5	6.2	–2.2	44.4
Infrastructure expenditure (water and electricity)	288	14.8	12.2	–1.3	66.1
Human capital index	288	99.1	33.8	0.0	149.3
Urban population as a share of total population	288	37.1	16.0	9.4	71.1
FDI net inflows	288	4.4	5.7	–1.0	42.1

Source: Authors' computation based on data from UNCTAD (2020) and the World Bank (2020).
CPI, consumer price index; FDI, foreign direct investment; ICT, information and communication technology.

obtained from the Africa Infrastructure Development Index database of the AfDB. Table 3.1 provides the descriptive statistics of all the variables included in the analysis.

3.3. Methodology

The choice of estimation technique to assess the determinants of employment varies across studies, with each technique having its

own downsides. While some studies have relied on the feasible generalized least squares (FGLS) (Anyanwu 2013; Anyanwu & Augustine 2013; Choudhry, Marelli & Signorelli 2012; Eastin & Prakash 2013; Tseloni, Tsoukis & Emmanouilides 2011), others have used the pooled ordinary least squares (OLS), fixed-effect and random-effect regressions (Pattanaik & Nayak 2014). Yet other studies have used the dynamic panel estimation technique (Demidova & Signorelli 2012; Pastore & Giuliani 2015). For instance, the FGLS controls for panel autocorrelation, heteroscedasticity and non-stationarity of the series (Stock & Watson 2003).

However, it was not possible to address the potential endogeneity, which may be the result of the correlation between the lagged variables and the individual effects. None of those estimation techniques is able to address any biases because of the high persistence effect of the dependent variable (Demidova & Signorelli 2012). In addition, the panel data used for the analysis had small time dimensions (T) and large country dimensions (N). Taking all these factors into consideration, the dynamic panel regression was used in this study to address the chapter's objective. Following Cameron and Trivedi (2010), the model is specified as Equation 1:

$$\text{EMP}_{it} = \alpha_0 + \alpha_1 \text{EMP}_{it-1} + \alpha_2 X_{it} + \alpha_3 \gamma_{it} + \epsilon_t \qquad \text{[Eqn 1]}$$

In Equation 1, EMP_t represents the dependent variables (employment, vulnerable employment and working poverty) which are the dependent variables of interest. In the same vein, EMP_{it-1} captures the lags of the dependent variables and addresses the presence of autocorrelation between their current and previous values. The variable X_{it} represents the two digital trade indicators (ICT goods as a share of total merchandise trade and digitally delivered services as a share of total services trade), while γ_{it} is the vector of other correlates. The parameter α_0 is the constant term, which represents employment in the absence of any explanatory variables; α_1 and α_2 are the coefficients of the lagged explanatory variables of interest, while the variable γ_{it} is a vector of the other correlates of employment, vulnerable employment and working poverty. The parameter α_3 is the vector

of the coefficients of the other correlates. Respectively, the subscripts $i.....N$, $t.....T$ and $t-1$ represent the individual countries, time dimensions and time lags of the dependent variables, which reflect the country fixed effects contained in the error term in Equation 1. That error term, which is specified as Equation 2, is made up of both the unobserved country-specific effects, φ_i and the observation-specific errors, δ_i.

$$\epsilon_{it} = \varphi_i + \delta_{it} \qquad \text{[Eqn 2]}$$

In addressing the potential endogeneity in this analysis, the Arellano and Bond (1991) two-step generalized method of moments (GMM) was applied. The lags of the potential endogenous regressors (ICT goods as a share of total merchandise trade and digitally delivered services as a share of total services trade) were used as instruments. In addition, because some studies have concluded that ICT infrastructure is a requirement for improved digital trade (Abeliansky & Hilbert 2017; Freund & Weinhold 2002; Mattes, Meinen & Pavel 2012), this variable was also included as an instrument of digital trade. The rationale for including the ICT infrastructure variable is that it is an enabler or a means through which digital trade influences the employment indicators.

Following Mileva (2007), the problem of the country-specific fixed effects was addressed (removed), using the first differences to transform Equations 1 and 2 into Equations 3 and 4:

$$\Delta \text{EMP}_{it} = \alpha_i \Delta \text{EMP}_{it-1} + \alpha_2 \Delta X_{it} + \alpha_3 \Delta \gamma_{it} + \Delta \epsilon_{it} \qquad \text{[Eqn 3]}$$

$$\epsilon_{it} - \epsilon_{it-1} = (\varphi_i - \varphi_i) + (\delta_{it} - \delta_{it-1}) = \delta_{it} - \delta_{it-1} = \Delta \epsilon_{it} \qquad \text{[Eqn 4]}$$

The empirical estimation equation can be derived from Equation 3 as Equation 5:

$$\text{EMP}_{it} = \beta_0 + \beta_1 \text{EMP}_{t-1} + \beta_2 \text{DT}_{2t} + \beta_3 \text{GE}_{3t} + \beta_4 \text{INf}_{4t} + \beta_5 \text{HC}_{5t} + \beta_6 \text{Urbpop}_{6t} + \beta_7 \text{FDI}_{7t} + \beta_8 \text{Infras}_{8t} + \mu_{it} \qquad \text{[Eqn 5]}$$

The quality (vulnerable employment and working poverty) and quantity of employment are largely dependent on country-, regional-, household- and individual-level characteristics. However, this study focused on macro or national-level indicators to allow for cross-country analysis and comparison. In Equation 5, EMP_{t-1} is the

lag of the dependent variables (employment as a share of total population, and vulnerable employment and working poverty as shares of total employment), while the key policy variables of interest (ICT goods as a share of total merchandise trade and digitally delivered services as a share of total services trade) are represented by DT_t. The other correlates are government expenditure (GE), inflation (Inf), level of education (proxied by the human capital index) (HC), net of FDI inflows (FDI) and water and electricity infrastructure (Infras). Studies using the dynamic panel approach have observed that previous values for employment have a significantly positive effect on current levels of employment. In view of this observation, the lags of the dependent variables in this study are expected to have positive effects on their current values.

As mentioned earlier in this chapter, the employment effect of digital developments and digital trade remain both empirically and theoretically uncertain. The extent and nature of the effect depend on several factors at the individual and country levels. However, in this analysis, digital trade is expected to increase employment as a share of total population and reduce vulnerable employment and working poverty.

Government expenditure, inflation, level of education, net of FDI inflows and expenditure on infrastructure are included in the model because of their impact on employment. Theoretically, the relationship between government expenditure and employment is uncertain and dependent on the transmission mechanism of policy actions (Anyanwu 2013). While the real business cycle (RBC) model suggests that increased government consumption expenditure contributes to a reduction in wealth and consumption and an increase in labour supply (Bouakez & Rebei 2007), the New Keynesian models posit that there is some degree of stickiness in the effect of government expenditure on the economy because of a lag adjustment between wages and prices (Moloi & Marwala 2020).

In Africa, government consumption expenditure has mostly been characterised 'by waste, corruption and crowding out of

resources for public-sector investment and employment creation' (Anyanwu 2013:124). In the present study's analysis, an increase in government expenditure is expected to contribute to employment. However, its effect on the quality of employment (vulnerable employment and working poverty) remains uncertain.

Like government expenditure, inflation is viewed – both theoretically and empirically – as having an uncertain effect on employment (Anyanwu 2013). In the neo-Keynesian model of the macro economy, which is based on the Phillips curve, inflation and unemployment are inversely related in the short term, but there is no trade-off between the two phenomena in the long term. On the contrary, the New Classical (pre-Keynesian) School, which is associated with rational expectations of prices, suggests that, in the long term, efforts to lower unemployment only raise inflation (Ferreira & Palma 2015). In the present study's analysis, inflation is expected to have a negative effect on employment because of its negative effect on production inputs (labour) and the resulting implications for the costs of investment.

In the same vein, the human capital theory suggests that education involving formal tuition at higher education institutions improves individuals' productivity as well as their employment prospects (Van der Merwe 2010). There is evidence of high youth and graduate unemployment rates in Africa and other developing countries because of perceived quality problems at many educational institutions and employers' dissatisfaction with the skills and personal qualities of graduates (McCowan, Reilly & Steven 2014). However, the net effect has been positive (Anyanwu 2013; Ogawa & Akter 2007). In the present analysis, therefore, education is expected to boost employment and reduce vulnerable employment and working poverty.

In addition, the population growth rate can affect the employment rate, depending on the population structure (shares of young and old people, respectively), density and migration flows. The UNDP's *Human development report 2015* emphasises that between 2010 and 2030, demographic changes will remain

the key drivers in the global quest to provide decent employment – particularly in low-income countries where population growth rates exceed the global average and a culture of decent work has not taken root (Bloom & McKenna 2015).

It is intuitive to expect a positive association between the share of urban population (to total population) and access to labour markets and formal employment opportunities, owing to agglomeration effects. However, evidence suggests that urban residents face a spatial mismatch (costs and barriers linked to the distance between people's places of residence and places of work), which usually leads to higher costs when searching for work, labour-market frictions (the extent of worker–employer mismatches) and higher commuting costs. These factors negatively affect people's job opportunities and discourage employment (Sanchez-Reaza, Grover & Lord 2016). Considering that many other factors affect employment in urban areas, the present analysis is expected to show that a larger share of urban population is associated with an increase in employment and a decrease in vulnerable employment and working poverty in the countries being studied.

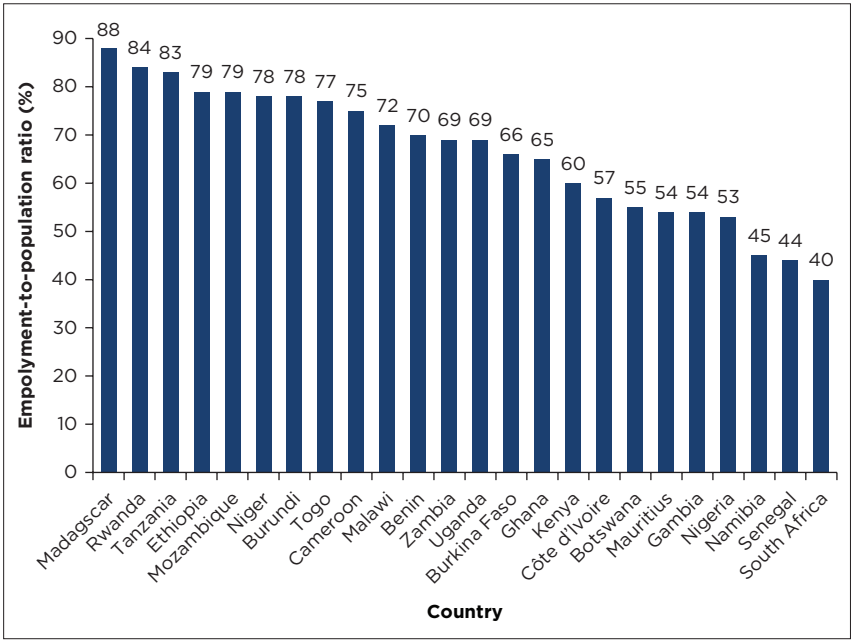
Incoming FDI is just as important for employment creation as efforts to control corruption, inflation and government expenditure. Foreign direct investment serves as a source of capital to complement domestic private investment, stimulate employment creation, enhance technology transfer and generally boost economic growth (Bekhet 2013; Hisarciklilar, Gultekin-Karakas & Asici 2014; Jenkins 2006). The present analysis is therefore expected to show that FDI inflows are associated with an increase in employment and a decrease in vulnerable employment and working poverty in the countries being studied.

Empirical evidence points to the fact that improved infrastructure, such as more efficient electricity and water systems, promotes employment – particularly in the rural areas and among women (Gibson & Olivia 2010; Ianchovichina et al. 2012). For instance, it is argued that electrification in households improves employment opportunities by releasing women from home-based production and encouraging the creation of more microenterprises

(Dinkelman 2011). On the basis of these observations, the present analysis is expected to show that infrastructure development is associated with an increase in employment and a decrease in vulnerable employment and working poverty. As mentioned earlier in this chapter, employment was further analysed at the sectoral level to identify the sector-specific differences and dynamics that may influence the effect of increased digital trade.

3.4. Results and discussion

This section starts with a brief description of the distribution of employment, vulnerable employment, working poor, share of ICT goods (in total merchandise trade) and share of digitally delivered services (in total services trade), which were the variables of interest in the analysis. It is striking to observe from Figure 3.1

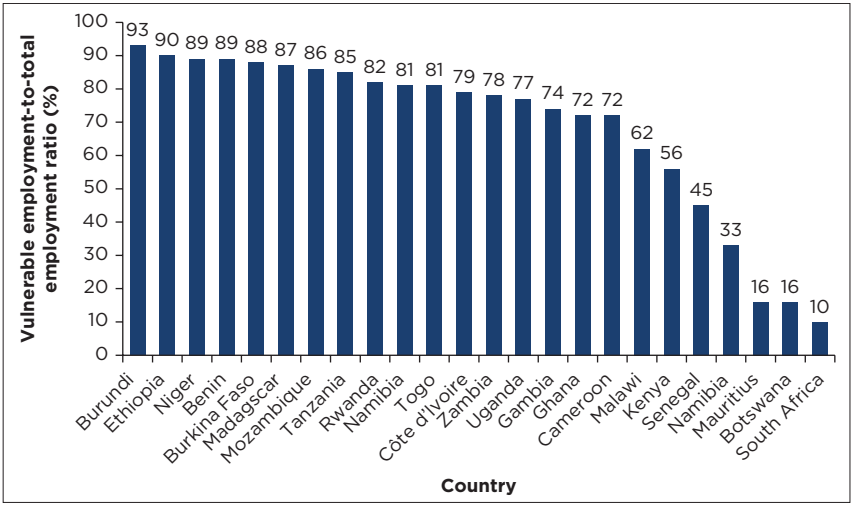


Source: Authors' computation based on data from the World Bank (2020).

FIGURE 3.1: Employment-to-population ratio by country.

that, compared with Madagascar, Rwanda, Tanzania and Ethiopia, the two leading economies on the African continent – South Africa and Nigeria – have among the lowest employment-to-population ratios. Of course, it is not only about the quantity of employment; the quality of employment is also important. Notwithstanding this, one would expect these two countries to perform better. However, this distribution needs to be interpreted with care because the employment indicator used in the analysis is the ratio of employment-to-population. As a relative indicator, countries that have larger populations might perform poorly, but in absolute terms their workforces might be bigger.

One interesting result appearing in Figure 3.2 is that the countries with higher employment-to-population ratios (Madagascar, Ethiopia, Niger, Tanzania, Mozambique, Rwanda and Burundi) also have a higher level of vulnerable employment as a share of total employment. In addition, the rate of vulnerable employment is very low in several southern African countries



Source: Authors' computation based on data from the World Bank (2020).

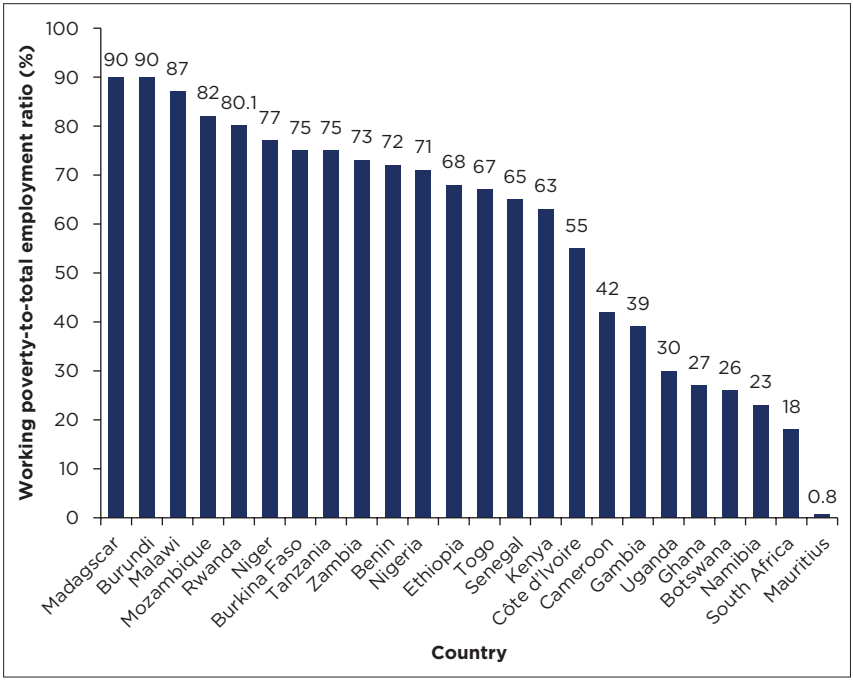
FIGURE 3.2: Vulnerable employment-to-total employment ratio by country.

(Namibia, Mauritius, Botswana and South Africa) where the employment-to-population ratio is also low. This highlights another dilemma that African policymakers need to confront: the widening gap between the population growth rate and the employment rate.

This prompts two important questions. Firstly, should policymakers in Africa aim to keep the population employed, regardless of the quality of the jobs, or should they take the time to create decent jobs? On a continent where the majority of countries have young populations and an available labour force that outstrips the rate of employment generation, one could argue that quantity (rather than quality) should be given first priority. Secondly, what initiatives can Africa implement to try and close the gap between population growth and employment? Any policy introduced to confront this issue should focus not only on job creation but also on how to create more jobs continually – jobs that will keep pace with the demands of a growing population.

Consistent with the vulnerable employment-to-total employment ratio in Figure 3.2, Figure 3.3 reveals that the majority of countries that have a high employment-to-population ratio also have a high working poor-to-total employment ratio. This is an important observation because statistics show that vulnerable employment remains pervasive in Africa in general and in Sub-Saharan Africa in particular. The ILO estimates that, compared with the global average of 46.3%, vulnerable employment in Sub-Saharan Africa constitutes almost 70% of total employment. In North Africa, over one-third of employed people are in vulnerable employment (ILO 2016).

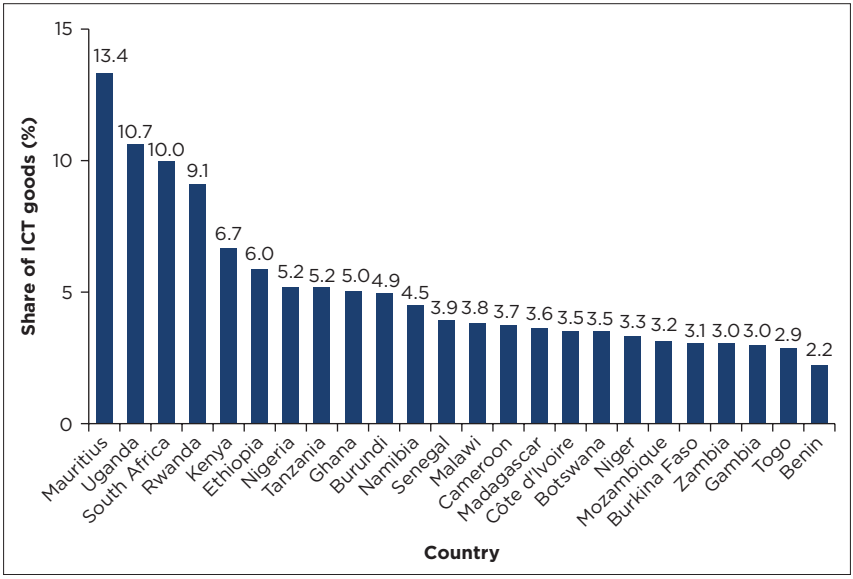
The above results are in line with the World Bank's assertion that the problem for most poor people in developing countries is not a lack of jobs or too few hours of work, especially as many people hold down more than one job and work long hours. The real problem is that they often do not earn enough to secure a better future for themselves and their families. An important consideration then is how African policymakers can bring about



Source: Authors' computation based on data from the World Bank (2020).
FIGURE 3.3: Working poverty-to-total employment ratio by country.

a reduction in vulnerable employment, which would include removing the obstacles that are currently impeding such a process.

Since this chapter aims to assess the relationship between digital trade and employment indicators, Figure 3.4 presents countries' share of ICT goods in total merchandise trade. The results show that three countries (Mauritius, South Africa and Uganda) have a higher share of ICT goods in total merchandise trade compared with the other countries. This is to be expected because these three countries also have a higher share of their populations using the Internet, with research having shown that the efficient use of ICT goods with high-speed Internet stimulates trade (Xing 2018). Four East African countries (Tanzania, Rwanda,



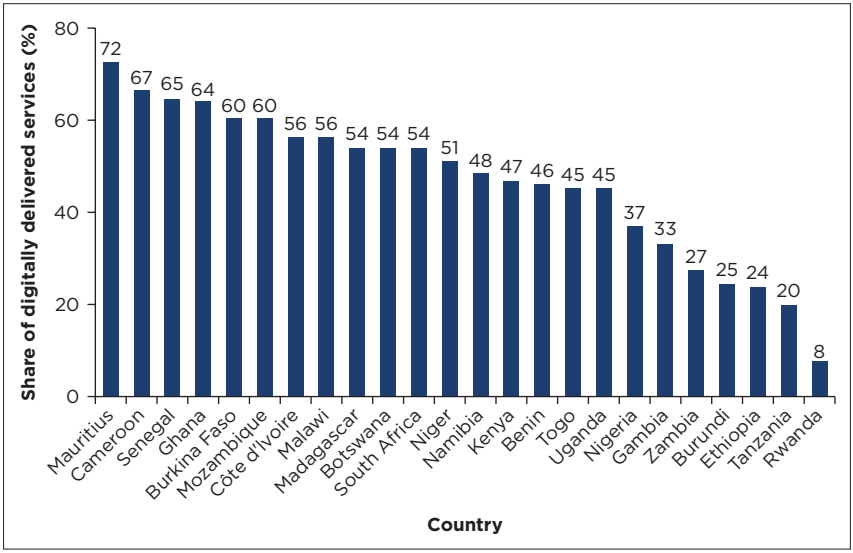
Source: Authors' computation based on data from UNCTAD (2020).
ICT, information and communication technology.

FIGURE 3.4: Share of ICT goods in total merchandise trade by country.

Kenya and Ethiopia) also perform well in terms of their share of ICT goods in total merchandise trade.

Information and communication technology goods as a share of total merchandise trade may either have a positive or a negative effect on employment, depending on various factors, including whether or not they will be used for personal or business purposes, the value that they deliver and the quality of the human resources performing the tasks in question. In essence, it depends on the countries' net trade balance in these goods and their ability to add value to make the goods more useful to other sectors of their economies.

Intuitively, one would expect the share of digitally delivered services (in total services trade) to be high in countries that have a higher share of ICT goods (in total merchandise trade) because these countries often have high ICT and Internet usage.



Source: Authors' computation based on data from UNCTAD (2020).

FIGURE 3.5: Share of digitally delivered services in total services trade by country.

Choi (2010), for instance, shows that a doubling of Internet usage in countries resulted in a 2%–4% increase in services trade. Bekkers et al. (2021) project that, in the period 2021–2030, global trade and developing countries' trade will grow by an average of 2% and 2.5% percentage points per year, respectively, as a result of digital developments. Furthermore, services exports are expected to account for a greater share (more than 25%) of global trade, while the share of services imports in (gross) manufacturing outputs will rise.

However, the results from the present study (Figure 3.5) seem to paint a different picture. Countries such as Senegal, Côte d'Ivoire, Cameroon, Malawi, Togo and Niger, which have a very small share of ICT goods in total merchandise trade, have a relatively higher share of digitally delivered services in total services trade. This means that factors other than just ICT goods and Internet access contribute to higher levels of digital service delivery. In the case of Senegal, for instance, the active involvement

of government and its various support and facilitation measures have been among the key success factors driving the country's digital services delivery (World Bank 2019b). As shown in Table 3A1 in the Appendix, the above-mentioned countries export more digitally delivered services than they import, compared with the other countries listed.

While the brief descriptive analysis provided above paints a general picture of the distribution of the digital trade and employment indicators across the countries being studied, the actual nature and extent of the association between the two remain uncertain. In view of this, a parametric analysis of the effect of digital trade on employment is presented in section 3.5.

3.5. Regression estimates

This section presents the econometric estimates of the employment, vulnerable employment and working poverty indicators, with a brief discussion of the post-estimation tests conducted to assess the reliability and robustness of the results.[25]

Regarding the digital trade indicators, the results (Table 3.2) indicate that an increase in ICT goods as a share of total merchandise trade is associated with an increase in employment

25. At the bottom of each table, the results of the autocorrelation and Sargan tests are presented. The insignificance of the *p* values for autocorrelation 2 (i.e. second order) validates the assumption of serially uncorrelated errors. Also, the *p* values of the Sargan test indicate that the instruments (ICT infrastructure and the lags of the dependent variables) are valid. It is also important to indicate that Model I and Model II in Table 3.2 represent models in which ICT goods as a share of total merchandise trade and digitally delivered services as a share of total services trade are the respective policy variables of interest. The regression estimates in Table 3.2 indicate that previous years' rates of employment, vulnerable employment and working poverty have significant, positive effects on current rates. This implies that the dependent variables are self-perpetuating or exhibit an element of autocorrelation in both the short term and long term. These observations, which are also consistent across the models for the three sectors (agriculture, manufacturing and services) of the economy (see Table 3.3 and Table 3A1 in the Appendix), can cause the estimates of the explanatory variables to be (upwardly or downwardly) biased, depending on their relationship with the other control variables.

TABLE 3.2: Estimates of employment, vulnerable employment and working poverty.

Dependent variable (Employment indicators)	Employment share		Vulnerable employment		Working poverty	
	Model I	Model II	Model I	Model II	Model I	Model II
Lagged employment	0.916***	0.926***	0.565***	0.591***	0.635***	0.556***
	(0.058)	(0.058)	(0.089)	(0.087)	(0.055)	(0.054)
Digital trade	0.104*	–0.072**	–0.004	0.131*	–0.619***	–0.062
	(0.055)	(0.028)	(0.139)	(0.069)	(0.144)	(0.078)
Logged government expenditure	0.138**	0.151**	0.685***	0.630***	1.581***	1.431***
	(0.068)	(0.067)	(0.141)	(0.133)	(0.154)	(0.153)
Inflation	0.085***	0.088***	0.209***	0.208***	0.338***	0.315***
	(0.025)	(0.025)	(0.064)	(0.063)	(0.064)	(0.065)
Human capital index	0.033	0.303*	–1.250**	–1.274***	–1.483***	–2.590***
	(0.202)	(0.161)	(0.495)	(0.383)	(0.488)	(0.419)
Share of urban population in total population	–0.190***	–0.172***	0.238*	0.125	–0.005	0.304*
	(0.057)	(0.058)	(0.134)	(0.141)	(0.159)	(0.157)
FDI net inflows	0.068***	0.076***	0.148**	0.136**	–0.313***	–0.247***
	(0.022)	(0.023)	(0.057)	(0.055)	(0.077)	(0.080)
Infrastructure	0.003***	0.004***	–0.003*	–0.004**	–0.005***	–0.007***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	205	205	214	214	126	126
Number of years	12	12	12	12	7	7
Arellano-Bond test for autocorrelation 1 (i.e. first order)	0.000	0.126	0.000	0.765	0.694	0.921
Arellano-Bond test for autocorrelation 2 (i.e. second order)	0.366	0.807	0.749	0.998	0.263	0.469
Test of over-identification restrictions	0.997	0.998	0.959	0.923	0.809	0.808

Source: Authors' computation based on data from UNCTAD (2020) and the World Bank (2020).
FDI, foreign direct investment.
Standard errors in parentheses: ***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$.

as a share of total population and a decrease in vulnerable employment and working poverty as shares of total employment, respectively. However, the inverse holds true for the estimates of digitally delivered services. In other words, an increase in digitally delivered services as a share of total services trade is associated with a decrease in employment as a share of total population and an increase in vulnerable employment.

At the conventional levels of statistical significance, an increase in ICT goods as a share of total merchandise trade is associated with an increase in employment as a share of total population of about 0.104% and a decrease in working poverty as a share of total employment of about 0.619%. However, an increase in digitally delivered services as a share of total services trade is associated with a decrease in employment as a share of total population of about 0.072% and an increase in vulnerable employment as a share of total employment of about 0.131%.

The results therefore suggest that the extent to which digital trade affects employment depends on the type of digital trade (ICT goods or services) and its link to sectoral, value-added activities. The digital trade indicators may influence employment through various mediums because they differ in nature and extent. By virtue of their definition, digitally delivered services, for instance, are final 'products' which may contribute less to value chains and employment than ICT goods which could serve as intermediate products for further production in the domestic economy.

Irrespective of the medium, the extent of the effect of digital trade on employment (quantity and quality) will also depend on other factors, such as domestic policies and infrastructure. Countries that have good ICT infrastructure and human resources who are skilled in ICT disciplines stand to gain more by adding value to imported ICT goods and eventually creating more jobs for their citizens than countries that rely heavily on imported, digitally delivered services which create jobs for the citizens of the exporting country. Although there have been extensive discussions on the effect of trade in ICT goods and services (as well as access to ICT) on employment (Bella & Quintieri 2000; Feliciano 2001), empirical assessments of the effect of digital trade remain limited in the literature. However, the results of studies that have been conducted provide evidence of both positive and negative effects arising from the ICT–employment nexus in Africa and developing countries in other parts of the world (Terzi 2011).

As with the trade in general goods and services, and e-commerce, the net employment effect of digital trade may not be uniform across countries, sectors/industries or skill groups. An increase in digital trade may stimulate direct employment in the ICT sector and indirect employment through increased demand and productivity. However, it may also cause the reallocation (shifts in employment) and destruction of jobs because of changes in businesses' modes of operations (Tarjáni 2017; Terzi 2011). These uncertainties make it difficult for policymakers to adopt specifically targeted labour-market policies relating to the digital economy (UNCTAD 2019).

In Table 3.3, it can be observed that an increase in both digital trade indicators is associated with a decrease in agricultural sector employment and an increase in industry and services sector employment. These results suggest an element of labour reallocation from the agricultural sector to the industry and services sectors, because of improvements in digital trade.

Caution needs to be exercised when situating these sectoral differences in the employment effect of digital trade within the context of the trade and employment literature because of the complexity of the mechanism and differences in the nature of the products and services involved. For instance, the extent of the effect of ICT goods as a share of total merchandise trade depends on whether they are final or intermediate goods and whether they are meant for personal or business use, which might further contribute to the digital economy. It also depends on the level of Internet connectivity, the quality of ICT-related infrastructure and the production structure of the economy (Freund & Weinhold 2002).

More importantly, the effects of both indicators should be discussed in relation to the components of the digital economy (core or foundational aspects, digital and information technology sectors, or a wider set of digitalising sectors)[26] in which they can

26. A detailed discussion of each of the components of the digital economy can be found in UNCTAD's *Digital economy report 2019*. The organisation classifies the core or foundational aspects of the digital economy as fundamental innovations (semi-conductors, processors), core technologies (computers, telecommunication devices) and enabling infrastructures (the Internet and telecommunication networks). The digital and information technology (IT)

TABLE 3.3: Estimates of sectoral-level employment.

Dependent variable (Sectoral employment)	Agriculture		Industry		Services	
	Model I	Model II	Model I	Model II	Model I	Model II
Lagged employment	1.051***	0.979***	–0.105**	0.191***	0.114**	0.133***
	(0.088)	(0.088)	(0.038)	(0.053)	(0.047)	(0.049)
Digital trade	–0.502***	–0.011	0.062	0.136***	0.189***	0.007
	(0.130)	(0.065)	(0.048)	(0.038)	(0.068)	(0.034)
Logged government expenditure	0.630***	0.547***	0.085	–0.093	–0.232***	–0.190***
	(0.130)	(0.130)	(0.092)	(0.070)	(0.065)	(0.067)
Inflation	0.117*	0.126**	–0.138***	–0.119***	–0.094***	–0.085**
	(0.061)	(0.062)	(0.025)	(0.037)	(0.032)	(0.034)
Human capital index	–0.590	–1.611***	1.784***	1.664***	0.217	0.563***
	(0.451)	(0.371)	(0.225)	(0.210)	(0.237)	(0.210)
Share of urban population in the total population	–0.462***	–0.285**	0.146***	0.036	0.921***	0.863***
	(0.128)	(0.129)	(0.029)	(0.080)	(0.064)	(0.069)
FDI net inflows	0.075	0.113**	–0.050**	–0.049	–0.032	–0.042
	(0.051)	(0.052)	(0.019)	(0.033)	(0.030)	(0.031)
Infrastructure	0.015***	0.015***	0.004***	0.008***	0.009***	0.008***
	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)
Observations	226	226	214	202	202	202
Number of years	12	12	12	12	12	12
Arellano-Bond test for autocorrelation 1 (i.e. first order)	0.738	0.310	0.001	0.137	0.000	0.008
Arellano-Bond test for autocorrelation 2 (i.e. second order)	0.497	0.245	0.717	0.184	0.160	0.747
Test of over-identification restrictions	0.661	0.432	0.896	0.513	0.999	0.987

Source: Authors' computation based on data from UNCTAD (2020) and the World Bank (2020).
FDI, foreign direct investment.
Standard errors in parentheses: ***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$.

be classified and their relevance to value addition in terms of either goods or services determined (UNCTAD 2019).

sectors are those that produce key products or services that rely on core digital technologies, including digital platforms, mobile applications and payment services, while a wider set of digitalising sectors involves increased utilisation of digital products and services (for the purpose of e-commerce, for instance) (UNCTAD 2019).

Employment in the digital economy (digital labour) in Africa has predominantly involved (Heeks 2018):

> [*S*]oftware engineering, business process outsourcing/impact sourcing, online freelancing (website development, web content management and social media content development), crowdsourcing and micro-work, which are prevalent in all three sectors of the economy. (p. 7)

However, these types of activities cannot be discussed without first considering a country's educational structure (Hilbert 2011).

In addition to the policy variables of interest (digital trade indicators), one of the control variables that significantly explains the dependent variables is government expenditure. In Table 3.2, the results indicate that at the conventional levels of statistical significance, increases in both ICT goods as a share of total merchandise trade and digitally delivered services as a share of total services trade are associated with an increase in the employment indicators. What can be observed across the sectors is that government expenditure is associated with an increase in employment in the agricultural sector and a decrease in employment in the services sector. The observation that government expenditure is associated with an increase in vulnerable employment and an increase in the working poverty raises the question: how productive has government spending been in many African countries and what are the implications for the creation of sustainable employment?

Like government expenditure, inflation is associated with an increase in employment, vulnerable employment and working poverty. In relation to the three economic sectors, inflation is associated with an increase in employment in the agricultural sector but a decrease in employment in the industry and services sectors. Although the results are implicitly consistent with the Phillips curve (Orji, Orji-Anthony & Okafor 2015; Ravenna & Walsh 2008), they should be examined in relation to the various sources of inflation in the different countries. The observed increase in the employment indicators because of an increase in inflation could be explained by the fact that more than half of Africa's

workforce relies on the agricultural sector for their livelihoods. Also, inflation on the continent has been predominantly driven by food inflation from 2009 onwards, following the 2007–2008 international food price surge (Alper, Hobdari & Uppal 2016). This encourages more people to go into farming and other value-added activities in the agricultural sector. The issue that requires policy attention is the quality and sustainability of such employment.

An earlier study by Nguyen et al. (2017) found that in Sub-Saharan Africa, domestic supply shocks and shocks to the exchange rate and monetary variables have been the main drivers of inflation over the past 25 years. However, the contribution of these variables has declined over time, and over the past decade, domestic demand pressures, global and output-related shocks have exerted a stronger influence on inflation. The Nguyen et al. (2017) study also identified country-specific factors (such as levels of oil and food imports, climate vulnerability and trade policy) as important predictors of inflation. These findings resonate with the results of the present study in that most inflation drivers tend to support agricultural production, to the disadvantage of industry and services sector activities.

One would expect that higher levels of education would translate into better employment prospects. However, available evidence suggests that in Sub-Saharan Africa, few graduates possess the skills that would enable them to find satisfying work or to transition into the formal labour market. Many African countries have high rates of graduate unemployment, with employers across the region complaining of graduates' lack of basic, technical and transferable skills (McCowan et al. 2014). There are growing concerns about the plight of unemployed university graduates because the supply of qualified young people well exceeds the capacity of economies to provide the requisite number of professional jobs (Elder & Koné 2014).

In the present analysis, education (proxied by human capital) is associated with an increase in employment as a share of total population, and a decrease in vulnerable employment and

working poverty at the conventional levels of statistical significance. Furthermore, a higher level of education is associated with a decrease in employment in the agricultural sector (see Table 3A1), but an increase in employment in the industry and services sectors (see Table 3.3). Similar to the digital trade indicators, higher levels of human capital seem to contribute to labour reallocation from the agricultural sector to the industry and services sectors.

Interestingly, an increase in the share of urban population is associated with a decrease in employment and an increase in working poverty and vulnerable employment. These results confirm the results across the three sectors in Table 3.3. Logically, an increase in the share of urban population is associated with a decrease in employment in the agricultural sector but an increase in employment in the industry and services sectors. The results for the share of urban population broadly underscore the unintended consequences of rural–urban migration, which manifest as high unemployment and the poor quality of available jobs in the urban areas (Basu 2000; Zhai & Wang 2002). Furthermore, since agriculture employs more people than the services and industry sectors in many African countries, it is not surprising that the overall employment-to-population ratio decreases when the urban population increases.

Employment in a country is determined not only by these domestic indicators, but also by the extent of the country's integration into the global economy. In the present analysis, FDI inflows, which were included as a proxy for a country's exposure to the global economy, were found to be associated with an increase in both employment and vulnerable employment but with a decrease in working poverty. Contrary to expectations, FDI inflows were associated with an increase in employment in the agricultural sector but a decrease in employment in the industry sector, irrespective of gender. These heterogeneous effects of FDI inflows reflect the differential employment effect of the various components of FDI (such as greenfield FDI and mergers and acquisitions) and the need for its disaggregation in

the assessment of its spillover effect. In a study on Egypt, Massoud (2008) argues that FDI should be analysed at the most disaggregated level possible, and that the ambiguous effect that some types of FDI had on employment growth was a result of contradictory effects on channels of growth.

In all African countries, employment challenges have been closely linked to infrastructural deficits (Ebegbulem 2012; Lim 2019; Ndikumana 2006). Consequently, a three-year lag of the Africa Infrastructure Development Index (electricity and water) was included in this analysis. The results (see Table 3.2) reveal that enhanced infrastructure significantly improves employment levels and reduces vulnerable employment and working poverty. The results also highlight the positive effect of water and electricity infrastructure on employment across the three sectors, but the magnitude of the effect is higher in the agricultural sector than in the industry and services sectors (see Table 3.3). These findings resonate with earlier studies conducted in Indonesia, Nicaragua and South Africa, where electricity infrastructure was found to have led to an increase in employment, particularly among rural residents (Dinkelman 2011; Gibson & Olivia 2010; Grogan & Sadanand 2013). There is also evidence of water infrastructure having a positive effect on small and medium-sized enterprise (SME) activities in Uganda (Davis et al. 2001) and agricultural employment in Bangladesh (Mahmud & Sawada 2018).

3.6. Conclusion

Digital trade is expanding in Africa and throughout the world, but African policymakers are grappling with the challenge of managing it so that it delivers on its expected developmental outcomes, particularly in the area of employment. At the same time, policymakers need to determine how digital trade can be used to drive greater inclusiveness in the labour market. However, there is limited empirical literature to guide policymaking on the continent, which would enable countries to maximise the

opportunities and minimise the disruptive effects of digital trade on employment. To address this problem, this chapter explored the effect of digital trade on both the quantity and quality of employment in Sub-Saharan Africa, using data on 24 countries drawn from different institutional databases.

The descriptive analysis revealed that countries that have a relatively higher employment-to-population ratio also have higher levels of vulnerable employment and working poverty. This raises concerns about the quality and sustainability of employment and the implications for sustainable livelihoods in Africa. It was also observed that the majority of countries that have a higher share of ICT goods in total merchandise trade have a lower share of digitally delivered services in total services trade. This contrasting phenomenon prompts questions about value addition in ICT goods and digitally delivered services, respectively, in African as well as other developing countries.

The regression results provided evidence to support both sides of the theoretical argument that the job creation or destruction effect of technological innovation (represented by digital trade) depends on the type of the innovation and the sectoral/economic structure of a country. An increase in ICT goods as a share of total merchandise trade improves the employment-to-population ratio and reduces vulnerable employment and working poverty, while the inverse was observed for digitally delivered services as a share of total services trade. The results for the sectoral-level analysis revealed an element of labour reallocation from the agricultural sector to the industry and services sectors. The control variables (government expenditure, inflation, the share of urban population to total population, FDI inflows and infrastructure) were also shown to have significantly heterogeneous effects on the employment indicators.

In view of these findings, governments in Sub-Saharan Africa should take critical steps towards embracing digitalisation, giving particular attention to the agricultural sector (where relevant) in

order to improve digital trade and minimise the tendency towards labour reallocation from the agricultural sector and overconcentration in the industry and services sectors. Such overconcentration would have more severe implications for heightened unemployment in the urban areas where most industrial and services sector activities take place.

The study revealed an apparent trade-off between employment quantity and employment quality in Africa: the former is promoted at the expense of the latter. While quantity is necessary for Africa's growing population, government policies and reforms aimed at closing the gap between population growth and unemployment should focus not only on job creation but also on how to create more decent jobs (to help address SDG8), which will satisfy the demands of an expanding, increasingly discerning population.

These policies should include creating a business- and investor-friendly environment which would allow the private sector to participate actively in the job creation process, building skills and (over time) facilitating workers' transition from low-level to higher-level/more decent work. The private sector is also the main driver of digital trade, but the government controls the 'valve' to digital trade flows, making trade either easier or more difficult, as the case may be.

Ultimately, countries that have good ICT infrastructure or digital ecosystems will benefit more because the net employment effect of digital trade may not be uniform across countries, sectors/industries or skill groups. Therefore, the results from this study should be viewed with caution and treated more as a starting point for more detailed future research.

3.7. Key takeaways from this chapter

- Africa needs to leverage the power of digital technologies and digital trade to address its extraordinarily high levels of

unemployment (and underemployment). However, as much of the work performed in Africa is of the low-skilled variety, with the agricultural sector constituting a leading employer, it is unclear how digital advances and digital trade would impact the African job market. In fact, concerns have been expressed that increased digitalisation has the potential to deprive people of their livelihoods.

- This study set out to determine – empirically – the relationship between digital trade (the trade in ICT goods and services) and employment (both quantity and quality) in 24 Sub-Saharan Africa countries. The digital trade indicators were ICT goods and digitally delivered services, while the employment indicators were employment (as a share of total population), vulnerable employment and working poverty. Other variables included FDI inflows, inflation and urban population.
- Key results from the study included the following: An increase in the trade in ICT goods is associated with an increase in total employment and a decrease in both vulnerable employment and working poverty. In contrast, an increase in the trade in digitally delivered services is associated with a decrease in total employment and an increase in vulnerable employment.
- These results signal that the effect of digital trade is to some extent dependent on the nature of such trade. For example, digitally delivered services are 'final' products whose production may create fewer employment opportunities than ICT goods which, as they are likely to incorporate various intermediate products, may create more employment opportunities. Adding value to imported intermediate ICT goods could do more to stimulate employment at the local level than relying on imported final ICT goods and digitally delivered services, which tend to create jobs in the exporting country. Of course, the effect of digital trade on employment will also be influenced by factors such as a country's ICT infrastructure and services, and skills levels.
- The net employment effects of digital trade may not be uniform across countries, sectors/industries or skill groups.

For example, an increase in digital trade may boost employment in the ICT sector but could trigger a decrease in employment in, say, the agricultural sector as labour migrates to the industry and services sectors.

- Not surprisingly, education is associated with an increase in employment and a decrease in vulnerable employment and working poverty. Moreover, higher education is associated with a decrease in employment in the agricultural sector and an increase in employment in the industry and services sectors. Interestingly, an increase in the share of urban population is associated with a decrease in total employment and an increase in vulnerable employment and working poverty. This highlights the unintended consequences of people migrating from rural to urban areas in search of work, which is often unavailable. The fact that the agricultural sector in Africa employs more people than the industry and services sectors is another reason for rising unemployment in urban areas.
- Another apparent anomaly is the fact that FDI inflows are associated with an increase in employment in the agricultural sector but a decrease in employment in the industry sector. This seems to highlight the need for FDI to be disaggregated to determine its spillover effects.
- Policymakers in Africa will have their work cut out for them if they are to embrace a digital culture while also addressing the opportunities, challenges and apparent anomalies in the digital trade–employment dynamic. In particular, the agricultural sector needs to be put under the spotlight – both in terms of developing its digital and digital trade potential and curtailing excessive labour reallocation to the industry and services sectors, which cannot adequately accommodate the high numbers of job seekers.
- Also deserving of attention at the policy level is the apparent trade-off between employment quantity and quality in Africa, and how these can be more effectively merged in the interests of driving more sustainable growth, development and trade on the continent.

APPENDIX

TABLE 3A-1: Summary statistics of digital trade indicators (exports and imports) by country.

Country	Frequency	Percent	Digitally delivered		ICT goods	
			Services exports (mean)	Services imports (mean)	Exports (mean)	Imports (mean)
Botswana	12	4.17	13.468	36.616	0.153	2.547
Burundi	12	4.17	16.754	14.792	0.266	3.904
Cameroon	12	4.17	33.144	31.329	0.029	3.841
Madagascar	12	4.17	16.394	29.235	0.145	2.612
Mauritius	12	4.17	36.332	46.229	5.040	6.877
Mozambique	12	4.17	17.631	48.602	0.071	2.637
Namibia	12	4.17	9.095	47.065	0.581	3.272
Senegal	12	4.17	37.817	29.033	0.476	3.111
South	12	4.17	23.718	34.877	1.281	8.351
Uganda	12	4.17	19.813	30.818	3.280	5.852
Benin	12	4.17	21.980	24.502	0.050	1.702
Burkina Faso	12	4.17	36.454	36.921	0.033	2.617
Côte d'Ivoire	12	4.17	32.194	19.360	0.145	2.855
Ethiopia	12	4.17	6.321	15.614	0.376	5.144
Gambia	12	4.17	5.374	15.666	0.121	1.757
Ghana	12	4.17	42.633	38.544	0.093	4.666
Kenya	12	4.17	19.568	30.525	0.938	6.292
Malawi	12	4.17	42.536	30.492	0.255	3.369
Niger	12	4.17	36.100	17.397	0.018	3.064
Nigeria	12	4.17	8.573	29.012	0.007	4.535
Rwanda	12	4.17	1.872	3.306	0.676	8.029
Togo	12	4.17	22.117	18.199	0.189	2.414
Zambia	12	4.17	15.110	19.472	0.061	2.488
Zimbabwe	12	4.17	19.878	31.797	0.051	2.488
Total	**288**	**100**	**22.287**	**28.308**	**0.597**	**3.934**

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

Chapter 4

Digital technologies, employment and labour-market polarisation in Africa

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4.1. Introduction

The effects of technological progress on the labour market have attracted much research attention over the years, with many conflicting views emerging on labour-market outcomes. For example, as described by Caprettini and Voth (2020), during the Industrial Revolution in 19th-century Britain, the Luddites protested against technological progress by destroying machines that they perceived were replacing manual work in the spinning and weaving sector. Today, the effects of digital technologies on

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employment, which goes to the heart of domestic and international competitiveness, continue to stimulate much debate (see Parry et al. 2021). There are many instances where computers have complemented the performance of highly skilled workers by enabling them to perform various tasks more efficiently. Yet there have also been numerous reports of digital technologies negatively impacting employment (Acemoglu & Restrepo 2017; Autor 2015; Autor, Levy & Murnane 2003; Baldwin 2019; Brynjolfsson & McAfee 2014).

This chapter explores some opposing views on the digital technologies–employment dynamic and presents an analytical discussion that formalises the different effects of digital technologies on the labour market.

4.2. Task production and polarisation

Significant changes in labour markets in developed countries have been in evidence since the 1980s (with developing countries, in contrast, showing different adjustment processes in respect of technological change). These changes have largely been observed in the areas of employment and earnings. The 'middle' segment of the labour market, with typical job categories including sales and administrative workers as well as machine operators, has been particularly affected by job losses, together with reduced earnings. This has resulted in the so-called 'polarisation of labour markets' or hollowing out of the middle segment, where the latter has been displaced by the low-skilled and high-skilled segments of the market.

As discussed by Katz and Autor (1999), several factors have been responsible for these changes in labour markets, including the influence of labour unions, minimum-wage agreements, declining economic growth rates and offshoring of production to countries with cheap labour. However, technological progress – particularly in the form of digital technologies that lower the

costs of production and distribution – appears to be the most important driving force behind these events, as suggested by Goldfarb and Tucker (2019). Autor and Dorn (2009) analysed these developments for the US, Goos, Manning and Salomons (2009) did the same for the EU, and Dustmann, Ludsteck and Schönberg (2009) reported on the German labour market.

The formal research methodology explaining these features of the labour market has changed markedly in recent years. The conventional neoclassical production model has been replaced by the task approach to production.[27] A notable feature of the task approach or model is that digital technologies give rise to new tasks in which skilled workers have a comparative advantage. Empirical studies on task-based models conducted by, for instance, Autor et al. (2003) and Acemoglu and Restrepo (2017) appear to project labour-market anxiety, in the sense that job losses are likely to escalate as machines take over more and more types of work. This outcome implies poor or ineffective countervailing adjustments in task-based models. As will be discussed, Africa's employment and development are not plagued by technology anxiety. The presence and effectiveness of countervailing adjustments in the labour market are also discussed later in this chapter.

Autor et al. (2003) analysed these labour-market tendencies in terms of the so-called task-based model of production. The concepts of task production and trade in tasks were originally applied by Grossman and Rossi-Hansberg (2008) to explain international trade in a GVC context. The task-based model demarcates the labour market into three segments, as described by Autor (2013, 2015). Each segment can be associated with certain occupational skills, namely the high-skilled, middle-skilled and low-skilled segments. The different segments are therefore

27. The application of digital technologies in production encourages the slicing up of the production value chain into specific tasks. This unbundled production process is described in detail by Grossman and Rossi-Hansberg (2008).

representative of certain educational achievements. Task-based models have been extended theoretically and applied in empirical labour-market research by, for instance, Acemoglu and Autor (2011), Autor (2013), Acemoglu and Restrepo (2017, 2018a, 2018b, 2019) and Autor (2019). This chapter draws on these authors' insights.

The task-based model partitions the continuum of tasks into three sets (Autor 2013). The least complex tasks are performed by 'L-workers', intermediate tasks by 'M-workers' and high-level tasks by 'H-workers'. The introduction of automation through digital technologies will have a cost-cutting effect, which will be most prominent in respect of routine tasks that are codifiable (Autor et al. 2003). These tasks are primarily present in the intermediate segment and performed by M-workers who typically have secondary school and limited tertiary education.

Codifiable tasks can be performed by machines or computers at much lower cost than M-workers (in terms of their remuneration). Once middle-segment tasks are performed by machines, M-workers find themselves in excess supply and their wages fall. These workers are then allocated to the ends of the occupational distribution scale, with many entering the low-skilled segment where L-workers perform personal service tasks that are not readily codifiable; such workers thus have a comparative advantage over machines. Task-replacing technological change complements employment in the two remaining (i.e. high- and low-skilled) segments and the end result is a polarised labour market. Digital technologies therefore have a displacement effect on employment in the middle segment of the labour market.

Digital technologies bring new tasks (and products) and H-workers have a comparative advantage in performing these tasks because they have a skill bias. H-workers' productivity advantage resonates with the Ricardian model which explains a country's entry into international trade on the basis of its comparative productivity advantage. Acemoglu and Autor (2011) applied this principle to expand the task-based model, referring

to it as the Ricardian theory of the labour market. The comparative advantage of H-workers is directly related to their educational achievements. Their comparative advantage, coupled with the supply of new tasks, boosts the demand for H-worker skills. If this segment of the market has been in equilibrium prior to the arrival of new tasks, it is now experiencing excess demand for H-workers. There is upward pressure on remuneration which, together with the downward adjustment in wages in the M-worker segment, results in wage polarisation across the labour-market segments. This has been a typical labour-market trend in developed countries in recent years. Furthermore, the new tasks and the demand for H-worker skills have a reinstatement effect on employment, as argued by Acemoglu and Restrepo (2019), or an employment complementary effect, in the terminology of Autor et al. (2003).

Several studies have confirmed the supply of new tasks, particularly in the H-worker segment of the labour market. Athey and Luca (2019) demonstrated that many new tasks are directly related to digitalisation, which is in line with the task-based model. They indicated that new tasks have arisen out of machine learning, mobile money and payment-related tasks, the development of digital platforms and the growth of online advertising. Similarly, Acemoglu and Restrepo (2018a) discovered many new digital technology-related tasks, as evidenced in a plethora of new job titles in the US. For instance, between 1990 and 2000, approximately 70% of computer software developers' job titles had changed. The authors found that the growth in new job titles in the US was particularly pronounced from 1980 to 2015.

Atalay et al. (2020), in turn, traced the evolution of jobs in the US by studying the information appearing in job advertisements. They confirmed the declining share of routine tasks in total employment and the expansion of non-routine tasks. Moreover, they discovered that advertisements for new job titles specified non-routine task requirements more frequently. Acemoglu and Restrepo (2019) established that from 1947 to 1987, the development of new tasks had a counterbalancing effect on job

displacement in the US. However, in the period 1987–2017, the authors failed to confirm such compensating effects.

The technological effect that places upward pressure on the remuneration of skilled workers is referred to as the skills premium for highly skilled workers. This premium is directly related to the supply of and demand for skilled people. In this regard, the demand-side effects have been discussed above. Goldin and Katz (2008) emphasised the importance of supply-side effects. They argued that the supply of skilled people is constrained by the long and expensive education required for the highly skilled. In their critical analysis, Bowen and McPherson (2016) discussed the factors influencing supply constraints, notably the excessive cost and long duration of education, limited access to quality institutions and outdated teaching methods at higher education institutions. Goldin and Katz (2008) argued that these supply constraints, together with the skill bias of new technologies, were indicators that the US education system started to lose the race against technology around 1980.

Recently, Autor, Goldin and Katz (2020) revisited this so-called hypothesis regarding the race between education and technology, using US data. They confirmed the validity of the hypothesis for the period 1990–2000. During this period, there was a significant increase in wage inequality because of a sharp rise in the college wage premium, resulting from a slowdown in the supply of college workers. After 2000, the situation changed, with wage inequality starting to feature within rather than between education groups. The supply constraint apparently became more evident in certain skilled occupations.

Thus far, the discussion has concentrated on the theory and evidence surrounding aggregate or economy-wide labour markets. Recently, Autor (2019) discussed the polarisation effects on city labour markets in the US. He confirmed the hollowing out of the middle-skilled segment of city labour markets, which have adversely affected non-college, blue-collar work as well as white-collar administrative work.

Task-based models show that technology-induced polarisation effects in developed-country labour markets are significant, and the distortive effects are likely to continue for the foreseeable future. Task-based models analyse the origin of these phenomena and their effects convincingly, while their policy proposals are appealing, particularly as they emphasise the importance of education and training. More effective, broad-based education is therefore likely to soften the polarisation effects. Furthermore, education reforms are likely to mitigate the supply constraints when it comes to sourcing highly qualified people.

Despite the favourable employment-creating effects of digital technologies, as discussed above, several empirical studies have given rise to labour-market anxiety by stressing net job displacement by digital technologies. These include task-based model research conducted by Autor et al. (2003) and research by Autor and Salomons (2018) who revealed a shortfall in countervailing, job-creating effects at the aggregate level for 18 OECD countries. Acemoglu and Restrepo (2017) reinforced this anxiety by providing a sombre outlook for jobs in the US in the face of increasing robotisation.

Recently, Baldwin (2019) highlighted the so-called 'globotics' upheaval, referring to the displacement of highly skilled, professional workers by intelligent machines. This new anxiety is likely to extend to the middle- and high-skilled labour market segments. The different aspects of labour-market polarisation and the hollowing out of middle-skilled jobs, particularly in manufacturing, as well as the growing sense of anxiety about the future of work have been described by Brynjolfsson and McAfee (2014).

These findings raise an important question about the effectiveness of the adjustment mechanism in task-based models. The anxiety phenomenon creates the impression that the models generate disequilibrium outcomes, following digital technology cost-cutting distortions. Yet adjustment mechanisms constitute an important methodology in economics. Several potential

mechanisms can be identified in task-based models. In the high-skilled segment, the supply constraint in respect of skilled labour is an indication that technological progress cannot carry on in an unlimited fashion. Similarly, the rising cost of skilled people, as expressed in the skills premium, is poised to induce a slowdown or a correction in technological developments.

In the middle-skilled segment, the presence of excess labour supply, following technological progress, signals lower cost incentives for new, middle-skilled labour to complement or reinstate technological effects. Recently Autor (2019) documented how middle-skilled workers worked closely with high-skilled workers in US cities after World War II. This points to the potential of labour to complement technology in the middle-skilled segment, owing to the favourable cost effects presented in the task model in today's labour markets.

The potential adjustment mechanisms referred to above should be strong enough to encourage countervailing economic adjustment processes. The presence of such countervailing processes challenges the anxiety outcomes of task-based models. Recently the World Bank (2019) released a research report on the changing nature of work, which concluded that there is no evidence of anxiety-induced labour market outcomes in the real world. This confirms that a reassessment of the model's adjustment mechanism is imperative. This conclusion appears to be supported by recent critical observations made by Caselli and Manning (2019). They were critical of the poor countervailing adjustments in task-based models discussed in, for example, Acemoglu and Restrepo (2018a) and Autor (2019) and presented a critical assessment of the partial equilibrium feature of task-based models.

At this stage of the debate, it is probably constructive to assess the effects of digital technologies by applying the methodology of narrative economics, as suggested by Shiller (2017). This will, at least, contribute towards a better understanding of the dissimilar effects of digital technologies in developed and

developing countries. The various possibilities are discussed in section 4.3.

4.3. Technology narratives

The apparent disequilibrium analysis inherent in task-based models requires closer analysis. This section explores technology narratives to illustrate the dissimilar behaviour of digital technologies and how their features contradict disequilibrium outcomes and the corresponding work anxiety mentioned earlier.

In contrast to the common impression of excessive automation emanating from digital technologies, Brynjolfsson, Mitchell and Rock (2018) demonstrated that machine learning as an element of ICT shows a low correlation with occupations. Moreover, there is a high degree of variability in potential machine learning within jobs, while few jobs are in fact eligible for full automation.

This notion of variability is well illustrated in the manufacturing sector in Germany. Research by Dustmann et al. (2009) clearly showed that labour-market distortions such as the polarisation effects in the US and Germany are comparable at the aggregate level. Yet the way these technology effects play out in the two countries reveals important dissimilarities. For instance, it has been suggested that earnings inequality at the top end of the income distribution scale is similar for the two countries. At the lower end of the income distribution scale, Dustmann et al. (2009) argued that the German situation is closely related to institutional factors, such as the sharp decline in the influence of labour unions which occurred much later in Germany than in the US.[28]

The dissimilarity in technological effects in Germany has been confirmed by Dauth et al. (2017) in the case of robotics. Germany

28. Unequal remuneration across and within occupations, owing to varying labour-market developments, clearly affects income distribution patterns within and between countries and has been discussed by a number of authors, including Acemoglu (2002) and Piketty (2014); however, this topic was beyond the scope of the present study.

has deployed far more robots in manufacturing than the US and its European partners. The authors showed that Germany has experienced significant job losses in the middle-skilled segment of the labour market because of automation, saying that, on average, every additional robot replaced two manufacturing jobs in the period 1994–2014. However, robots did not reduce total employment because new employment has been created outside manufacturing which has fully compensated for the job losses. The high-skilled segment of the labour market has benefited from new jobs. Reinstatement has been important, owing to high-skilled workers having a comparative advantage when performing new technology-related tasks. The significant job destruction occurring in manufacturing has encouraged interesting countervailing actions. For instance, German labour unions negotiated trade-offs between lower incomes and job security in order to maintain employment levels. Moreover, firms reached out to, and accommodated, affected workers by offering them additional training to enable them to perform new tasks.

Research conducted by Gregory, Salomons and Zierahn (2018) appears to support the above findings. Their study of the labour data for 27 EU countries in the period 1999–2010 revealed substantial job losses arising from the substitution effects of routine job-replacement technologies. The positive income effects of technological progress on demand (which rose) and prices (which fell), and the spillover effects to non-tradable sectors were responsible for strong countervailing employment-creating efforts. These efforts were so significant that the authors concluded that, in the period in question, labour was racing with and not against machines (to paraphrase the title of their study). Furthermore, they confirmed that the countervailing forces identified in their analysis led to the demand for labour exceeding the supply. This means that had labour markets been more flexible, more workers could have found jobs.

In a different vein, Atack, Margo and Rhode (2019) argue that, throughout history, automation and industrialisation have been

responsible for substantial increases in productivity because of the division of labour. This means that a worker concentrates on performing a single task in production – evidenced, for instance, in artisans making way for more specialised workers. Before the Industrial Revolution, an artisan like a blacksmith managed a whole spectrum of tasks, from design to production, maintenance and repair. The Industrial Revolution unbundled the blacksmith occupation and it finally disappeared (Atack et al. 2019).

In the late 1800s, artisanal skills could be learnt on the job at a modest cost. In contrast to 19th-century manufacturing norms, automation today is skill-biased and requires costly investment in skills. Once skills have been acquired, workers need to engage in continuous learning to secure a sustained, occupational comparative advantage. Furthermore, unlike in the past, contemporary occupations command a suite of diverse skills, according to Atack et al. (2019). Human adaptation to new patterns in the division of labour induces countervailing adjustments in labour markets which themselves change over time.

The countervailing adjustments discussed so far in this chapter were also evident in a famous study by Graetz and Michaels (2018) which analysed the effects of robotics on employment. The authors studied the labour-market effects of increased robot density (the stock of robots per million hours worked) in 17 countries in the period 1993–2007. They confirmed that growing robot intensity had a significant effect on productivity and regarded the size of this effect to be comparable to the productivity contribution of steam technology to Britain in the period 1850–1910. Their research did not reveal a significant decline in total employment because of robot densification. However, they did find a robot-induced decline in hours worked by low-skilled workers compared with high-skilled workers. Furthermore, robot densification contributed to higher factor productivity, which was passed on in the form of lower output prices. As a typical digital technology cost-cutting feature, this benefited consumers.

The absence of overall negative effects on employment in the Graetz and Michaels (2018) study confirms that increased robot density resulted in countervailing employment-reinstatement adjustments, despite the decline in low-skilled employment. A unique result from this research was that the authors did not confirm labour-market polarisation, as claimed by task-based models. In this regard, robotics probably prompts some dissimilar behaviours within the family of digital technologies. Another important result from the research was that increased robot densification is accompanied by a fairly rapid decline in the marginal return on robots. This points to a typical economic adjustment process that adheres to basic economic principles. This is strong evidence of the presence of countervailing adjustments in labour markets.

Technology narratives clearly illustrate the close cooperative behaviour between humans (human capital) and the digital technology of AI. The latter refers to sophisticated machines (robots) that follow algorithms to change their output according to new information obtained from sensors in ways that mimic human intelligence. Artificial intelligence is primarily applied for the purpose of discovering behavioural patterns, such as particular correlations, in large data sets. In a self-driving car, for instance, an AI unit follows its algorithms and observes new data from sensors to predict the path of the vehicle. Agrawal, Gans and Goldfarb (2019) suggest that the predictive ability of AI provides an important tangent between machine performance and human behaviour. The authors define prediction as a process using existing data to fill in missing observations. This implies that AI predictions complement human decision-making by reducing the element of uncertainty in decision-making.

Expressed more formally, prediction allocates values to the parameters within which decisions are made. Using task-model terminology, it could be said that every prediction task complements a decision task. This technology narrative drives

home the important principle that machines provide services to human beings and also brings into sharp focus the complementary role of digital technologies in human decision-making. Successful predictions reduce uncertainty and so better decisions are taken about new tasks. Furthermore, it is clear that the cost-cutting features of digital technologies can take on dissimilar formats, from machine learning to straightforward digital applications.

Technology narratives also cover other new employment possibilities that are directly related to digital technologies. These refer to jobs that are mediated through online platforms and are collectively referred to as the gig economy. These new work opportunities fall outside the scope of the present study as they are not supplied through labour markets, but rather through digital platforms. They are discussed by Abraham et al. (2019), among others.

In sum, technology narratives confirm the job-destructive effects of digital technologies in developed countries. These effects are observed in the middle-skilled segment of labour markets and are quantitatively significant. As opposed to populist assessments (discussed by Gregory et al. 2018) and prominent empirical research, which have presented a sombre outlook for the future of work, the technology narratives emphasise the significance of countervailing, corrective adjustments with employment-creating outcomes. Such a methodology focuses on the complementary role of digital technologies in human decision-making.

Technology narratives thus defy technology anxiety in labour markets. They also emphasise the dissimilarities in the application of these technologies across occupations and countries and are important in explaining the effects of digital technologies in an African context, which are discussed next.

4.4. Labour-market outcomes in Africa

The labour-market polarisation effects of digital technologies in developed countries have been evident primarily in manufacturing, with the decline in manufacturing output being particularly pronounced in the US. This has rendered the polarisation effects relatively more prevalent in that country.

In Africa, the situation is very different. For example, employment in industry is low in Sub-Saharan Africa. From 1995 to 2019, the percentage of the total population who were employed in industry remained fairly constant at approximately 11%.[29] Measured in terms of employment, agriculture in Sub-Saharan Africa is far more important, at 52.6% in 2019 compared with 62.3% in 1995.[30] In addition, most agricultural activities in Africa are informal and low in productivity (Newman et al. 2016). These statistics show that skill-displacing technologies have very little scale in African countries.

In Chapter 5, it is maintained that a core economic challenge in Africa is how to transform economic activity from low-productivity agriculture to high-productivity industry, preferably manufacturing, in accordance with the proposals by McMillan, Rodrik and Verduzco-Gallo (2014), Newman et al. (2016) and Rodrik (2016). Africa has been unsuccessful in achieving this transformation in any meaningful way. Where transformation has occurred, it has mainly been from agriculture to self-employment and informal services, which have generally been unproductive and ineffective in creating sustainable employment. This in turn has curtailed African countries' internationalisation efforts which, if they are to bear fruit, need to be underpinned by a more diverse and value-added range of economic activities. Given this outcome, Africa faces the opportunity, but also the challenge, of

29. Author's calculation using data from: data.worldbank.org.

30. Author's calculations using data from: data.worldbank.org.

embracing digital technologies to assist in making the transition from low-productivity to high-productivity economic activity. Such a transformation would spur sustainable economic growth, with improved prospects of quality employment geared for local as well as export development.

The application of digital technologies is very dependent on supporting infrastructure. The most basic requirement is an effective, reliable and affordable electricity supply. Unfortunately, many African countries have failed to establish electricity supply networks that meet the necessary conditions for effectiveness and efficiency. New technological developments in the supply of sustainable energy are likely to be important means of addressing this deficiency in the future, particularly when spearheaded and managed by the private sector.

Internet connectivity is another basic condition for digital technology applications. Fixed-line broadband connectivity in Africa is expensive and in limited supply. Instead, Internet connectivity in Africa is dependent on mobile technology which is supplied and maintained by private-sector companies. The implication, therefore, is that mobile connectivity is primarily supplied in more profitable urban areas. However, many African countries still rely on 3G communication networks which are slow, expensive and inefficient, while the availability of the faster 4G networks is very limited. In South Africa, at the time of writing, the authorities were still in the process of licensing 5G networks, which will be faster than earlier generations, will be able to carry more information (such as big data) and will bring down the cost of communications.

The upshot of all this is that Internet access in Africa is limited and expensive by global standards. The IMF (2018) reports that, on average, only 20% of the population in Sub-Saharan African countries use the Internet, the lowest proportion in the world. The corresponding number in the EU is 81%. The monthly cost of mobile broadband connectivity in Sub-Saharan Africa is comparable to that in other regions. However, if this cost is

weighted against gross national income, it compares very unfavourably with that in other regions (IMF 2018).

The structure of African industry, as described above, leaves very little scope for technological polarisation of employment. In view of this, it appears that digital technologies can and should be important instruments of development on the continent. The World Bank (2020) asserts that despite digital technologies being skill-biased, they have positive employment reinstatement effects in Africa. Furthermore, there is evidence that these technologies have positive development effects through international trade, as discussed in Chapter 5.

As discussed, digital technologies are associated with productivity effects and cost-reducing processes, which are passed on to consumers by way of lower prices. In the African context, digital technologies are effective in raising real income, which in turn stimulates demand and higher levels of employment across different sectors. The World Bank (2020) confirms that in Africa, digital technologies have surprised researchers by successfully creating employment for less-skilled and less-educated workers. This appears to be a plausible outcome because the different labour-market segments are not rigidly defined, as will be explored below.

The most important digital technology application in African countries is mobile money – particularly in countries without a well-developed banking system. Financial services are provided via financial platforms, of which M-Pesa is probably the best example. It is a safe and secure way to send and receive money, to make payments, and to apply for short-term loans. The facility was established in 2007 by Vodafone's Kenyan associate company, Safaricom. The World Bank (2019) reports substantial employment creation in Kenya through M-Pesa, primarily in the form of new job categories such as mobile payment agents. Interestingly, the number of new jobs – which to a large extent have been taken up by women – has exceeded that of jobs lost in the banking sector by a considerable margin (World Bank 2019).

According to the World Bank (2019), the introduction of mobile technology has enabled many Kenyan women to move out of subsistence agriculture into business and other service-sector occupations. This is an example of how digital technologies can be instrumental in driving transformation from low-productivity to high-productivity economic activity.

Das (2018) describes two labour-market features in developing countries that emphasise the difference between labour markets in developed and developing countries. Both features are the result of rising employment in routine jobs, but the outcome is very different in developed labour markets and developing labour markets, respectively. The distinction is an important one and requires further elaboration.

The first feature is evident in developing countries that successfully transition from low-productivity to high-productivity jobs in manufacturing. This transformative shift might take the form of labour being moved out of non-routine, unproductive agricultural jobs into routine, productive manufacturing and services-sector jobs. In contrast to developed markets, this is accompanied by higher productivity, rising incomes and sustained employment across the occupational distribution scale. In the event that this transformation is driven by digital technologies, there will be the additional advantage of lower product prices in view of the cost-cutting features of such technologies.

The second feature is evident in developing countries that experience increased employment in routine jobs when developed countries diversify their routine jobs through offshoring. Again, the situation is very different from that in developed countries because these represent new, high-productivity jobs as opposed to existing, local-level, low-productivity jobs. Apart from creating new jobs, offshoring activities involve establishing production facilities in developing countries. Moreover, developing countries are opened up to international trade through GVCs. This outcome is reminiscent of Adam Smith's 'vent for surplus' theory. In short, this theory explains how a country with surplus resources enters

the international trade arena and benefits from trade by moving underutilised resources into production for export (Myint 1958).[31]

These two features are helpful for understanding the unique effects of advancing digitalisation in developing countries. There is little scope for labour-displacing effects because manufacturing employment is low in all segments of the labour market. It appears that the demarcation of the labour market is less rigid in developing countries. As observed by the World Bank (2020), this is not only a feature of low levels of employment but also of limited skills owing to the low quality of human capital. As the occupational distribution is fairly narrow, there are limited opportunities for job displacement. Rather, production and employment will benefit from labour-complementing technology.

It is also clear that the routine jobs are in fact new jobs that provide few incentives to introduce cost-cutting production processes, aimed at reduced labour demand. The low labour costs, associated with the lower end of the occupational distribution scale, compare favourably with those in developed counties, and this differential encourages offshoring through GVCs. This technology application creates employment in support of offshoring. All in all, it is clear that the two mentioned features of developing country labour markets are likely to encourage labour-complementing rather than labour-substituting technology interventions.

Hjort and Poulsen (2019) examined the effects of digital technologies in African countries in the late 2000s and early 2010s. This period coincided with the arrival of 10 submarine Internet cables from Europe which were connected to the terrestrial cable network. This brought fast Internet connectivity to many African countries, which implies that average Internet speeds and usage increased significantly during the period in question. The authors compared changing employment patterns in areas with limited Internet connectivity with those in areas

31. Surplus resources refer to unemployed people and idle means of production.

with good and fast Internet connectivity. The data comprised three different data sets covering 12 African countries. The authors verified that fast Internet access gave rise to new, strong, direct and long-term employment opportunities. The specific drivers of Internet-related employment, for instance, were heightened productivity, firms commencing operations and exporting. This means that the typical cost-cutting effects of digital technologies created employment on the basis of these drivers.

Hjort and Poulsen (2019) verified that fast-Internet employment creation was not identical across the different countries. A common element was that digital technologies created employment in favour of skilled occupations, but the manifestation of this skills bias was different from that in developed countries. The authors distinguished between different skilled job categories, of which moderately skilled occupations appeared to be the major beneficiaries of the employment boost. Such occupations included operating machines and electronic equipment, driving vehicles, and doing maintenance and repairs to electrical and mechanical equipment. These are comparable to the middle-skilled segment jobs in developed countries. In the African context, these occupations are not at risk of displacement. On the contrary, as argued by Hjort and Poulsen (2019), they are in fact beneficiaries of technological progress.

There is another dissimilarity with developed countries that requires closer analysis. Hjort and Poulsen (2019) and the World Bank (2020) point out that African firms accept less-educated workers into the production supply chain while providing on-the-job training. In this sense, digital technologies are spreading the complementary effect of employment creation over a larger set of occupations and skills and leveraging human capital development in Africa. This situation reminds one of the more flexible labour-market conditions in Germany which encourage workers to sign up for on-the-job training while remaining employed, as discussed by Dauth et al. (2017). It is no surprise that Hjort and Poulsen conclude that digital technologies

help to drive the process of transforming an economy from low-productivity to high-productivity endeavours.

Closely related to this is another interesting dissimilarity that was evident in three of Hjort and Poulsen's data samples: that fast Internet increased employment across the skills spectrum of primary, secondary and tertiary education. In certain cases, workers with primary school education only had greater access to employment opportunities than those with secondary education. This finding implies a dispersal of employment across sectors, occupations and education levels. It stands to reason then that fast Internet access has reduced employment inequalities in African countries, as emphasised by Hjort and Poulsen (2019).

Similarly, the World Bank (2020) emphasises that in developing countries, employment creation through fast Internet adoption appears to be distributed evenly across workers with primary, secondary and tertiary education. The World Bank (2020) confirmed that, during the research period in the Hjort and Poulsen (2019) study, fast Internet increased the probability of employment for individuals across the sample of countries, from 3.1% to 13.2%. In the case of South Africa, the probability of employment rose by 3.1% (Hjort & Poulson 2019). Unskilled and less-educated workers experienced positive employment effects, in contrast to these categories of worker in developed countries. Furthermore, the World Bank (2020) verified that the probability of an individual accessing skilled jobs increased from 1.4% to 4.4% after the introduction of fast Internet. Moreover, the probability of having an unskilled job did not decrease.[32]

In sum, African labour markets are very dissimilar from labour markets in developed countries. The analysis of these dissimilarities has shown that they lend themselves to significant employment creation through the application of digital technologies. Moreover, such employment creation straddles different occupations and educational achievement levels. The

32. Statistically not different from zero.

present structure of industry (specifically manufacturing) in African countries leaves little scope for technological displacement of routine jobs. In fact, in Africa, technology brings new jobs, which are further enhanced in those countries that embrace offshoring. By participating in offshoring, African countries acquire new sources of employment in routine jobs, which are exported by developed countries and form the basis of production and exporting via digitally driven GVCs.

The flexible manner in which digital technologies are applied in African countries, in the sense of introducing on-the-job training, allows employment opportunities to extend to those with varying educational backgrounds. Over and above this, digital technologies improve the generally poor quality of human capital in Africa and are well placed to make a large developmental footprint in Africa. One of the most important features of digital technologies discussed in this section is that they drive the shift from low-productivity to high-productivity economic activity, thus making them instruments of economic development. This promotes sustainable, quality jobs – particularly for women – as has been evident in Kenya with the help of mobile technology (World Bank 2019).

It has also been argued that certain basic conditions have to be met in order to realise the professed long-term, developmental contributions of digital technologies. Meeting these conditions requires systematic and sustainable policies. Ultimately, the effectiveness of these policies will determine how successful Africa will be in harnessing digital technologies. The three most important policy areas are briefly discussed below.

Firstly, African countries need to secure an affordable and reliable electricity supply. This is the main pathway to sustainable development. Without accessible and reliable electricity, Africa will deprive itself of opportunities to stimulate economic growth, which forms the bedrock of quality employment and the type of society that is conducive to building a productive and entrepreneurial middle class.

Secondly, African countries need to connect more people to the Internet with quality broadband so that appropriate digital technologies can be accessed and applied. Africa is lagging behind the rest of the world in addressing these basic infrastructural requirements. If these shortcomings are not attended to, Africa will undoubtedly continue to fail to shift economic activity from a low-productivity to a high-productivity level.

Thirdly, African countries need to focus on extending the pool of skilled people. By global standards – and even by developing country standards – Africa scores poorly in the development of its people. The World Bank (2020) pinpointed Sub-Saharan Africa as the region with the lowest level of human capital development and the highest number of low-skilled workers. This disappointing outcome contradicts the assumption that the continent, with its substantial youth dividend, has great capacity for learning and entrepreneurship. The evidence shows instead that Africa is failing to use its demographic dividend.

Without serious, corrective and courageous interventions on the policy design and implementation fronts, Africa's much-needed economic transformation is at considerable risk, and the rich opportunities offered by ongoing digital advances will be wasted against a backdrop of fundamental developmental failures.

4.5. Conclusion

This chapter explored the effects of digital technologies on labour markets in developed countries as well as in African countries. The effects are very dissimilar, and it is important to take cognisance of these differences as it permits a fuller understanding of the rationale for and circumstances surrounding the application of various digital technologies. The discussion covered the mainstream research results for the effects on labour markets in developed countries, which rely primarily on task-based models. Despite the analytical departure from neoclassical

production theory, these sophisticated models are still based on typical neoclassical production assumptions.[33]

Economic adjustments in developing countries are of a rough-and-ready nature and are not easily explained in terms of task-based models, which assume smooth and costless market adjustments. Consequently, African labour markets have not been readily analysed using task-based models. In a sense, task-based models contradict the basic essence of digital technologies. The two key features of these technologies are their productivity effect and cost-cutting effect, which are passed on to consumers in the form of lower prices. These features have typified digital technologies for many years and are unlikely to change in the foreseeable future.

To gain a better understanding of digital applications in the real world, this chapter examined technology narratives. These narratives reveal that the quality of human capital can be improved through more efficient combinations of workers and technology-driven machines in the production context. Such a process is supported by flexible arrangements that encourage effective on-the-job training. This arrangement appears to be important for human capital development in Africa. As digital technologies in Africa accommodate participation across the occupational spectrum, it narrows the scope for polarisation.

In addition, technology narratives emphasise the absence of distortions associated with codifiable jobs in Africa. In developed countries, these jobs are crowded into the middle-skilled segment of the labour market. In Africa, they are new, employment-creating, home-grown jobs as well as jobs imported from developed countries as a result of offshoring. In Africa, digital technologies are geared towards employment creation – mainly because the design of the production process accommodates

33. These comprise perfect competition, the marginal productivity theory and constant returns to scale.

workers from occupations that are comparable to middle-skilled segment jobs in developed countries.

Furthermore, technology narratives show that the division of tasks – reflected in many different phases of technological development throughout the economic history of the world - does not always come in the same format. It is evident that digital technologies adapt to different types of task division as time goes by. In modern times, they require a suite of skills, in the words of Atack et al. (2019). In Africa, the application of digital technologies allows for different levels of these suites of skills. This flexible application of digital technologies narrows the scope for labour-market polarisation and appears to be an interesting policy option for African and other developing countries. Such flexibility could also assist employment creation in developed countries.

In analysing task-based models more closely, it becomes evident that the adjustment process is deficient. Adjustment mechanisms are important methodological instruments in economics as they promote convergence in an analysis. Without this capability, the outcome is an unstable intellectual framework that cannot support systematic, scientific analysis. In the light of this observation, it is not surprising that empirical research, based on these models, produces technology-anxious outcomes. As mentioned, anxiety over technology has been around since the Industrial Revolution and in recent times has reached a crescendo.

Technology narratives carry a different message from task-based models. They confirm that adjustment processes take place in the real world. Machines do not take over in an unrestrained manner. That occurs only in disequilibrium models. Moreover, technology narratives confirm that technological progress creates wealth, together with new products and new jobs. Old jobs disappear, but, on balance, new jobs exceed lost jobs by a significant margin. Even in a developing region like Africa, mobile technology (including the M-Pesa digital platform)

has displaced jobs in commercial banks but, on balance, has created more jobs for payment agents and other intermediaries, particularly women (World Bank 2019).

Despite Africa's poor institutional framework – characterised by unreliable, expensive and unevenly distributed electricity, expensive and poorly accessible broadband connectivity – digital technologies have a definite presence. Given Africa's current industrial structure and the fact that there is little scope for labour-market polarisation, digital technologies are well placed to open up new, quality employment opportunities in the manufacturing and services sectors. Applying digital technologies is like clearing a mountain pass into the interior, making overlooked opportunities more visible and accessible. However, stubborn hurdles (both at the policy and practical levels) first need to be cleared if the landscape is to change for the better.

4.6. Key takeaways from this chapter

- Regarding the effects of technological advances on employment, a key consideration is whether digital technologies threaten or rather complement different job categories. Developed countries have experienced the polarisation of their labour markets, with the so-called middle-skilled segment of the market being hollowed out and displaced by the low-skilled and high-skilled segments (particularly in the manufacturing sector). Technological progress has been a key driver of this trend.
- In developed countries, tasks that are codifiable can be performed by machines much more cost-effectively than humans in the middle-skilled worker category, who face the risk of falling wages or redundancy. These middle-skilled workers sometimes join the ranks of the low-skilled or high-skilled, whose jobs are not as easily codifiable. As the digital economy has expanded, many new (non-routine) job opportunities have opened up to those in the educated, high-skilled segment.

- Despite the evident employment-creating effects of digital technologies, labour markets often display 'technology anxiety', which is the fear that countervailing employment-creating initiatives will be insufficient to compensate for middle-skilled and even high-skilled jobs being taken over by machines. However, the risk of this occurring is highly variable across industry sectors.
- The labour-market polarisation effects of digital technologies in developed countries are not mirrored in Africa. For example, the proportion of people employed in the manufacturing sector in Sub-Saharan Africa is comparatively low (around 11%) – much lower, in fact, than in the agricultural sector (around 53%) where economic activity is largely of an informal, low-productivity nature. Given the slow pace of industrialisation and digital uptake in most African countries, there is little scope for technology-induced labour-market polarisation. Thus, there is little risk of African labour markets experiencing 'technology anxiety', as in developed countries.
- In many developing regions, including Africa, digital advances have the potential to drive the transformation from low-productivity to higher-productivity economic activity. There are two main reasons for this. Firstly, the application of digital technologies can prompt a shift of labour out of non-routine, unproductive agricultural jobs into routine, more productive jobs in the manufacturing and services sectors, which are comparatively untapped. This would be accompanied by rising incomes and more sustainable employment. Secondly, offshoring by developed countries gives African and other developing countries the opportunity to use more advanced production techniques and technology to shift from low-productivity to higher-productivity economic activity, and in the process become exposed to international trade through GVCs.
- Instead of being labour-displacing, digital technologies in Africa have the potential to be largely labour-complementing, even in the face of different education and skills levels as the

application of such technologies is often combined with on-the-job training. For example, studies have shown that African countries have successfully applied mobile technologies to improve productivity in the agricultural and services sectors. Furthermore, the expansion of fast Internet on the continent in recent years has boosted both employment and income growth.

- Traditional jobs do disappear in the wake of technological advances, but on balance the number of new jobs created should exceed those that fall away by a considerable margin. Of course, if African countries are to leverage the power of the digital economy, they need to remove current stumbling blocks that are impeding the development of infrastructure, connectivity and human-centred capacity.

Chapter 5

Leveraging global value chains and digital technologies to strengthen Africa's industrial base

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5.1. Introduction

Africa is the world's poorest continent because most African countries have been unsuccessful in structurally transforming their economies and achieving sustainable economic growth and

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development. There are many reasons for this, including geographical location, historical developments, policy failures and other impediments that have given rise to a 'poor business climate', as discussed by McMillan, Rodrik and Verduzco-Gallo (2014), Cilliers (2018), Newman et al. (2016) and Rodrik (2018).

A fundamental criterion for bringing about sustainable economic growth and development in developing countries is the structural transformation from low-productivity to high-productivity economic activity, as discussed by Lectard (2017) and McMillan et al. (2014). According to Newman et al. (2016), this transformation is best achieved through manufacturing-led industrialisation.

In contrast to a developing region like Asia, which has relied on industrialisation to turn low-productivity economies into high-productivity economies, Africa has not been able to mirror this transformation. Rodrik (2016) and Newman et al. (2016) observe that intended structural adjustments have failed in African countries because they have made the transition from agriculture to informal services, performed largely by informal traders. Industrial development has therefore stagnated, and economic transformation has failed because informal services, which are characterised by low productivity, are unable to generate diversified economic activity with sustainable employment.

According to Hidalgo and Hausmann (2009:5), the measures of a country's economic complexity (i.e. the diversity of goods that a country can produce) 'are correlated with a country's level of income and any deviations from this relationship are predictive of future growth'. For example, all countries have different inputs that can be used to produce a different mix of outputs, with the result that countries display different production capabilities. Therefore, development efforts should focus on creating conditions that encourage higher levels of

complexity with a view to generating sustainable growth and prosperity.

Bhorat, Steenkamp and Rooney (2017) assert that a key reason for Africa's failed transformation attempts is that, except for Tunisia, all African countries have low levels of economic complexity and therefore lack the capability to produce a diverse range of manufactured products. These authors' analysis points to the fact that African countries tend to underestimate the importance of increasing the complexity of the manufacturing sector – particularly if manufacturing is developed as part of an integrated supply chain.

In this chapter, a different route to industrialisation is proposed – one that escapes the complexities associated with integrated supply chains and the export of homogeneous, finished products. The proposed route is for Africa to participate more in GVCs,[34] which allow countries to step away from complicated integrated supply chains. Global value chains enable firms to specialise in the production of niche, intermediate goods and to 'trade in tasks' (instead of trade in final goods), thereby creating new economic opportunities (Grossman & Rossi-Hansberg 2008).

Recent developments in international trade and ICT have created potential new pathways for industrialisation in Africa. By embracing digital technologies and engaging in niche production for GVCs, Africa could achieve industrialisation through 'hyper-specialisation' (World Bank 2020). According to the World Bank (2020), African countries that make the transition from exporting commodities to exporting simple manufactured products via manufacturing GVCs are likely to experience higher growth rates than if they were to export homogeneous, finished goods.

34. At a regional level, value chains are known as regional value chains (RVCs). This chapter mainly talks about GVCs in a generic sense, unless it is appropriate to make specific reference to RVCs.

The aim of this chapter is to discuss how GVCs can be leveraged to strengthen Africa's industrial base. It first discusses Africa's participation status in value chains and the efficiency gains and expanded scale resulting from the application of digital technologies as well as new, ICT-related employment opportunities. It goes on to analyse the behaviour of large firms and SMEs, respectively, when they engage in international trade as these two types of firm integrate differently into GVCs.

5.2. Development of, and participation in, global value chains

The interrelationship between ICT and international trade is best explained in terms of Baldwin's (2013, 2016) globalisation narrative. The high costs of production tend to concentrate or 'bundle' production where it is the cheapest. Therefore, production and consumption are forced together. Prior to the Industrial Revolution, which commenced in the 18th century, these two activities occurred in a village household. The discovery of steam power after 1830 gave rise to the development of railways and steamships, which reduced transport costs and led to the spatial separation of production and consumption. Baldwin (2013, 2016) refers to this process as globalisation's 'first unbundling', meaning the separation of production and consumption because of lower transport costs. This unbundling of industrial activity expanded in developed countries and prompted major resource extraction in developing countries. This in turn led to the so-called 'Great Diversion' in income and wealth distribution between developed and developing countries.

Proximity or distance between producers and consumers became a prominent feature of international trade as production expanded, with production largely concentrated in the developed countries. As a result, coordination costs (the costs of moving goods from producers to consumers) started becoming an impediment to trade. However, developments in ICT and its

associated digital technologies from 1990 onwards triggered a new growth phase in international trade and globalisation. This development was an extension of the well-known, post-World War II phenomenon of intraindustry trade (where similar goods and services are both imported and exported), which paved the way for the 'slicing up' of the production value chain (Krugman 1980).

In the wake of new ICT developments during the 1990s, costs of communication declined and high coordination costs, in turn, were subjected to downward pressure (Goldfarb & Tucker 2019). These technological advances in the ICT domain signalled the 'second unbundling' of globalisation. High-tech firms opted to combine their firm-specific knowledge and expertise with low labour costs in developing countries, making the global dispersal of production possible (Baldwin 2016). As a result, the traditional factory has ceased to exist in the 21st century (Baldwin 2016; Fontagné & Harrison 2017).[35]

Similar to the first unbundling, the second unbundling saw the spatial effects of the separation of factories. The difference, however, was that the spatial effects had a more pronounced impact on global income distribution. In contrast to the 'Great Diversion' during the first unbundling (where income and wealth were distributed from developing to developed countries), the second unbundling led to the 'Great Convergence' (Baldwin 2016), where income was distributed in favour of developing countries. The breaking up of factories was triggered by the development of GVCs, which saw the production process sliced up so that the different components of the final product, together with associated services, could be produced in spatially separated locations.

35. As explained by the cited authors, the fabrication of homogeneous, finished goods (such as bottles of wine) was overtaken by value-added, unbundled production in GVCs and high value-added production of services where the latter is also referred to as 'servitisation' or the factory-free economy.

A GVC is managed by a single or a lead firm that coordinates the activities of other participating firms. For example, a firm can allocate production to a subsidiary in a different location or country. This unbundling of production is referred to as 'offshoring'. If the unbundled production goes to an independent firm, it is referred to as 'outsourcing'. The unbundling of production is primarily driven by labour-cost differences. Thus, the rationale for establishing a GVC is that it makes it possible to shift production from high-wage to low-wage countries.

The advantage of this type of production fragmentation is that participating countries or firms are able to specialise in the production of components of a final product; they are not required to have a comparative advantage in the production of that product. The comparative advantage lies in the ability to participate in the production of segments of (or intermediate) goods in the unbundled production process. Countries or firms that participate in GVCs in effect benefit from the comparative advantages of other participants.

The spatial fragmentation of production implies that the same intermediate product passes over national borders at least once. These products are associated with simple GVCs, while complex GVCs require several border crossings. The problem of double counting implied by this has been resolved through the measurement of GVC trade in value-added terms. The relevant data in this regard have been developed by the WTO and the IMF in the form of trade in value-added (TiVA) data. According to the World Bank (2020), the share of GVC exports is approximately 50% of global exports. However, African countries account for only 3% of global GVC trade in intermediate goods (Abreha et al. 2020; World Bank 2020).

As mentioned, GVCs can be globally or regionally organised. In the EU, for example, there are many opportunities for intra-EU trade via RVCs, while in South Asia, GVCs dominate. African GVCs are global in nature because intra-Africa trade is very limited.

Songwe (2019) estimated that in 2017, intra-Africa exports represented only 17% of total African exports, which is low compared with the share in Europe (69%), Asia (59%) and North America (31%). However, there are hopes and expectations that intra-Africa trade will increase once the new AfCFTA becomes fully operational. According to the World Bank (2020), the strong expansion of intraregional trade in the world from 1990 to 2015 can be attributed to both GVCs and RVCs.

The interrelationship between GVCs and manufacturing can be described in terms of two concepts: backward integration (or participation) and forward integration (or participation). Ignatenko, Raei and Mircheva (2019) describe forward integration/participation as the share of domestic value-added embodied in intermediate exports which can be consumed at destination or re-exported to a third country, and backward integration/participation as the share of foreign value-added embodied in total exports of a country. Backward integration/participation is also referred to as vertical specialisation. In short, according to Baldwin (2013), backward integration/participation is *buying from* global supply chains and forward integration/participation is *selling into* global supply chains. Commodity exporters primarily sell/supply inputs to other countries and show low value-added in their manufactured exports. In contrast, countries that specialise in manufacturing buy inputs from other countries and show meaningful backward and forward integration/participation.

Evidence submitted by the World Bank (2020) shows that from 1990 to 2015, certain countries participating in GVCs were able to switch from trading mainly in commodities to limited trading in manufactured goods. Among the African countries in this group were Ethiopia, Kenya, South Africa and Tanzania. Over the same period, Lesotho downgraded from limited trade in manufactured goods to commodities trade. Eswatini switched from limited trade in manufactured goods to trade in advanced

manufactured goods and then back to limited trade in manufactured goods.[36] Songwe (2019) explains that Botswana and Mali moved up the commodities GVC, meaning that they sold more commodities to other countries as they became more forwardly integrated.

It is clear that countries participate in GVCs in different ways, with actual trading patterns also changing over time. Trade in value-added data provided by the WTO can be applied in order to analyse some of these patterns (see Table 5.1). Table 5.1 provides information on different countries' participation in GVCs. It shows forward and backward integration/participation as well as total participation as the sum of these two magnitudes. The change in participation over the period 2005–2015 is reflected in the last column of the table. Unfortunately, many countries do not feature in the WTO's TiVA database. For the current analysis, those African countries for which TiVA data were available, plus Turkey and the BRICS countries, were selected.

The selected countries are listed in the first column of Table 5.1. It is clear from the table that Morocco, South Africa and Tunisia had the highest total GVC participation rate during the period. In respect of all three countries, the World Bank (2020) confirmed that services comprised approximately 40% of value-added exports. Furthermore, for all three countries, backward participation was greater than forward participation. This confirms that these countries were leaning towards more manufacturing participation,[37] which is in line with the World Bank findings reported above. The information in the last column of Table 5.1 can be used to expand on this observation for other time periods.

36. Ethiopia, Kenya, South Africa and Tanzania moved into manufacturing using some simple production processes, but then lost momentum. Lesotho and Eswatini managed to go into manufacturing of (particularly) textiles with trade policy support, but the process failed to produce domestic spillover effects because of poor backward participation in the domestic economy.

37. Backward participation facilitates the acquisition of more sophisticated inputs from abroad, which allows the upgrading of domestic production.

TABLE 5.1: Participation in global value chains: Selected countries, 2005–2015.

Country	Share of value-added components in gross exports, 2015 (%)		Total GVC participation index, 2015 (%)	Annual % change in GVC participation, 2005–2015
	Forward participation	Backward participation		
Brazil	19.6	12.5	32.1	5.8
China	17.5	17.3	34.9	10.1
India	14.9	19.1	34.0	9.5
Morocco	17.5	25.7	43.1	6.1
Russia	30.5	10.8	41.3	3.8
South Africa	20.1	22.6	42.7	3.6
Tunisia	16.1	28.5	44.5	2.0
Turkey	16.6	16.8	33.4	8.4

Source: WTO (2018).
GVC, global value chain.

It is evident that the tendency to move towards manufacturing has been losing momentum over time, evidenced in a falling annual percentage change in GVC participation. This is particularly true in the case of South Africa and Tunisia. It appears that these two countries changed their GVC participation rate by being less commodity driven, but their participation in GVCs for manufactured goods has also lost momentum. This is less apparent in Morocco, which moved successfully into an automotive production GVC with the EU in 2019 (World Bank 2020). Table 5.1 highlights the typical African problem of being unable to ensure a sustainable transition from low-productivity to higher-productivity, value-added manufacturing.

The last column in Table 5.1 shows that China and India maintained a healthy momentum in GVC participation over the period 2005–2015. In a similar vein, the World Bank (2020) confirmed China's and India's sustained upgrading, in terms of GVC participation, to advanced manufacturing and services. In contrast, Brazil and Russia remained prominent GVC commodity traders through strong forward participation, exporting only commodities into GVCs.

The strong backward participation in GVCs by the three African countries, as shown in Table 5.1, requires further elaboration. As indicated earlier, Africa's share of GVC activity is small, while its share of global trade in intermediate goods is presently about 3%. This number, however, does not reveal Africa's dynamic interactions with GVCs. As has been demonstrated by the AfDB, the OECD and the UNDP, Africa is in third place, after Europe and South-East Asia, in terms of GVC participation (AfDB, OECD & UNDP 2014). This means that the continent's GVC participation rate is higher than that of East Asia and Latin America – a phenomenon that has also been discussed by Abreha et al. (2020).

Such a pronounced increase in Africa's GVC participation rate is mainly because of the growth in Africa's backward integration activities (i.e. buying from global supply chains), as Table 5.1 hesitantly suggests. From 1995 to 2011, approximately 80% of Africa's participation in GVCs was because of backward integration. The corresponding figure for Latin America was 30%. Southern Africa accounted for approximately 40% of this GVC participation rate in 2011, with approximately 36% of it constituting backward participation (AfDB, OECD & UNDP 2014). Nevertheless, the figures in the last column of Table 5.1 offer a sobering reminder of the importance of ensuring that countries follow a sustainable GVC integration strategy.

Backward participation in GVCs is significant when transitioning from low-productivity to high-productivity manufacturing. A prominent manufacturing industry in Africa that relies on backward integration is the medium-tech automotive industry, which is mainly concentrated in Egypt, Morocco and South Africa. Other, similar industries are electrical machinery and metal products. Industries that are well integrated into GVCs but involve limited backward participation are the mining, construction, low-tech apparel and textile industries (AfDB, OECD & UNDP 2014).

While the discussion so far has emphasised the importance of backward integration for bringing about an economic transition,

this does not mean that forward integration (selling to global supply chains) should be discouraged. An important example in the African context is mining, a forwardly integrated industry in terms of GVCs but a significant driver of domestic growth and employment. Sadly, in South Africa, mineral exploitation, in real terms, declined by more than 50% in the period 2012–2019 because of misplaced, rent-seeking government policies that discouraged new development in this very important industry.

From the analysis on GVC participation, it is clear that African countries do participate in GVCs, both in terms of backward and forward integration. However, countries experience difficulty in achieving sustained integration. This appears to be a key reason for Africa's failure to transform the character of its manufacturing sector from low productivity to high productivity. The application of digital technologies can change this, as will be demonstrated below.

5.3. Digital technologies, efficiency gains and scale expansion in global value chains

The crucial role played by ICTs in the evolution of GVCs has been examined above, particularly their cost-reducing effects which have facilitated the dispersal of manufacturing from high-cost to low-cost destinations. Moreover, these technologies have made it possible to unbundle the production process into value-added, intermediate tradables[38] and supporting services,[39] grouped into tasks as the basic unit of production. The common denominator in all these activities is information, which is applied, communicated

38. Also referred to as components. An example is Samsung which uses special technologies to produce digital computer/tablet/cell phone screens.

39. Supporting services could take the form of design, maintenance, programming, data access and marketing.

and saved in a digital format and referred to as digital technologies (Goldfarb & Tucker 2019)

Digital technologies change economic activity in two main ways: through productivity enhancement and cost-cutting. These benefits are, as a rule, passed on to consumers without delay. The two main benefits of digital technologies are important for the transformation of African economies from low-productivity, informal production to high-productivity economic activity. With reference to the title of this chapter, such transformation can be achieved by leveraging GVCs to develop a stronger and more sustainable industrial base. The productivity effect of digital technologies induces scale expansion in GVCs. Large-scale expansions are referred to as GVC production hubs. Germany, for instance, is the global hub for complex GVC production, while the two major global hubs for medical supply chains are China and India.

Digital technologies are interrelated, and so it is not always possible to isolate a particular application within a specific GVC. This is because of the reliance of digital technologies on information or large data sets, referred to as 'big data' – particularly where the accessing of data is the result of high-speed connectivity between digital devices. Data access is driven by Internet, Wi-Fi and Bluetooth connectivity without human intervention – also referred to as the IoT. If this logical sequence of connectivity between devices and technologies is extended, the technologies are regarded as logistics technologies, according to Lund and Bughin (2019). These technologies are responsible for efficiency gains as production is upgraded in line with higher value-added supply chains associated with complex GVCs. An example is when automotive assembly is upgraded to automotive components manufacturing.

The positive, expansionary effects of digital technologies on GVCs have recently been challenged by, for instance, Lund and Bughin (2019) who claim that 3D printing is likely to send production back to the home country, reversing the GVC phenomenon.

This so-called 'reshoring' is explained in terms of the lower cost of production with 3D printing. A high-profile example was the decision by Adidas, the sports shoe manufacturer, to produce 1 million pairs of shoes a year by 2020 using 3D printing (World Bank 2020). However, in the context of GVCs, which account for approximately 70% of global trade, this is a very small number. It also represents a small fraction of Adidas's annual production of 403 million pairs of shoes (World Bank 2020).

In recent years, it appears that developments in 3D printing and the more intensive use of robots have in fact boosted the trade in intermediate products between developed and developing countries (World Bank 2020). The major participants in this expanding trade scenario are technology-intensive manufacturing industries, such as the automotive industry. Oldenski (2015) demonstrated that, apart from a few high-profile cases, there is no evidence of a significant reversal of GVC activity or a switch to reshoring in the US because of 3D printing. Antràs (2020) reached a similar conclusion in his analysis of possible reshoring, particularly in the wake of developments in 3D printing.

Global value chains that make use of digital technologies are gradually expanding in Africa. Various countries (e.g. GVCs in financial services and the automotive industry in South Africa, mobile money in Kenya, and textiles and fintech [a potential hub] in Mauritius) are taking steps to develop the capacities of these industries, through collaboration between research and training institutions in Africa and the UK in the area of international machine learning (Carman & Rosman 2019). Following on from these initiatives, various research and educational partnerships have been formed in South Africa, Kenya, Tanzania, Rwanda and Nigeria, among others, with South African universities (Carman & Rosman 2019).

Closely tied to the above-mentioned developments are a number of AI business start-ups, as discussed by Timm (2020) and Sahara Ventures (2019), in South Africa (Cape Town,

Stellenbosch and Johannesburg), Tanzania, Kenya, Nigeria and Egypt. These start-ups use AI applications in the areas of finance, insurance, banking, telecommunications, agriculture, money transfers and medical diagnostics. The most extensive and advanced AI applications are presently occurring in the South African mining industry and require further examination.

The use of robots, in the context of AI, is well established in the South African mining industry. The Minerals Council South Africa (2018) reported on the decision to introduce AI into the mining industry under the motto of 'smart mining'. Mining companies have spent over R500m in recent years on innovation and the implementation of AI, robotics, IoT connectivity and large data sets to assist with the effective, real-time management of underground, machine-driven operations. The automation of mines will ensure much safer working conditions. Moreover, mining costs are likely to fall by approximately 50%. For example, surveillance of waste dumps, stockpiles and exploration will be conducted more cheaply by drones (unmanned, airborne robots), which will collect digital imagery for further research (Arnoldi 2018). According to the Minerals Council South Africa (2018), the upgrading of mining and management procedures through the use of digital technologies, such as robotic processes in shaft sinking, is expected to extend the lifespan of mines and prevent 200 000 job losses by 2030.

The efficiency gains from this transformation of the mining industry are likely to be extensive. They will affect GVCs in a number of ways. There will be the quality and lower-cost effects that permit upgrading to more advanced GVC participation. In addition, there will be a scale effect that will increase the extent (volume) of GVC participation. The mining industry is known for its forward participation in GVCs. The extent of technological change envisaged in the South African mining industry will tilt current GVC participation towards more backward participation through imported services that accompany digital technologies.

From a developmental perspective, the leaning towards more backward GVC participation is likely to see mining become a stronger, more direct driver of economic growth. This implies that as a forwardly integrated supplier to GVCs, South Africa will become more competitive. Important destinations in the global supply chain are markets in Asia and Germany's auto resources (platinum) market. The South African mining industry will also integrate into advanced German GVCs that supply digital technologies and support services. In this sense, the industry will become more backwardly integrated than it has been up until now.

In summary, digital technologies are having an expansionary effect on GVCs, which is associated with efficiency gains and scale effects. Some African countries are positioning themselves for the application of digital technologies that support GVC participation. The most extensive and advanced applications (particularly AI applications) are evident in the South African mining industry. However, as indicated above, digital technologies are interdependent. Section 5.4 elaborates on GVCs in Africa.

5.4. Regional and global value chains in Africa

The development of RVCs is important for leveraging intraregional trade opportunities as a route towards GVC participation. The World Bank (2017) puts intraregional trade in Africa at a mere 15.7%. In Asia and the EU, intraregional trade is roughly four and five times higher, respectively. Moreover, in Asia and the EU, the extent of intraregional trade exceeds external trade by a considerable margin.

The low level of intra-Africa trade is attributable to several factors. The most important is high trade costs. Key elements of these costs are high tariffs on some products and the costs associated with NTBs, including inadequate and inefficient logistics and the high cost of transport. The formation of the

AfCFTA is expected to reduce these trade costs in a meaningful way. Unfortunately, as reported by Naidoo (2020), the underlying agreement is expected to be fully operational only in 2030 in the face of political rigidities, coupled with the effects of the COVID-19 pandemic which delayed important deliberations in 2020. The planned 17 cross-border road corridors, which are intended to integrate Africa and will be financed by the AfDB, will also take time to become fully developed and functional (AfDB 2019).

The World Bank (2017) indicates that NTBs impose additional cost elements that discourage intra-Africa trade. An example is extensive regulatory requirements, such as import and export documentation and customs procedures, which are 25%–30% more expensive than in the rest of the world. These excessive costs can easily be reduced through the standardisation of procedures and the application of digital technologies. Eliminating these costly procedures is imperative if the African continent is to open up to regional trade.

There are only a few RVCs/GVCs in Africa, the most important ones being in the automotive industry. Three countries feature prominently in automotive RVCs/GVCs. They are, in order of importance, South Africa, Tunisia and Morocco. Egypt's participation is small in comparison with that of these three countries, with the focus mainly on exports. As demonstrated by Stuart (2020), the African automotive RVCs are small in comparison with global automotive supply chains. North African countries are mainly linked to the EU's automotive supply chains, while South Africa is more integrated into the southern African market. Furthermore, African automotive RVCs are primarily focused on assembly and participating countries are therefore active as exporters – mainly of passenger vehicles.

The main automotive RVCs in Africa are assembly hubs with a large proportion of foreign value-added in their exports, from technological design features to automotive parts. This confirms their links to international networks of auto manufacturers (AfDB, OECD & UNDP 2014). South Africa is the only serious exporter of

automotive components in Africa, as reported by Stuart (2020). These components are catalytic converters which are used to control pollution from internal combustion engines. According to Stuart (2020), African countries import only 5.4% of their automotive components from other African countries.

In view of the particular nature of the automotive industry in Africa, Bell et al. (2018) and Stuart (2020) propose that the manufacturing of automotive components be expanded through an RVC. The already dominant position of the South African automotive industry in southern Africa, particularly within SACU, qualifies South Africa as a potential production hub for the mooted RVC. As Bell et al. (2018) and Stuart (2020) maintain, such a development could provide the pathway for the RVC to ultimately integrate into an international GVC.

An effective RVC would stimulate economic development through the operation of a dispersed regional supply chain. This would enhance backward integration, with positive economic spillover effects. In view of the dependence of the automotive production process on digital technologies, the expansion of the industry would benefit from the cost-reducing effects of digital technology usage. Moreover, expanded applications of digital technologies would create new jobs, as explained in Chapter 4.

Bell et al. (2018) explain that the South African automotive industry was developed to function as an export sector. Over time, it developed a net trade deficit because of an escalation in imports of components. Moreover, the policy assistance framework encouraged manufacturers to utilise export earnings to obtain rebates on imports. This behaviour inhibited the backward integration of the industry through the supply chain.

Apart from the dispersal of component suppliers in several South African provinces, component manufacturing has been established as part of a regional supply chain within SACU (Farole 2016). To this end, manufacturing ventures in Botswana and Lesotho, though small, are integrated into the regional supply chain.

As discussed by Farole (2016), Botswana established manufacturing facilities to produce automotive lead-acid batteries and wiring harness products. Lesotho supplies stitched leather products through subsidiaries of auto manufacturers in South Africa.

However, the expansion of the automotive component supply chain is constrained by the poor infrastructure in SACU countries, evidenced in inefficient and expensive electricity, unreliable logistics and poor Internet connectivity. Furthermore, small suppliers often lack the capability of meeting international quality certification requirements on a sustainable basis. Fixing these infrastructural deficiencies and removing excessive red tape are imperatives for SACU governments because it will clear the way for the application of digital technologies to enhance quality control, digital certification and communication with major auto manufacturers. In the absence of such reforms, auto manufacturers will have little incentive to expand their regional presence, preferring instead to develop the existing automotive supply parks in major industrial centres in South Africa (Farole 2016).

As discussed by the World Bank (2020), the automotive RVC within SACU has delivered a mixed performance. Its development has also come at great cost to the South African taxpayer. Despite substantial policy interventions by the South African government, the SACU automotive industry is still battling to survive. It appears that under present conditions, the industry lacks a comparative advantage to function on its own.

Other African RVCs are much smaller than the RVC discussed above. An example is the food supply chain, driven by major South African retailers. Then there is the animal feedstock and poultry supply chain. However, the development of the latter has been inhibited largely by inefficient and expensive logistics. Machinery and mining equipment developed into a successful supply chain but this was adversely affected by the decline in the South African mining industry. More recently, however, the

technological renewal of the industry has improved its long-term prospects.[40]

To be effective and sustainable, RVCs/GVCs in Africa require courageous public policy reform to improve logistics and address high trade costs, especially through the removal of punitive tariffs and the elimination of long border delays. Digital technologies could, for example, play an important role in reducing border delays through digital scanning, and digitalised documentation and certification (see Baghdadi & Guedidi 2021; and ch. 7).

5.5. Firm behaviour in global value chains

It is imperative for policymakers to understand how firms behave in GVCs, as this knowledge is one of the cornerstones of an effective industrial policy. In this regard, a distinction should be made between large firms and small and medium-sized firms.

5.5.1. Large firms

Over the past two decades, international trade has become characterised by a complex network of cross-border transactions involving intermediate goods through GVCs, with the trade patterns being driven by large, global firms. This view is informed by research conducted on the behaviour of global firms by Antràs and Rossi-Hansberg (2009), Bernard et al. (2007), Helpman (2011), Inomata (2017), Bernard et al. (2018) and Matthee et al. (2018). The important difference between these particular studies and preceding contributions is the explicit recognition of firm heterogeneity, as suggested by Melitz (2003).

40. For more insight into RVCs and GVCs in Africa, readers can consult the following: AfDB, OECD and UNDP (2014); Goger et al. (2014); Farole (2016); World Bank (2017); Arndt and Roberts (2018); Bell et al. (2018); Stuart (2020); World Bank (2020); and Christianson (2020).

The above-mentioned authors emphasise the uniqueness of international trading firms, in the sense that they have particular characteristics that distinguish them from non-trading firms or firms that serve only the home market. This is a meaningful departure from the neoclassical factor-proportions trade theory, which asserts that trade patterns are associated with homogeneous goods (single, self-contained products such as wine) that are traded by firms that subscribe to the same behavioural rules.[41] In the context of new patterns of international trade, homogeneous goods are replaced by dissimilar, intermediate goods that are traded in global supply-chain networks. The abandonment of the assumption about firm similarity or the so-called 'representative firm' makes it possible to understand international trade in new ways.

5.5.1.1. Global firms (importers and exporters) and international trade

The analysis of heterogeneous firms by Melitz (2003) suggests that firms embark on international trading activities (importing and/or exporting) if, owing to their productivity levels, they can cover the high fixed costs of trade. This implies that, in most cases, high-productivity firms are the ones entering the international trade arena, firms with medium productivity serve the home market and unproductive firms cease to operate.

Much research has been conducted in recent years on firms involved in international trade, which have been described as follows: they are large and highly productive, and command access to special technologies, particularly digital technologies. This is in line with the fact that GVCs are heavily dependent on ICT. Relatively few firms engage in international trade, which means that their presence is highly concentrated. A corollary of this is that large volumes of global trade can be traced to a small

41. A firm that abides by these behavioural rules is referred to in the literature as the representative firm.

number of international firms. These firms pay high salaries that are commensurate with their strong complement of skilled staff. Furthermore, exporting firms in various industries employ more people than non-exporters in those industries.

The above-mentioned firm characteristics have been confirmed by studies conducted in several countries. Although results differ across different country studies, the specific characteristics highlighted above have been confirmed in the US, the EU, South Africa and nine other African countries. Examples of these country studies are those by Bernard et al. (2007) and Bernard, Redding and Schott (2010) in connection with the US, Giordano and Lopez-Garcia (2019) in connection with the EU, Van Biesebroeck (2005) in connection with nine African countries and Edwards, Sanfilippo and Sundaram (2018) in connection with South Africa.

Another feature of international firms is that the performance of multi-product firms tends to be superior to that of single-product firms. This has been confirmed by Bernard et al. (2018) in connection with the US and by Matthee et al. (2018) in connection with South Africa. Bernard, Redding and Schott (2011) elaborated on the features of multi-product, multi-destination firms using US and Canadian data. For a discussion on multi-product firm models, see Breinlich and Cuñat (2016).

Clearly, the higher productivity of exporting firms is of particular importance in explaining their behaviour in international trade. It is this feature that enables them to cover the high cost of entering the international trade arena. Trade costs include the costs of identifying export markets, sourcing intermediate inputs from other countries, and arranging international production and distribution via offshoring or outsourcing alternatives. It is the large and highly efficient firms that are responsible for wage premiums, employment, productivity and product quality.

For instance, Matthee et al. (2018) demonstrated that South African export growth is driven by existing firms that expand sales of existing products in existing markets – also referred to as

expansion at the intensive margin. In addition, the analysis by Van Biesebroeck (2005) revealed that African firms that are starting to export can enhance their productivity by adopting a 'learning-by-exporting' approach. This appears to have been a significant factor in African countries achieving scale economies. Bernard et al. (2018) point out that the learning process described by Van Biesebroeck has also been observed in developed countries.

5.5.1.2. Global firm behaviour (importers and exporters) and strategic decision-making

Firms that are engaged in international trade make particular decisions regarding their organisational structure, which will determine the trade-off between offshoring and outsourcing and the FDI that is needed to support their chosen structure (eds. Helpman, Marin & Verdier 2008). These decisions are directly related to the microeconomic features of firms and can be referred to as the micro foundations of international trade.

As discussed by Antràs (2016) and others, contract theory has been successfully integrated with decision-making at the firm level. This development is explained by the importance of formal arrangements in establishing a firm's organisational structure. Contracts are also important in the formal relationships between participating parties. In this respect, Antràs (2020) refers to the relational conceptionalisation of GVCs to describe the relationships that arise from the flow of intermediate goods in these supply chains, together with technologies and services.

The cross-country nature of these relationships implies that formal agreements are hard to enforce, particularly if the quality of institution-based judicial enforcement differs across countries. It is therefore common to refer to incomplete contracts, as opposed to complete contracts, that cover all possible risks and are fully enforceable. The presence of incomplete contracts

governing the interrelationships in GVCs highlights the presence of uncertainty in firm behaviour. Trading firms, particularly multinational enterprises (MNEs), react to such uncertainty through two possible decisions. Firstly, they decide on the *location* of the different stages of GVC production, which is also referred to as the global organisation of production. Secondly, they decide on the extent to which production sites will be *controlled*. The main way to implement such control is through ownership of the producer's physical assets. These control decisions are also referred to as internalisation (Antràs 2016).

The research conducted into firm behaviour can be extended by pursuing the micro foundations concept further and relating firm behaviour to the uncertainty of incomplete contract enforcement. This relates directly to the quality and efficiency of judicial institutions. This subject has been extensively covered in the literature by, for instance, Antràs (2003, 2016), Helpman (2011, 2014), Nunn (2007), Antràs and Helpman (2008) and Nunn and Trefler (2008).

In an influential study on judicial quality and contract enforcement, Nunn (2007) concluded that the quality of law-enforcement institutions turned out to be so significant that it could feature as a comparative advantage of the country concerned. Furthermore, judicial quality and contract enforcement are particularly important in technology-intensive industries. The main reason for this is that they rely heavily on the effective and secure transmission of data or information in a digital format. The regulation of access to data can be complicated by the fact that large data sets are presently barter traded between service providers and Internet users.[42]

Antràs (2016) asserts that uncertainty about the quality of institutional litigation and contract enforcement discourages exports by new firms – also known as the extensive trade margin.

42. Service providers such as Facebook do not pay Internet users for access to their personal data but provide a range of services to their users. This is a form of barter trade.

In this respect, the observation by Matthee et al. (2018) about the intensive margin and South African exports is of particular interest. Regarding his relational approach to GVCs, Antràs (2020) maintains that the effective contractual protection of these different relationships will bestow an additional comparative advantage on GVCs. The presence of intellectual property rights as a relational element in GVCs emphasises the importance of contractual enforcement and judicial protection of such property rights. Countries that are shown to pose risks of expropriation are unlikely destinations for GVCs and FDI. Such poor judicial institutional arrangements will encourage firms to opt for different locations or to control their assets through vertical integration.

Regulatory arrangements can be complicated by diverse and often contradictory rules across countries, which discourage the development of GVCs. Moreover, they could have the unintended consequence of forcing firms into second-best global supply chains. It is important that policymakers are aware of dissimilar regulations applied by their trading partners. Nigeria, for example, is lagging behind its neighbours in the development of mobile money because local regulations act as an impediment (Gillwald & Mothobi 2019). Prospecting in the South African mining industry has been discouraged for many years, owing to the proportionately severe, cost-enhancing effects of stringent government rules pertaining to black economic empowerment.

Firms react in different ways to contract uncertainty. As argued by Bernard et al. (2010), multi-product firms have more options to switch products or markets, depending on how these impact trade costs. This is clearly illustrated in the divestment and diversification behaviour of resource and commodity-based companies in South Africa, such as the BHP Group plc. Other examples in Africa are British American Tobacco divesting from Zimbabwe and Cipla Ltd divesting from its animal health business in South Africa and Sub-Saharan Africa.

5.5.2. Small and medium-sized firms

Small and medium-sized firms or enterprises are very different from large firms. They do not have access to ample resources, such as capital and highly skilled people. Instead, family and personal savings are important sources of capital. Generally, they do not possess a particular technological feature that would secure them a cost advantage in international trade. Small and medium-sized enterprises are often highly entrepreneurial and flexible in their decision-making, though, particularly in relation to digital technologies in their businesses. As will be discussed, they are well-placed to specialise in services that support the application of digital technologies. Services are an important access route for SMEs into international trade, particularly through GVCs (Grater, Parry & Viviers 2017). As mentioned earlier, services make up a significant proportion of GVCs.

Generally, SMEs are businesses with assets, income and employment levels below a certain threshold. As a rule, they outnumber big firms and, taken together as a business category, they employ large numbers of people. Unfortunately, as indicated by Grater et al. (2017) and Liberto (2020), an analysis of their specific role in a country's economy is complicated by the absence of a generally accepted definition of the thresholds referred to above. International institutions like the IMF and the World Bank have no distinct way of identifying SMEs. Individual countries abide by their own definitions. This implies that the assessment of their economic significance differs from one country to the next.

Furthermore, Grater et al. (2017) explain the difference between formal and informal SMEs, with the former referring to registered enterprises that pay tax. South Africa's Department of Small Business Development (2019) defines SMEs in terms of employment and annual turnover, with turnover differing by sector. In terms of paid employees, the department distinguishes between micro enterprises with up to 10 employees, small enterprises with 11–50 people and medium-size enterprises with 51–250 employees.

In developing countries with small economies, SMEs are likely to employ more people than large firms. This is unlikely to be the case in large developing countries like South Africa, Kenya, Nigeria and Tunisia, where large firms are the most important employers. In this regard, Atkinson and Storey (1994) and North, Smallbone and Leigh (1994) emphasise the importance of size of SME in generating sustainable levels of employment.

The above research was followed by a study by Kerr, Wittenberg and Arrow (2013) on non-agricultural and non-mining enterprises, using South African data, covering the period 2005–2011. Their study revealed that the smallest firms experienced net job destruction because job losses, in the wake of firm failure, exceeded job creation. This pattern started to reverse itself when a firm's size grew to 500 employees and was maintained with further growth. This suggests that a firm size of 500 employees appeared to be the threshold of net employment creation in South Africa over the period 2005–2011. The application of this reasoning to international trade suggests that a size threshold for entering the trade arena is just as important for SMEs as it is for large firms.

The above analysis suggests that certain barriers to entry are probably more of a burden to small firms than to large ones. These barriers include the high cost of trade, the challenge of obtaining international certification, the difficulty in developing or acquiring the necessary skills, and the challenge of ensuring sustainable (and, in trading partners' eyes, reliable) participation in international supply chains. Another problem is discriminatory regulatory requirements (Grater et al. 2017). Ganne and Lundquist (2019) revealed that SME exports comprise 3% of Africa's gross exports. They demonstrated that SMEs feature more prominently in intermediate goods trade. This means that SMEs perform better in value-added exports than in gross exports. As argued by Grater et al. (2017), the importance of services in intermediate goods trade opens up trading opportunities for SME service providers, an area where they have a competitive advantage.

The above discussion suggests that SMEs are well placed to take advantage of their competitive advantage by joining GVCs through intermediate goods trade. By engaging in specialised trade through GVCs, SMEs are able to control trade costs more effectively than if they followed the more conventional trade route because of division of labour and the opportunity to specialise in certain components in the GVC. By importing quality, intermediate goods directly, SMEs are in a position to supply inputs to domestic production and assembly plants. Ganne and Lundquist (2019) report that such upstream SME activities are prominent in developing countries and are particularly common in automotive component manufacturing. These SME trade transactions then stimulate economic development through backward integration.

Furthermore, SMEs could export directly, which constitutes forward integration. From a cost perspective, it is more advantageous for SMEs to enter GVCs indirectly – in other words, they supply intermediate goods to exporting firms. This activity is referred to as indirect forward integration. Ganne and Lundquist (2019) indicate that SMEs in developed countries mainly engage in indirect exporting through large firms. However, such activity appears to be much more limited in developing countries, according to the authors. Small and medium-sized enterprises can also participate in GVCs through indirect backward integration, which means that they source inputs from other importers. There are numerous examples of such activity in the African retail GVC. Local SMEs source goods from South African retailers that operate shops and warehouses in the region, either for their own use or for onward supply to other local firms. Ganne and Lundquist (2019) confirm that SMEs in developing countries are mainly involved in backward integration, whether it is direct or indirect. However, their overall participation in GVCs remains small.

Grater et al. (2017) and Ganne and Lundquist (2019) discuss the many factors that inhibit SMEs' participation in GVCs on a

sustainable basis. With each of these factors, cost is the common denominator. Contributing to high costs are regulatory rigidities (such as requirements in respect of land rezoning, road signage, licensing and certification), unfriendly and cumbersome government policies, expensive and ineffective logistics, border delays, a lack of affordable finance and limited access to skills. On top of this, SMEs in Africa experience a lack of affordable and reliable electricity and Internet access because of infrastructural weaknesses.

Digital technologies, with their various cost-cutting features, can assist SMEs in reducing their present cost burdens. Broadband connectivity is a core feature of these technologies because it delivers quality Internet access. A study by Ganne and Lundquist (2019) confirmed that ICT-enabled SMEs experience more success in joining GVCs, particularly in terms of backward integration (imports). Moreover, the authors' research showed that smaller enterprises with 15 to 25 employees benefited proportionately more by becoming ICT-enabled and that women-owned SMEs were more inclined to be ICT-enabled.

The entrepreneurial behaviour of many SMEs is well illustrated by their active participation in the application and supply of digital technologies. Several South African SMEs with less than 250 employees are successfully supplying services that support digital technologies.[43] These include broadband solutions and analytical applications powered by AI and cloud computing. Small and medium-sized enterprises can reduce costs while simultaneously expanding business opportunities by applying digital technologies. Artificial intelligence, in particular, makes it possible to conduct business directly with clients and suppliers, and the details of the transactions can be saved digitally.[44]

43. See, for instance, *Mybroadband* online magazine, www.naked.insure and http://www.iol.co.za.

44. See, for instance, www.naked.insure and http://www.tymebank.co.za.

Large firms are the main drivers of and participants in GVCs. This does not, however, exclude SMEs from meaningful participation in GVCs, although the extent of SME participation (both direct and indirect) is not yet significant in developing countries. From the foregoing discussion, it is clear that SMEs are well-placed to participate in GVCs through backward integration, which serves to integrate GVC trade with the domestic economy. Under the African Growth and Opportunity Act (AGOA) trade initiative, apparel exports from Lesotho to the US initially stimulated Lesotho's economic growth, but momentum was lost because of a lack of sustained GVC integration with the domestic economy through backward integration (World Bank 2020).

According to Ganne and Lundquist (2019), SMEs do not feature strongly in GVCs. It is argued that SMEs need to attain a certain minimum size to succeed both in the domestic market and in international trade. Furthermore, SMEs are constrained by the high cost of entering the international trade arena. It has been argued that digital technologies reduce costs and open up opportunities for growth and GVC participation. Small and medium-sized enterprises are, nevertheless, dependent on supportive trade and industrial policies.

5.6. Conclusion

Africa's failure to achieve sustainable economic growth and development can be attributed to many factors. However, the root cause is the absence of a sustainable manufacturing industry. This chapter has shown that there are different ways of addressing this complex problem. Notably, developments in recent years in international trade and manufacturing have cleared the way for African countries to participate in international trade through GVCs. These value chains, which are managed by large lead firms, offer scope for producers to specialise in the production of intermediate products as opposed to standalone, finished goods.

The integration of domestic manufacturing with GVCs is only possible if the production and trade conditions are conducive to lead-firm participation. Recent research on firm behaviour confirms that lead firms are dependent on their ability, because of their superior productivity, to cover the high fixed costs of international trade. Cost-enhancing factors such as trade barriers, excessive labour costs that do not reflect a country's production capabilities, border and port delays, and inefficient transport and logistics all add to the cost burden and are not conducive to lead-firm participation.

The participation of firms in the economy of a host country appears to be highly sensitive to effective judicial and contractual enforcement by the relevant institutions. Ineffective institutions create uncertainty about the integrity and enforceability of contracts between partners along the value chain. Moreover, the protection of property rights and technology-driven intellectual property rights are of prime importance to firms. The risk of expropriation is a major deterrent to FDI.

In addition to the presence of effective judicial institutions, economic development depends on reliable infrastructure, of which electricity and broadband connectivity are probably the most important outcomes because they constitute pathways to the application of digital technologies. Africa has to come to terms with the reality that factories and electricity are inseparable.

5.7. Key takeaways from this chapter

- Africa is the poorest continent because countries have been unable to bring about the necessary structural transformation of their economies. The latter involves moving from low-productivity to high-productivity economic activities, ideally through a process of manufacturing-led industrialisation. Some African countries can be credited with developing a number of impressive, flagship industries. Yet, on the whole, economic transformation efforts have seen countries transition

from agriculture to informal, low-productivity services, which do not promote economic diversification or sustainable employment.

- Africa's industrialisation efforts could be given a boost if countries put more energy into participating in GVCs and RVCs and becoming 'niche' producers of intermediate goods. The application of digital technologies, in turn, can help to lower the costs of production, thereby enhancing competitiveness.
- Two key concepts associated with GVCs and RVCs are backward integration and forward integration. Backward integration involves buying from global supply chains, while forward integration involves selling into global supply chains. More specifically, backward integration is the share of foreign value-added (inputs) embodied in a country's exports and forward integration is the share of domestic, value-added (inputs) embodied in a country's exports. Both backward and forward integration, in their own way, help countries to grow their economic and trade capacity.
- Morocco, South Africa and Tunisia are the most active GVC participants in Africa, although their GVC participation rate is still low. A prominent manufacturing industry that relies heavily on backward integration is the automotive industry, concentrated mainly in Egypt, Morocco and South Africa. Another important industry in Africa that relies on forward integration is mining.
- Digital technologies (ranging from simple Internet access to 3D printing, robotics, AI and the IoT) deliver two main benefits: productivity enhancement and cost-cutting. Both are core requirements if African countries are to move away from informal, low-productivity activity towards high-productivity activity.
- Intra-Africa trade is very limited, and thus African value chains are largely global in nature. The main impediment to intra-Africa trade is high trade costs, which are largely because of NTBs. While Africa has automotive RVCs, they are small

compared with global automotive supply chains and focus mainly on assembly and exports. Africa could develop an RVC to coordinate existing component manufacturing in the SACU region, with South Africa as the main production hub. With the help of cost-saving digital technologies and government support, this could pave the way for the RVC to eventually integrate into a GVC. Food, machinery, mining equipment and other sectors could similarly benefit from the development of RVCs.

- Large firms are the main drivers of and participants in GVCs as they have the resources to meet the high fixed costs of trading internationally. Large, internationally connected firms can more readily access digital technologies (an important ingredient in GVCs), invest in the right human capital, and cope with a complex array of trade-related rules and regulations. Small and medium-sized enterprises are able to participate in GVCs, but it is usually more cost-efficient that they do so indirectly – by supplying intermediate goods to exporting firms. This would constitute indirect forward integration, while the intermediate goods may be acquired through backward integration or indirect backward integration.
- Even when participating indirectly in GVCs, SMEs often face hurdles, including onerous government regulations, poor connectivity, a lack of access to finance and inadequate knowledge – all of which add to the cost of doing business. Having access to fast, affordable broadband would be a major step forward for an entrepreneur with limited resources, while digital applications such as cloud computing or AI could help to open doors to many new economic opportunities.
- Governments in Africa have a major role to play in creating the type of enabling environment that will fuel more inclusive business and trade opportunities and clear the way for more direct and indirect GVC and/or RVC participation.

Chapter 6

Mobilising tax revenues in the digital era: Challenges for Sub-Saharan Africa?

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6.1. Introduction

Digitisation provides an effective means of formalising an economy so that it is better positioned to deliver steady growth, more jobs, more equitable access to public utilities, improved service delivery on the part of government and a better quality of

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life for many (Katz et al. 2010; Sabbag et al. 2012). However, policymakers are faced with a conundrum: how to balance policies aimed at expanding the digital economy and digital trade[45] with fiscal policies aimed at maximising government revenue. This is of particular concern in developing countries, which often lack robust policy frameworks to guide the complex process of taxing the digital economy.

The rapid pace at which new technologies such as advanced robotics, 3D printing and digital business models[46] are continually introduced into the marketplace makes it difficult for lawmakers and tax agencies to update tax rules as the technological landscape changes (Hadzhieva 2016). Tax practitioners face ongoing challenges in understanding both the latest technologies and how tax rules should be applied (Nellen 2015).

While discussions on ways to overcome these challenges are ongoing in both academic and policy circles, few empirical studies have been conducted to inform and motivate taxation policy reform, particularly in developing countries where tax effort[47] and tax collection are already low and comprehensive data on tax remain limited. This chapter aims to address this research gap by assessing the effect of the expanding digital

45. The digital economy can be categorised into three components: (1) business transactions using virtual currencies, such as Bitcoin, (2) the production of and trade in digital goods and services, and (3) business transactions enhanced by Internet usage (Nellen 2015).

46. Cuofano (2020) defines a digital business model as a model that leverages digital technologies to improve several aspects of an organisation. It includes how the company acquires customers and the type of products and services it offers. Examples of digital business models include the freemium model (e.g. Spotify and Dropbox), subscription-based model (e.g. Salesforce), on-demand model (e.g. Uber, Airbnb, Lyft and Etsy), peer-to-peer model (e.g. Uber and Airbnb), e-commerce model (e.g. Zappos and Amazon), ad-supported model (e.g. Google, Twitter and Facebook) and hidden revenue-generation model (e.g. Google and Facebook).

47. Le, Moreno-Dodson and Bayraktar (2012:7) define tax effort as 'an index of the ratio between the share of the actual tax collection in gross domestic product and taxable capacity'. Put simply, it is an index showing a country's effectiveness in using its available tax instruments to collect tax, relative to normal expectations regarding tax-collection abilities.

economy on government tax revenue in Sub-Saharan Africa, a region where the tax revenue-to-GDP ratio was estimated to average 16.5% in 2018 – below the Latin America and Caribbean (LAC) average of 23.1% and the OECD average of 34.3% (OECD, African Union Commission [AUC] & African Tax Administration Forum [ATAF] 2020).

The taxation challenge in the digital economy has two distinct layers. The first layer basically relates to the principle of equity and the ability to pay, and the implications thereof for the tax base. It has to do with how to determine the appropriate level of taxation on capital equipment acquired by telecommunication operators, on Internet sales and on the consumption of digital goods, as well as how consumers' purchases of wireless devices and personal computers should be taxed. There are also growing concerns over whether or not the owners of digital platforms, such as Amazon, Google and Facebook, should be taxed in the country in which revenues are generated or, alternatively, whether they should be allowed to benefit from corporate tax exemptions in certain locations (Katz 2015). These and many other issues are potential threats to governments' tax revenue mobilisation capacity in both developed and developing countries, set against the backdrop of a fast-expanding digital economy (Crivelli, De Mooij & Keen 2015).

In relation to strategic tax policy, digital advances have the potential to limit the options available to policymakers when they set out to determine the overall tax mix. Over the past decade of digital developments, companies have contributed to fiscal revenue in the form of a broad range of taxes (over and above corporate tax), such as employment taxes, environmental taxes, property taxes and land taxes. However, the emergence of increasingly sophisticated digital technologies could potentially pave the way for economic agents to avoid, remove or significantly reduce their tax liability in these spheres (OECD 2019). Digital advances have made the physical presence of customers in markets less relevant, amplified the importance of intangibles

and encouraged higher levels of integration in value chains. The challenge facing policymakers is how to reform international taxation systems to incorporate a realistic and stable approach to taxing the profits of multinational companies (Olbert & Spengel 2017).

The second layer of the taxation challenge relates to tax efficiency and collection. In this context, one could argue for the maximisation of revenue collections in the face of exponential growth in digital flows. Thus, governments should consider digitalisation as critical for revenue generation. In this regard, they should lower taxes on the digital sector to trigger revenue spillovers that are larger than the foregone taxes (Makiyama & Narayanan 2019). It can be argued that lowering taxes offers direct benefits to consumers and businesses, thereby encouraging economic growth (Olbert & Spengel 2017).

The two layers of the taxation challenge have been further compounded by the recent emergence and heightened use of digital money,[48] which is an electronic measure and store of value. In the face of escalating globalisation and urbanisation in the world, and also the high levels of interconnectedness in global trade, there is growing interest in the use of digital money for commercial transactions involving goods and services (Dodgson et al. 2015).

This chapter aims to explore, using an empirical analysis, the above-mentioned issues and debates by assessing the effect of the expanding digital sector in Sub-Saharan African economies on governments' ability to mobilise tax revenues, and in particular, tax revenues from cross-border trade. The study specifically analyses the effects of three digital development indicators (ICT goods as a share of total merchandise trade, digitally delivered services as a share of total services trade and individuals using

48. Dodgson et al. (2015) define digital money as any means of payment that is equivalent to cash but is stored in a purely digital form.

the Internet as a share of total population) on value-added tax (VAT), government taxes, excise tax, trade tax and import tax.

Performing an empirical analysis has become particularly important in the face of the COVID-19 pandemic, which could change governments' taxation priorities, divert political attention away from optimal taxation arrangements, and make it difficult for countries to contribute to discussions aimed at achieving a sustainable global consensus (Christensen 2020). The rapid spread of the virus and the measures introduced to contain its socioeconomic impact have subjected (particularly) developing country governments to the double burden of meeting domestic needs in an economically draining COVID-19 environment, while also actively participating in ongoing global negotiations over the taxing of the digital economy.

The sections that follow introduce the debate around taxation and digital developments (from both developed and developing countries' perspectives), discuss the methodology used in the empirical analysis and the main findings, and provide recommendations for policymakers and the research community.

6.2. Overview of the digital developments–tax revenue debate

The policy implications of the evolving digital economy for tax revenue mobilisation have long been discussed in the literature (Jones & Basu 2002; Teltscher 2002). Paris (2003) foresaw the potential challenges confronting governments in effectively taxing global commerce amid the growth in new digital communication technologies and the need for greater harmonisation and coordination of national tax policies. The author indicated that the pace at which international trade transactions were being conducted digitally through the Internet and other electronic networks was increasingly challenging the assumptions made by existing tax systems, including the notion of the physical locations in which transactions are effected.

This may necessitate what the author called 'globalisation of taxation' in view of countries' desire to halt the growing phenomenon of international digital commerce evading taxation. However, countries cannot effectively tax this new form of commerce unless they cooperate closely with other countries.

While such cooperation is considered a critical factor in driving the international exchange of information to address the tax administration challenges associated with the digital era, developed and developing countries have different policy positions on the matter. The differences can be traced to the taxation approaches used by developed countries and the trade liberalisation history of developing countries. The developed-country taxation narrative concentrates on multinational corporations (MNCs) and the difficulties that tax authorities experience in taxing these companies according to well-established tax principles, such as equity, an ability to pay and a generally accepted tax base (Clausing 2020).

Large MNCs that participate in world trade as geographically dispersed entities have strong links to the digital economy. As a result, they have outgrown conventional approaches to company taxation. They are highly technologically driven, with asset structures that are very different from those for which conventional taxation was designed. They are highly mobile in terms of the geographical location of their plant or head office and carry out different forms of production. Many engage in factory-free production (Morgan 2016). They also employ high-calibre human capital, which underscores the high quality of their production processes and trade in goods and services, and they devise business strategies and plans aimed at effective production, distribution, and research and development (R&D), as well as tax efficiency.

Brynjolfsson, McAfee and Jurvetson (2015) describe these features of the digital economy as 'engines of great prosperity' which require a new approach to taxation in order to capitalise on the digital economy's welfare-creating effects. Schreiber

(2015) concludes that the tax authorities in developed countries, given their obsession with 'base-erosion and profit-shifting' (BEPS)[49] avoidance measures, are preventing (or at least discouraging) investment and the welfare-creating effects of the digital economy and MNCs. In looking at the world through a BEPS lens, they overlook the opportunity to formulate tax policies that could positively contribute to wealth creation.

The OECD tax authorities are therefore looking at the 'new digital world' through old-world lenses, with tax policy, in their view, needing to be aimed at preventing BEPS (Lennard 2018). The OECD tax authorities have agreed to tax MNCs on the basis of 'value creation', yet there is no common understanding of what this means. The result is that, in the absence of a general consensus, developed OECD countries follow their own rules when taxing MNCs. By choosing this option, countries have adopted a counterproductive taxation approach, which merely adds to the cost of trade. Incurring high trade costs[50] in excess of firms' productivity levels discourages the spread of the digital economy and thus its 'engines of great prosperity' are unable to operate at full throttle.

The tax narrative of developing countries used to reflect a reluctance to support the trade liberalisation efforts initiated after World War II, with the continued imposition of high tariff walls against imports (IMF 2001). With the expansion of GVCs during the 1990s, however, developing countries experienced the

49. Base erosion and profit shifting (BEPS) can be described as 'corporate tax planning strategies that multinationals use to 'shift' profits from higher-tax jurisdictions to lower-tax jurisdictions. This contributes to the 'erosion' of the tax base of the higher-tax jurisdictions' (Schreiber 2015).

50. The trade cost–productivity nexus is explained by the heterogeneous-firm models of international trade which predict that economic activity will be redirected towards high-productivity firms in the wake of falling trade costs. This proposition has been validated by empirical evidence in the US which revealed that industries that experience a relatively significant decrease in trade costs in turn display a relatively significant increase in productivity (Bernard, Jensen & Schott 2006).

devastating effects of tariffs on their economies and embarked on strategies of trade liberalisation and industrialisation through GVC participation (Baldwin 2011). This marked the start of the era of the 'Great Convergence', with many developing countries gaining from globalisation and different patterns of income distribution. However, as described by Baldwin (2016), Africa missed the Great Convergence because African countries pursued an industrialisation strategy that involved trying to develop domestically integrated supply chains while remaining behind protectionist walls. These efforts failed, as the rest of the world had already moved on to embrace the digital era.

In recent years, exemplified by the controversy surrounding the moratorium on customs duties on electronic commerce (e-commerce) transactions, disagreements between developed and developing countries over trade liberalisation have resurfaced. Certain developing countries (India, South Africa and Indonesia) have petitioned the General Council of the WTO to review the moratorium (Business Standard 2019; General Council 2019). The moratorium refers to a policy arrangement that has been in place since the WTO's Ministerial Conference in 1998, when member countries committed to not impose customs duties on electronic transmissions (European Centre for International Political Economy [ECIPE] 2019; International Chamber of Commerce [ICC] 2019). Since its introduction, the moratorium has been renewed every two years by the WTO (Banga 2019b).

However, in communication with the WTO, the three countries emphasised the adverse revenue and employment implications of the moratorium for developing and least-developed countries (LDCs). Partly owing to differences in measurement methodologies, the estimates of the revenue implications of the moratorium differ substantially. The OECD estimates that the foregone revenue because of the moratorium ranges from 0.08% to 0.23% of overall government revenue. The effect is estimated to be relatively small for developing countries but high for those countries that rely the least on customs revenue for their overall government budget (Andrenelli & González 2019). In contrast,

estimates by UNCTAD, which have constituted the basis of developing countries' argument against maintaining the moratorium, indicate that the potential loss of tariff revenue to developing countries and LDCs was about US$10bn and US$1.5bn, respectively, in 2017. While Sub-Saharan African countries lost around US$2.6bn, the total revenue loss to high-income countries was estimated at only US$289m that year (Banga 2019b).

In relative terms, the potential tariff revenue loss for Sub-Saharan African countries was almost 10 times that for high-income countries, while for LDCs, the revenue loss was five times that for high-income countries. The top six developing countries predicted to experience the highest tariff revenue loss from the moratorium in 2017 were Mexico (US$1.9bn), Thailand (US$1.7bn), Nigeria (US$580m), India (US$497m), China (US$493m) and Pakistan (US$367m) (General Council 2019). It is projected that, by imposing customs duties on electronic trade, developing countries could generate tariff revenue that is 40 times the value of that generated by developed countries, many of which have almost zero-bound duties on physical imports of digital products (Banga 2019a; General Council 2019).

On the basis of these statistics, the three petitioning countries argue that the moratorium negatively impacts the efforts of many developing countries, which are finding it challenging to achieve digital industrialisation (Business Standard 2019). They further contend that the moratorium could threaten existing infant digital industries in developing countries owing to competition from well-established foreign industries. Such infant industries, they assert, therefore need to be protected until they are able to attain competitiveness and realise economies of scale.

Another concern of developing countries is the absence of customs duties on imports of the main resources (software, data and computer-aided design [CAD] files) used in 3D printing, a technology that is set to become increasingly popular in most manufacturing industries. This will make manufacturing sectors in developing countries more dependent on developed countries

and will adversely affect digital industrialisation, employment creation and trade competitiveness among SMEs (Business Standard 2019). Banga (2017) argues that developing countries and LDCs are fast losing their competitiveness. Unlike developed countries, which occupied the top 15 spots for electronic product exports (constituting 82% of total global goods exports) in 2015, developing countries exported just US$4bn-worth and imported about US$11bn-worth (that is, more than twice the value of their exports) of electronic products. Considering the share of cross-border e-commerce (CBEC)[51] to global trade as a whole, no developing country is among the top six countries that capture more than 85% of total global trade (Banga 2017).

Customs revenue loss is a problem not only for developing countries and LDCs. As of 2009, the annual national, state and local sales tax losses on e-commerce in the US were estimated to grow from US$8.6bn in 2010 to US$11.4bn in 2012, with a less optimistic scenario of estimated losses being US$12.65bn and an aggregate loss of US$56.3bn (Bruce, Fox & Luna 2009). European Union member countries together lose €50bn–€70bn in tax revenue annually owing to factors such as tax avoidance by digital companies and accelerated BEPS (European Commission 2019). In relation to e-commerce, identified challenges include anonymity of taxable income sources, difficulty in determining the amount of tax payable, the presence of tax havens, the prevalence of companies incurring liabilities in multiple countries, and the limited capacity of tax administrators to identify companies and manage VAT (Hadzhieva 2016). In Finland, it is estimated that a 10% movement of taxable income to platforms that do not permit access to the necessary information (data) translates into a tax shortfall of about €2.7bn for the country (Intra-European Organization of Tax Administration 2018).

51. Banga (2017:n.p.) describes 'cross-border e-commerce (CBEC) as international trade via e-commerce (i.e. when consumers buy online from merchants located in other countries and jurisdictions). It can be categorised as business-to-business (B2B), business-to-consumer (B2C), consumer-to-consumer (C2C) and business-to-government (B2G)'.

In spite of these potential losses, developed countries such as the US and various members of the EU that are net exporters have proposed a permanent ban on tariffs on e-commerce with a view to providing greater certainty to consumers and businesses. They argue that the resulting revenue losses for developing countries are small and that a tariff ban on electronic transmissions reduces market distortions (Cheng & Brandi 2019). As the moratorium lapsed at the end of 2019 without any concrete decision on the way forward (the matter was to have been debated at the WTO's 12th Ministerial Conference [MC12], scheduled to take place in Kazakhstan in June 2020, but was postponed because of COVID-19), WTO members have agreed to maintain the status quo (Hope & Stuart 2019).

However, over 130 countries are engaged in discussions regarding new rules, under the OECD's Inclusive Framework (IF) on BEPS, for the allocation of certain taxable profits to jurisdictions where users live (Doherty & Verghese 2019). Even before the release of the OECD Secretariat's proposal in October 2019, which was intended to help countries to achieve consensus by the end of 2020, some countries had unilaterally implemented interim measures to ensure tax compliance in the digital economy. For instance, in July 2019, France imposed a 3% tax on digital services-related revenues where French users are actively involved in value creation. India amended its laws in April 2019 to compel remote businesses to pay corporate tax if they have a 'significant economic presence' in the country (Doherty & Verghese 2019).

Other measures include the imposition of consumption taxes, such as VAT and goods and services tax (GST), on CBEC. In some instances, items of a low value are exempt from consumption taxes because the collection cost at the border is not worth the effort. Considering the growing volumes of these low-value imports and their associated revenue losses, some countries are considering digital platforms as a means of improving tax collection. For instance, Australia requires foreign vendors whose sales to Australian consumers exceed AU$75 000 annually to

register for and pay GST. These streamlined procedures have generated more revenue than anticipated and won the support of many businesses (Australian Taxation Office 2017).

In the African context, Hearson (2019) indicates that major policy measures that have been adopted include the imposition of VAT and excise duties on digital transactions and services delivered by foreign digital service providers and 'equalisation levies' on the profits produced by foreign digital businesses. However, the effective implementation of such measures requires international (and specifically intergovernmental) cooperation in compelling companies with no established presence in a particular country to pay taxes for which they are liable. For example, Hearson (2019) describes how Ugandan officials failed to receive the necessary cooperation from foreign companies which had ignored an instruction from the Uganda Revenue Authority to register for VAT in that country.

It is evident that the digital tax revenue mobilisation challenges that developing countries face are multi-faceted. Such challenges include an underdeveloped legal system, difficulty in measuring the tax base and uncertainty when it comes to determining taxable objects (Zeng, Guo & Huang 2012). Additional problems are the absence of a level playing field between developed and developing countries in terms of policy formulation and implementation capabilities, and the need for developing countries to enjoy greater policy space in order to participate more actively in the digital economy.

6.3. Methodology

For the analysis, the nature of the data (time and country scope) and the relationship between the digital development indicators and the proxies for tax revenue required the use of the dynamic panel GMM estimation technique. The tax revenue and digital development variables were assumed to be endogenous because of the potential simultaneity between them. Thus, there could be a reverse causality from digital developments to tax revenue and

vice versa, leading to a potential correlation between the regressors and the error term. Time-invariant country characteristics (fixed effects), such as geography and demographics, are likely to correlate with the explanatory variables (Mileva 2007).

While the data set had a small time dimension (17 years) and a larger country dimension (30 countries), the presence of the lagged dependent variable (tax revenue in the previous years) gave rise to autocorrelation (Cameron & Trivedi 2010). Furthermore, similar cross-country studies on determinants of tax revenue used the same dynamic panel regression approach (Agbeyegbe, Stotsky & WoldeMariam 2006; Alm & Embaye 2013; Castañeda Rodríguez 2018; Gupta 2007).

Taking these factors into consideration, the dynamic panel model is specified as Equation 1:

$$TR_{it} = \beta_0 + \beta_1 TR_{it-1} + \beta_2 DD_{it} + \beta_3 X_{it} + \epsilon_t \qquad \text{[Eqn 1]}$$

In Equation 1, TR_{it} represents the five tax revenue indicators (VAT, government tax revenue, excise tax revenue, international trade tax revenue and import tax revenue) which are the dependent variables of interest. In the same vein, TR_{it-1} represents the lags of the dependent variables and addresses the presence of autocorrelation between current and previous values of tax revenues, while *DD* captures the set of indicators used as proxies for development. Similarly, X_{it} is the vector of other control variables, such as GDP per capita growth rate, share of urban population to total population (urbanisation), corruption control, political stability, real effective exchange rate (REER), life expectancy and FDI inflows. The parameter β_0 is the constant term that represents tax revenue if all the explanatory variables are equal to zero.

In addition, the parameters β_1 and β_2 represent the coefficients of the lag of the tax revenue variables and digital development indicators, while the parameter β_3 represents a vector of the other control variables included in the model. The subscript *i*.....*N* represents the individual countries, *t*.....*T* is the time dimension of

the model and $t - 1$ shows the time lag of the dependent variable. It indicates that the fixed effects are a component of the error term in Equation 1, which comprises the unobserved country-specific effects, v_i, and the observation-specific errors, e_i. As a result, the error term in Equation 1 can be expanded and re-specified as Equation 2:

$$\epsilon_{it} = v_i + e_{it} \qquad \text{[Eqn 2]}$$

A variable like GDP per capita growth rate is expected to be endogenous in tax revenue because there is a potential element of simultaneity between these two variables. In addressing these problems, the Arellano and Bond (1991) difference GMM estimator, first proposed by Holtz-Eakin, Newey and Rosen (1988), was applied by using the lag levels of GDP per capita growth rate as an instrument. The inclusion of this lag variable makes the endogenous variables pre-determined and uncorrelated with the error term in Equation 1. Furthermore, in addressing the problem of the country-level fixed effects, first differences are used to transform Equation 1 into Equation 3:

$$\Delta Y_{it} = \beta_i \Delta Y_{it-1} + \beta_2 \Delta X_{it} + \Delta\epsilon_i \qquad \text{[Eqn 3]}$$

By transforming the regressors by first differencing, the fixed country-specific effect is eliminated, since it is time invariant. From Equation 2, the transformation process can be expressed as:

$$\epsilon_{it} - \epsilon_{it\text{-}1} = (v_i - v_i) + (e_{it} - e_{it\text{-}1}) = e_{it} - e_{it-1} = \Delta\epsilon_{it} \qquad \text{[Eqn 4]}$$

Something that needs to be noted is that the first-differenced, lagged dependent variable (in Equation 3) is also instrumented with its past levels. In addition, the Arellano–Bond estimator was designed for small time dimensions (T) and large country dimensions (N) panels, as in this study's case where the time is 17 years (from 2000 to 2016 inclusive) and 30 countries. Roodman (2009) observes that in large time (T) panels, a shock to the country's fixed effect, which shows in the error term, will decline over time. Similarly, the correlation between the lagged dependent

variable and the error term will be insignificant. In such cases, the Arellano–Bond estimator will not be useful in producing consistent and unbiased estimates.

However, Hayakawa (2009) indicates that the type of transformation used largely influences the finite sample behaviour of the GMM estimator. According to the author, the GMM estimator of the dynamic panel data (DPD) model transformed by the forward orthogonal deviation (FOD) tends to work better than that transformed by the first difference. This is because, in practice, using too many instruments degrades the finite sample behaviour and causes the GMM estimator to be biased. Baum (2013) confirms this assertion, saying that in the event of a large number of missing observations, the FOD is useful for minimising any biases because of gaps in the data. The advantage of the FOD over the first-difference transformation in DPD estimators is that the first-difference transformation magnifies any gaps in the data by replacing one period of missing data with two missing differences (Baum 2013).

The initial exploration of the weakly balanced data used in this analysis showed a high number of missing observations on both tax revenue indicators and proxies for digital developments across some of the countries. As a result, the models were estimated using the FODs transformation of Arellano and Bover (1995). Considering all the other explanatory variables, Equation 4 can be expanded into Equation 5 as:

$$TR_t = \beta_0 + \beta_1 TR_{t-1} + \beta_2 DD_{2t} + \beta_3 GDPPC_{3t} + \beta_4 UP_{4t} + \beta_5 REER_{5t} + \beta_6 CC_{6t} + \beta_7 PS_{7t} + \beta_8 LE_{8t} + \beta_9 FDI_{9t} + \epsilon_t \quad \text{[Eqn 5]}$$

$$\beta_1 > 0,\ \beta_2 > 0 < 0,\ \beta_3 > 0,\ \beta_4 > 0,\ \beta_5 > 0 < 0,\ \beta_6 > 0,\ \beta_7 > 0,\ \beta_8 < 0,\ \beta_9 > 0$$

In Equation 5, GDPPC represents the GDP per capita growth rate, while UP, REER and CC represent the share of urban population to total population, the REER and corruption control. In the same vein, PS, LE and FDI capture political stability, life expectancy at birth and net of FDI inflows. In this analysis, it is expected that

previous tax revenue will contribute to improved current tax revenue because of the multiplier effect of investing tax revenue through government expenditure, employment and wages.

Digital developments can have either positive or negative effects on tax revenue, depending on several factors, including existing physical infrastructure and the extent of coverage of tax policy. The *a priori* expectation of digital developments is indeterminate since African countries are at various stages of digital development and differ in their endowments of complementary factors like infrastructure, human capital and institutional frameworks, which will enhance (or impede) the implementation and application of taxation rules and regulations.

The GDP per capita growth rate is expected to have a positive effect on tax revenue because enhanced development in a country is positively associated with the relative expansion of the formal sectors of the economy (Castro & Camarillo 2014). The literature suggests a strong, positive association between education and tax revenue (Mitra 2017). However, the data on education in African countries are mostly characterised by missing observations across years. The proportion of urban population to total population was used as a proxy for both urbanisation and level of literacy because of the strong correlation between urbanisation and education. It is expected that urbanisation will have a positive effect on tax revenue.

The volume of trade can have a positive or negative effect on tax revenue, depending on the levels of formalisation and competitiveness in the economy and the extent to which trade openness (tariff reduction and removal of other trade barriers) affects tax collection (Baunsgaard & Keen 2010). However, in this analysis, two of the digital development indicators (share of ICT trade in total merchandise trade and share of digitally delivered services in total services trade) contain some trade-related elements, which raises the issue of multicollinearity with the volume of trade. This issue was addressed by using the REER as a proxy for the competitiveness of the respective countries. An increase in

REER implies that exports become more expensive (signalling a loss in trade competitiveness) and imports become cheaper. Since many African countries are import-dependent, it is expected that improved REER will translate into greater imports and consequently an increase in tax revenue from cross-border trade.

Foreign direct investment is expected to have a negative effect on tax revenue as countries may be inclined to create fiscal incentives to attract more inflows of foreign investment. From another perspective, it can have a positive effect on tax revenue as FDI inflows boost competitiveness and the formalisation of the economy. Political stability and control of corruption also create a more conducive environment for investment and the efficient management of the economy. This has an indirect effect on taxpayers' perception of government's utilisation of tax revenues. It is therefore expected that improvements in these two variables will have a positive effect on tax revenue. Improved life expectancy signifies both a cause and an outcome of development and social security. It is expected that life expectancy will have a positive effect on tax revenue, regardless of the tax indicator.

6.4. Description of data

This study relied on data from different sources for the respective years and countries. Data on tax revenues were extracted from the Government Revenue Dataset (GRD) compiled by the International Centre for Tax and Development (ICTD) and the United Nations University World Institute for Development Economics Research (UNU-WIDER) (UNU-WIDER 2019). Five indicators (VAT, total excise tax, general taxes on goods and services, taxes on international trade transactions and total tax on imports) were used as proxies for tax revenues. The average value of tax revenues measured as shares of GDP (see Table 6.1) are higher for government tax revenue (5.3%), followed by VAT revenue (2.7%), tax revenues from international trade (2.7%) and import tax revenue (1.5%), with excise tax revenue having the least value (1%).

TABLE 6.1: Summary statistics of the variables used in the analysis.

Variable	Observations	Mean	Std Dev.	Min.	Max.
Trade tax revenue	510	2.728	2.700	0.000	16.450
Import tax revenue	510	1.489	2.052	0.000	16.450
Government tax revenue	510	5.329	3.288	0.000	18.140
Excise tax revenue	510	0.985	1.079	0.000	6.016
VAT revenue	510	2.676	2.716	0.000	12.170
ICT goods as a share of total merchandise trade	510	4.827	3.083	0.000	26.059
Digitally delivered services as a share of total services trade	510	32.536	29.083	0.000	130.363
Individuals using the Internet as a share of total population	510	7.998	11.035	0.000	56.515
Urban population as a share of total population	510	21824.900	30180.550	80.998	185960.200
Real effective exchange rate	510	102.362	26.327	0.000	163.114
FDI net inflows	510	4.082	5.711	–1.048	57.838
GDP per capita growth rate	510	1.913	3.958	–36.830	17.333
Corruption control	510	33.788	22.206	0.000	84.848
Political stability	510	34.525	24.738	0.000	93.750
Life expectancy	510	57.188	6.950	43.065	74.395

Source: Authors' computation based on data from UNU-WIDER (2020) and UNCTAD (2019).
FDI, foreign direct investment; GDP, gross domestic product; ICT, information and communication technology; VAT, value-added tax.

In line with the definition of the variable in the user guide on the data, VAT, total excise taxes, and general taxes on goods and services were classified as domestic taxes in this analysis, while taxes on international trade and tax on imports were classified as cross-border transaction taxes. Total taxes on goods and services included, but were not necessarily always equal to, sales taxes

and excise taxes. Similarly, total taxes on international trade comprised both import and export taxes and, in some cases, included VAT collected at the border where countries consistently reported revenue in this way (UNU-WIDER 2019).

Similar to the tax indicators, three indicators (digitally delivered services as a share of total services trade, ICT goods as a share of total merchandise trade and individuals using the Internet as a share of total population) were used as proxies for digital developments (UNCTAD 2019). As reported in Table 6.1, the average share of digitally delivered services to total services trade (33%) is higher than the share of ICT goods to total merchandise trade (5%). The first two indicators were extracted from the United Nations Conference on Trade and Development database (UNCTADSTAT), while the data on individuals using the Internet as a share of the total population and the other correlates were extracted from the WDI of the World Bank (2019). The coefficients and the signs of the correlations among these variables included in the analysis are presented in Table 6A2 in the Appendix. They provide a preliminary idea of the potential endogeneity concerns that were addressed through the use of the GMM estimation technique.

UNCTAD (2018) defines ICT goods as:

> [*T*]hose that are either intended to fulfil the function of information processing and communication by electronic means, including transmission and display, which use electronic processing to detect, measure and/or record physical phenomena, or to control a physical process. (p. 1)[52]

In the same vein, UNCTAD (2015:5) defines digitally delivered services (ICT-enabled services) as 'services products delivered remotely over ICT networks'. As indicated in the preceding

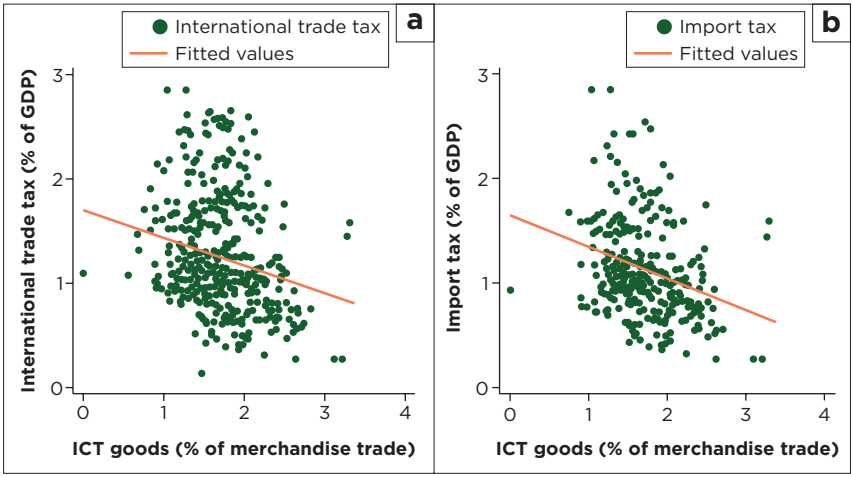
52. Details of the various classifications, constituents and methods of computing the share of ICT goods can be found in the UNCTAD technical note on ICT development No. 10 (UNCTAD 2018), while detailed explanations of the distinction between ICT goods and digitally delivered services (ICT-enabled services) and their constituents can be found in the UNCTAD technical note on ICT development No. 3 (UNCTAD 2015).

section, the large number of missing observations for both the tax revenue and digital development indicators required that the final data set used for the analysis be restricted to 30 Sub-Saharan African countries covering the period 2000–2016 (see Table 6A1 in the Appendix).

6.5. Results and discussion

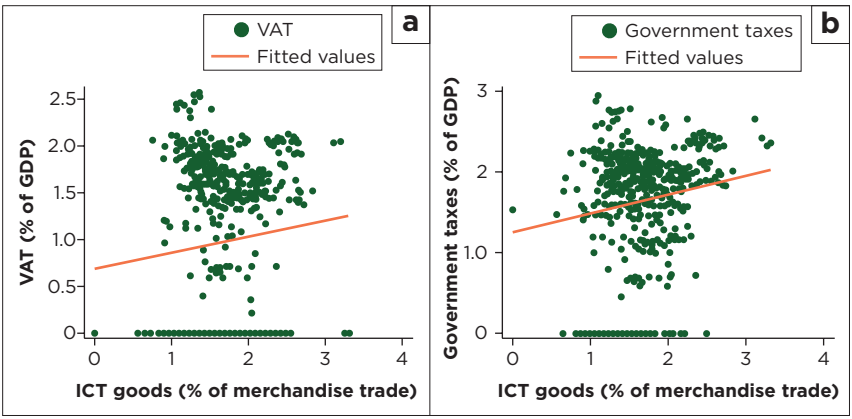
This section starts with a brief analysis of the relationship between the digital development and tax revenue indicators and then moves into a discussion of the regression estimates.

The results in Figure 6.1 show that ICT goods as a share of total merchandise trade are associated with a reduction in taxes on international trade and taxes on imports. Thus, as the cross-border trade in ICT goods as a share of total merchandise trade improves, the collection of both import and export tax revenues becomes more complex, possibly because of the sophisticated nature of the various stages of value addition in the digital economy.



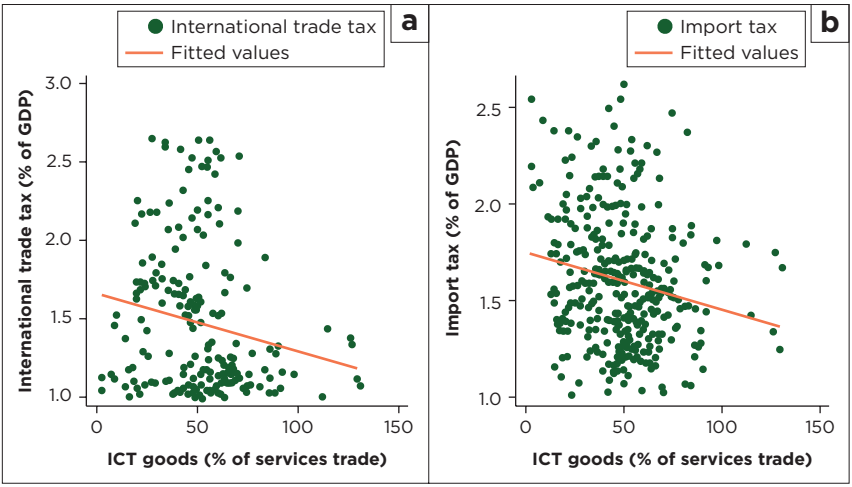
Source: Authors' computation based on data from UNU-WIDER (2020) and UNCTAD (2019).

FIGURE 6.1: Share of ICT goods in total merchandise trade and (a) international trade tax and (b) import tax.



Source: Authors' computation based on data from UNU-WIDER (2020) and UNCTAD (2019).

FIGURE 6.2: Share of ICT goods in total merchandise trade and domestic (a) VAT and (b) government taxes.



Source: Authors' computation based on data from UNU-WIDER (2020) and UNCTAD (2019)

FIGURE 6.3: Share of digitally delivered services in total services trade and (a) international trade tax and (b) import tax.

In contrast to Figure 6.1, the results in Figure 6.2 show that ICT goods as a share of total merchandise trade are associated with an increase in domestic tax revenue (VAT and government taxes on goods and services). The results suggest that although

governments in Sub-Saharan African countries may lose some tax revenue from an increase in ICT goods as a share of total merchandise trade (partly because of underdeveloped infrastructure and policy frameworks that do not effectively track the flow of transactions) (see Figure 6.1), they stand to gain if they are able to reform their domestic tax policies to leverage the opportunities associated with the expansion of trade in ICT goods.

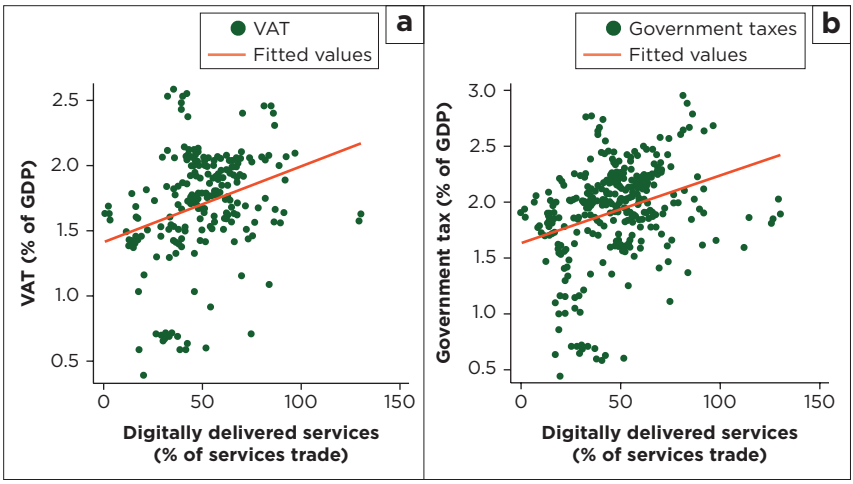
Figure 6.3 shows that as digitally delivered services increase, taxes from cross-border trade (international trade tax and import tax) decrease.

These results highlight the need for policymakers and tax administrators in developing countries to look beyond the revenue losses from cross-border trade and to consider the overall impact of digital developments on tax revenues owing to the multiplier effect of digital goods and services used in other socioeconomic activities.

Consistent with the results in Figure 6.2, Figure 6.4 shows that as the share of digitally delivered services in total services trade increases, VAT revenue and government tax revenue from goods and services also increase.

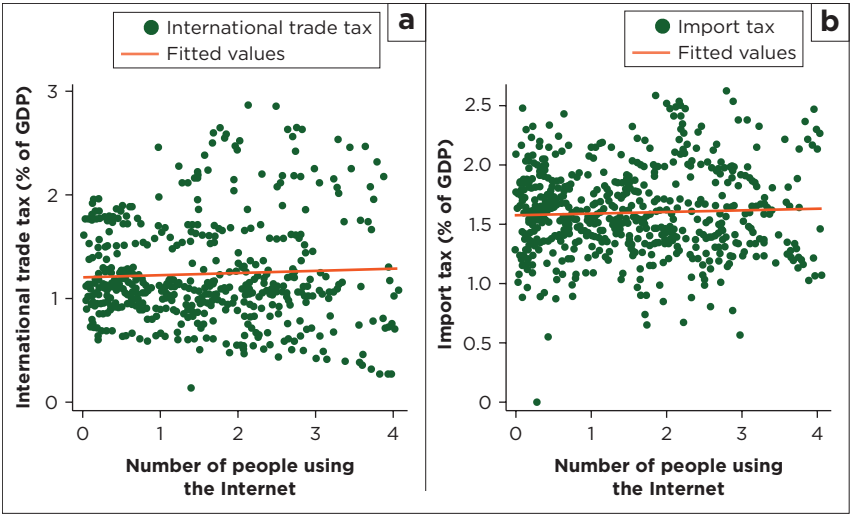
What is very evident from Figures 6.1 to 6.4 is that an increase in digitally related international trade is associated with a reduction in taxes from cross-border trade but with an increase in domestic tax revenue. It can be inferred from the results that the extent and direction of the effect of digital developments on tax revenues are largely influenced by the level of development of the country in question, its domestic tax policies, and the existence of frameworks to effectively monitor and formalise international transactions in digitally related goods and services.

The relationship between the number of people using the Internet and taxes from cross-border trade in Figure 6.5 (panels a and b) is not all that obvious. However, Figure 6.6 (panels a and b) shows that there is a positive correlation between the number



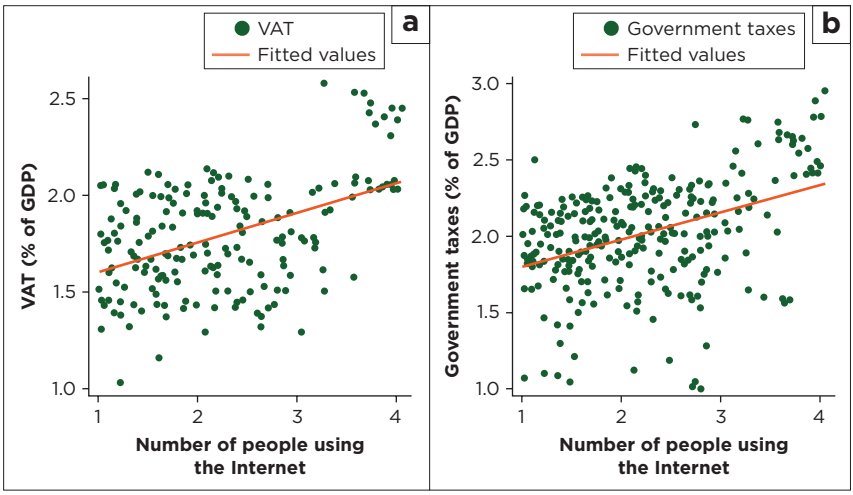
Source: Authors' computation based on data from UNU-WIDER (2020) and UNCTAD (2019)

FIGURE 6.4: Share of digitally delivered services in total services trade and domestic (a) VAT and (b) government taxes.



Source: Authors' computation based on data from UNU-WIDER (2020) and UNCTAD (2019).

FIGURE 6.5: Number of people using the Internet and (a) international trade tax and (b) import tax.



Source: Authors' computation based on data from UNU-WIDER (2020) and UNCTAD (2019).
FIGURE 6.6: Number of people using the Internet and domestic (a) VAT and (b) government taxes.

of people using the Internet and domestic taxes. This implies that as more people use the Internet for both commercial transactions and for personal use, government is able to generate more tax revenues, including those imposed on value addition.

On the basis of the above descriptive analysis, one can conclude that digital developments may not have a universal effect on all avenues of tax revenue mobilisation. The nature and extent of the effect largely depends on the type of tax (i.e. internal or cross-border) and existing tax revenue mobilisation frameworks, which vary across countries according to their levels of development.

6.6. Regression estimates

The estimates of the dynamic panel regression are presented in the same order as in the descriptive analysis to allow for easy cross-referencing. The results are grouped into three sections:

(1) ICT goods as a share of total merchandise trade and taxes, (2) digitally delivered services as a share of total services trade and taxes, and (3) individuals using the Internet as a share of total population and taxes. The discussion of the results is preceded by a brief overview of the results of the post-estimation tests (presented at the bottom of each output table), designed to assess the reliability and robustness of the estimates. The requirement for testing the presence of serial correlation is that the autocorrelation 2 (i.e. second-order) statistic must not be significant; otherwise, the second lags (previous years' values) of the endogenous variables (tax revenues) would not be appropriate instruments for their current values. The test for autocorrelation 2 (i.e. second-order) errors proves that the system-GMM models are robust, well specified and devoid of autocorrelation – hence the need to reject the test for autocorrelation 1 (i.e. first-order) errors in the models. Similarly, the Hansen test of over-identifying restrictions for testing the joint validity of the full instrument is satisfactory in all the output tables.

6.7. Effect of ICT goods as a share of total merchandise trade on tax revenues

The results in all the output tables show that tax revenues in previous years were statistically significantly[53] associated with an increase in tax revenues in the current year.[54] These positive associations could be ascribed to several factors, including government's ability to expand the tax net, an expansion in both

53. Statistical significance refers to 'the claim that a result from data generated by testing or experimentation is not likely to occur randomly or by chance but is instead likely to be attributable to a specific cause' (Kenton 2020).

54. This could possibly be explained by the multiplier effect of government spending of the tax revenue of previous years in sectors that create employment. This in turn would boost tax revenue in the current year.

public- and private-sector employment, improved investor and consumer confidence, and an increase in government's productive investment of tax revenues to spur employment and economic growth.

From Table 6.2, it is clear from the estimates of the digital developments–tax revenues nexus that at a 5% significance level, a 1% increase in ICT goods as a share of total merchandise trade is associated with an increase in VAT revenue of approximately 0.196% and an increase in government tax revenue of 0.227%, *ceteris paribus*. The results further show that at a 1% significance level, a 1% increase in ICT goods as a share of total merchandise trade is associated with an increase in excise tax revenue of 0.390%. In comparing the results, it can be deduced that an expansion of the digital economy offers opportunities for governments to mobilise more domestic revenue, with VAT constituting more than half of total tax revenues.

In terms of their classification, ICT goods – like computer monitors, cathode-ray tube, printing and copying machines, cash registers, automatic data-processing machines and many others – can be considered production inputs, which could contribute to tax revenue collection in the domestic economy. However, the decline in tax revenues from cross-border trade can largely be explained by the ban (because of the e-commerce moratorium) on customs duties on cross-border digital goods and data flows.

However, the results for cross-border trade indicate the significantly negative effect of an increase in ICT goods as a share of total merchandise trade on tax revenues. It can be observed that at a 5% significance level, a 1% increase in ICT goods as a share of total merchandise trade is associated with a 0.404% decline in trade tax revenue and a 0.234% decline in import tax revenue. The most revealing observation from these results is that the loss in tax revenue from imports is relatively high compared to that from total trade. This implies that although an increase in ICT goods as a share of total merchandise trade contributes to a decrease in both import and export revenues,

TABLE 6.2: Share of ICT goods in total merchandise trade and taxes.

Tax revenues	VAT	Government tax	Excise tax	Trade tax[a]	Import tax
Tax revenues (lag)	0.121***	0.272***	0.289***	0.389**	0.148***
	(0.037)	(0.057)	(0.060)	(0.154)	(0.049)
Share of ICT goods in total merchandise trade	0.196**	0.227**	0.390***	–0.404***	–0.231***
	(0.084)	(0.089)	(0.050)	(0.150)	(0.043)
GDP per capita growth rate	0.144***	0.282***	0.048**	0.439***	0.078**
	(0.048)	(0.045)	(0.024)	(0.063)	(0.035)
Share of urban population to total population	0.134***	0.090***	0.099***	–0.226***	–0.055***
	(0.028)	(0.033)	(0.020)	(0.032)	(0.015)
Real effective exchange rate	0.238***	0.256***	0.125***	0.029	0.077*
	(0.069)	(0.089)	(0.033)	(0.051)	(0.041)
Corruption control	0.001	–0.004	0.000	0.014***	0.006***
	(0.003)	(0.004)	(0.003)	(0.005)	(0.002)
Political stability	0.010***	0.016***	0.006***	–0.013**	–0.003
	(0.003)	(0.003)	(0.002)	(0.006)	(0.002)
Life expectancy	0.004	–0.004	0.003	–0.018*	0.020***
	(0.011)	(0.013)	(0.006)	(0.011)	(0.006)
FDI net inflows	-0.047	-0.039	–0.102**	–0.186***	–0.210***
	(0.037)	(0.091)	(0.045)	(0.072)	(0.061)
Constant	–2.457***	–1.634**	–2.046***	4.069***	0.006
	(0.582)	(0.712)	(0.397)	(0.657)	(0.306)
Observations	434	434	434	434	434
Number of years	17	17	17	17	17
Autocorrelation 2 (i.e. second-order) test	0.841	0.110	0.211	0.493	0.551
Hansen test of over-identification	12.040	21.110	11.200	7.460	13.880

Source: Authors' computation based on data from UNU-WIDER (2020), UNCTAD (2019) and the World Bank (2019).
FDI, foreign direct investment; GDP, gross domestic product; ICT, information and communication technology; VAT, value-added tax.
Robust standard errors in parentheses: ***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$.
a. Trade tax comprises both import and export taxes, while government taxes are total taxes on goods and services, which include (but are not necessarily always equal to) sales taxes and excise taxes.

the impact on import revenue is greater than that on export revenue.

Considering the other explanatory (control) variables in the models, it can be observed that a 1% increase in the GDP per

capita growth rate translates into an approximately 0.26% increase in VAT revenue and a 0.041% increase in both government tax revenue and trade tax revenue. As an indicator of the level of development of the different countries, the positive effect of a rise in GDP per capita on tax revenues reflects possible improvements in the underlying indicators of development, such as higher-calibre human resources and higher employment levels. It also gives an idea of the reciprocal effects of development and governments' fiscal space.

The results for urban population vary according to the tax revenue indicator. While an increase in the share of urban population to total population is associated with an increase in domestic tax revenues, it is associated with a reduction in tax revenues from cross-border trade. These observations can be partly explained by a potential correlation between digital development indicators and urbanisation. In other words, urban residents are more likely to use digitally related goods and services than their rural counterparts.

Consistent across all the models, the REER has a significantly positive effect on VAT revenue, government tax revenue and trade tax revenue. An increase in a country's real exchange rate increases its net imports because its exports to foreign countries become more expensive. This contributes to the widening of the current account deficit and lower domestic aggregate demand and, in turn, a lower inflation rate. The inverse can be observed when the real exchange rate declines, which makes domestic goods more competitive in foreign markets. The observed positive effects of the REER on tax revenues in this analysis support the findings from an earlier study by Agbeyegbe et al. (2006) who found that a currency appreciation contributes to lower tax revenues or its components.

Similar to the estimates of the REER, improvements in the governance indicators (corruption control and political stability) are associated with an increase in VAT and import tax revenues.

This result is intuitive because perceived high levels of corruption and frequent incidents of political instability affect both investor and consumer confidence. They also affect people's perceptions of how their taxes are used and consequently their willingness to pay taxes. The results also highlight the importance of good governance for tax revenue mobilisation in Africa.

Improved life expectancy is also associated with significant improvements in VAT and import tax revenues. As a measure of human capital, improved life expectancy contributes to increased productivity and capital accumulation for further investment. The relationship between life expectancy and tax revenue is somehow cyclical and self-perpetuating. This means that investing in the health of the population has an indirect effect on a country's ability to mobilise tax revenue.

Inflows of FDI have great implications for economic growth, capital accumulation, human capital development, competitiveness, development of the financial sector, technological progress and the generation of tax revenue in the host country (Bayar & Ozturk 2018). In this analysis, an increase in FDI net inflows is associated with a reduction in revenues from VAT, government tax and import tax, but is associated with an increase in trade tax revenue. It can be deduced that the contribution of FDI net inflows to export tax revenue is higher than that to import tax revenue. These results are both causes and consequences of domestic policies that influence international trade.

Many African countries offer tax holidays to foreign investors with the objective of spurring employment in specific sectors. However, in many instances, domestic policies are not binding enough to compel these investors to employ more local people. Consequently, taxes from investors and potential employees are not realised. There is evidence that these incentives often trigger large revenue losses and administrative and welfare costs for governments (Klemm 2009). The results from this study suggest that tax revenue losses associated with FDI net inflows are largely

the result of the type of tax indicator and possibly also the existing domestic policies relating to tax incentives in a given country.

6.8. Effect of digitally delivered services as a share of total services trade on tax revenues

Consistent with the descriptive analysis (see Figure 6.3), the results in Table 6.3 show that at the conventional levels of statistical significance, digitally delivered services are associated with an increase in domestic tax revenue indicators (VAT, government tax and excise tax revenues), but a decrease in trade tax and import tax revenues. Compared with ICT goods as a share of total merchandise trade, the estimates of digitally delivered services as a share of total services trade are lower. This observation is intuitive because transactions involving digitally delivered services are more advanced than transactions involving ICT goods – hence, the smaller proportion of the former in developing countries.

It is also important to indicate that while these coefficients may appear to be small in percentage terms, the magnitudes in value terms depend on the size and level of development of the country in question. For instance, 0.5% of GDP in South Africa and Nigeria would be substantial compared with 0.5% of GDP in a country such as Burundi. Although the magnitudes and the level of significance differ, the direction of the relationships of the other correlates are the same as in Table 6.1, where ICT goods as a share of total merchandise trade is the policy variable of interest. Another important observation, which is also consistent with the preceding analysis, is that the effect of an increase in the GDP per capita growth rate is higher in the government expenditure tax revenue and trade tax revenue models than in the sub-components of tax revenue models, such as VAT and excise tax revenue.

TABLE 6.3: Share of digitally delivered services in total services trade and taxes.

Tax revenues	VAT	Government tax	Excise tax	Trade tax	Import tax
Tax revenues (lag)	0.117**	0.233***	0.597***	0.297*	0.129**
	(0.052)	(0.047)	(0.071)	(0.171)	(0.052)
Share of digitally delivered services in total services trade	0.003*	0.005***	0.011***	–0.003*	–0.003***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)
GDP per capita growth rate	0.138**	0.496***	0.047	0.058	0.059
	(0.054)	(0.066)	(0.063)	(0.107)	(0.039)
Share of urban population to total population	0.125***	–0.002	0.161***	–0.217***	–0.041**
	(0.013)	(0.031)	(0.043)	(0.056)	(0.016)
Real effective exchange rate	0.108	0.086	–0.036	0.156*	0.122***
	(0.113)	(0.091)	(0.066)	(0.083)	(0.034)
Corruption control	0.000	0.005	0.012**	0.012**	0.000
	(0.003)	(0.005)	(0.005)	(0.005)	(0.002)
Political stability	0.007**	0.007**	0.001	0.003	0.001
	(0.003)	(0.004)	(0.003)	(0.006)	(0.002)
Life expectancy	0.013	–0.003	–0.018*	–0.033***	0.030***
	(0.011)	(0.010)	(0.010)	(0.008)	(0.006)
FDI net inflows	–0.198***	–0.389***	–0.098**	–0.297**	–0.166***
	(0.076)	(0.051)	(0.050)	(0.140)	(0.053)
Constant	–1.719***	0.496	–0.763	3.834***	–1.125***
	(0.616)	(0.693)	(0.661)	(0.702)	(0.369)
Observations	434	434	434	434	434
Number of years	17	17	17	17	17
Autocorrelation 2 (i.e. second-order) test	0.974	0.386	0.153	0.190	0.470
Hansen test of over-identification	8.480	15.820	15.480	13.200	14.650

Source: Authors' computation based on data from UNU-WIDER (2020), UNCTAD (2019) and the World Bank (2019).
FDI, foreign direct investment; GDP, gross domestic product; VAT, value-added tax.
Robust standard errors in parentheses: ***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$.

Other variables, both from domestic economic activities and cross-border trade, that have a positive effect on tax revenues are the REER and good governance indicators (corruption control and political stability). While an increase in FDI net inflows is associated with a decrease in all types of tax revenues, an increase in the share of urban population to total population is associated

with an increase in domestic tax revenues and a decrease in tax revenues from cross-border trade. For instance, at a 1% significance level, a 1% increase in the proportion of urban population to total population is associated with a 0.125% increase and a 0.161% increase in VAT and excise tax revenues, respectively. However, at 1% and 5% significance levels, a 1% increase in the share of urban population to total population is associated with a 0.217% decline and a 0.041% decline in tax revenues from international trade and imports, respectively.

6.9. Effect of individuals using the Internet on tax revenues

The results of estimates of the relationship between the number of people using the Internet and taxes appear in Figure 6.6. An increase in Internet usage by one person is associated with an increase of 0.018% in VAT revenue, an increase of 0.007% in government tax revenue and an increase of 0.006% in revenue from excise duties, *ceteris paribus*. These results support the argument promoted in an earlier study that 'the Internet induces a change in the structure of public revenue from resource revenue to non-resource revenue', particularly in resource-rich developing countries (Gnangnon & Brun 2019:1). The Internet may be used by some individuals to conduct business transactions and engage in other economic activities, which could contribute to government tax revenues.

Furthermore, Table 6.4 shows that at a 1% significance level, an increase in the number of people using the Internet is associated with a 0.012% decrease in tax revenues from imports. It is evident across all the models that the effects of digital developments depend on the tax indicator and, to some extent, the nature of the association between a given digital development indicator and the other correlates. The findings from the present study support those of an earlier study (Makiyama & Narayanan 2019) that any protectionist action, such as the complete revocation of

TABLE 6.4: Individuals using the Internet and taxes.

Tax revenues	VAT	Government tax	Excise tax	Trade tax	Import tax
Tax revenues (lag)	0.110**	0.181***	0.144***	0.260**	0.136***
	(0.045)	(0.038)	(0.036)	(0.107)	(0.048)
Internet use	0.018***	0.007**	0.006***	0.001	-0.012***
	(0.004)	(0.003)	(0.002)	(0.006)	(0.002)
GDP per capita growth rate	0.155***	0.308***	0.070***	0.386***	0.069**
	(0.039)	(0.052)	(0.022)	(0.054)	(0.033)
Share of urban population to total population	0.120***	0.056***	0.096***	–0.105***	–0.063***
	(0.028)	(0.021)	(0.020)	(0.032)	(0.018)
Real effective exchange rate	0.166*	0.078	0.059**	–0.005	0.115***
	(0.094)	(0.084)	(0.026)	(0.054)	(0.032)
Corruption control	0.001	–0.001	0.002	0.002	0.003
	(0.003)	(0.003)	(0.002)	(0.003)	(0.002)
Political stability	0.007***	0.008**	0.005***	0.002	0.000
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
Life expectancy	–0.009	0.010	0.007	–0.027**	0.032***
	(0.013)	(0.009)	(0.005)	(0.012)	(0.006)
FDI net inflows	–0.147***	–0.238***	–0.212***	–0.173**	–0.194***
	(0.046)	(0.047)	(0.021)	(0.070)	(0.057)
Constant	–0.847	–0.449	–1.137***	2.986***	–1.062***
	(0.589)	(0.555)	(0.409)	(0.605)	(0.305)
Observations	434	434	434	434	434
Number of years	17	17	17	17	17
Autocorrelation 2 (i.e. second-order) test	0.128	0.171	0.125	0.156	0.643
Hansen test of over-identification	14.710	12.760	14.51	6.49	14.150

Source: Authors' computation based on data from UNU-WIDER (2020), UNCTAD (2019) and the World Bank (2019).
FDI, foreign direct investment; GDP, gross domestic product; VAT, value-added tax.
Robust standard errors in parentheses: ***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$.

the moratorium on tariffs on international electronic transmissions, could be fiscally counterproductive.

The positive effect of digitalisation on domestic tax revenue across the models can be attributed to the digital economy's contribution to the expansion of the tax base. For instance,

digital platforms facilitating person-to-person commercial exchanges (such as Airbnb or Uber) can elevate transactions that were previously conducted informally to more formal economic activity, which enhances these transactions' transparency for the tax authorities (Devereux & Vella 2017). Digitalisation can also limit the chances of tax avoidance and tax evasion. For example, governments can leverage the power of digital technologies to expose taxpayers' true income levels and efficiently allocate various types of information to relevant parts of the tax system. Digitalisation can, therefore, potentially improve tax compliance and revenue collection (Jacobs 2017). In Kenya, for instance, the financial inclusion reforms made possible by innovations like mobile money and banking spurred the development of the Kenya Revenue Authority's iTax system (Ndung'u 2017).

Aside from Internet usage, other control variables that have a significant effect on VAT revenue and government tax revenue are the GDP per capita growth rate and the REER. An increase in the share of urban population to total population is associated with a significant reduction in excise tax and import tax revenues, but an increase in VAT, government tax or trade tax revenues. Although the results are statistically insignificant, increased corruption control is associated with an increase in government tax, trade tax and import tax revenues, but a decrease in VAT and excise tax revenues. Similarly, political stability significantly increases VAT, excise tax, trade tax and import tax revenue, but not government tax revenue. Foreign direct investment net inflows are associated with a decrease in all indicators of tax revenue, while life expectancy is associated with a significant increase in import tax revenue only.

This analysis has revealed that the determinants of tax revenues in Sub-Saharan Africa are multi-faceted and each indicator needs to be analysed on its own merits. The results partly support the conclusion reached in earlier studies by Jones and Basu (2002) and Teltscher (2002) that developing countries

would be adversely affected by tariff revenue losses if CBEC took place in a tax- and tariff-free environment. Yet the results also contradict the generalisation by Jones and Basu (2002) that such a decrease in tax revenues would place developing country economies in jeopardy.

The present study provides evidence that corroborates the Makiyama and Narayanan (2019) argument that it is important to look beyond the revenue losses incurred in cross-border trade and consider the potential impact that the imposition of tariffs on digitally related goods and services will have on domestic prices, consumption, economic growth and public finances through government receipts of various domestic taxes. The study also reveals elements of the Brynjolfsson et al. (2015) view of the digital economy: that the expansion of the digital economy offers opportunities for governments to collect more domestic revenue through VAT.

6.10. Conclusion

Digital developments will continue to shape all spheres of life, from social to economic and scientific. However, taxing the digital economy has remained a challenge for many countries – particularly developing countries which generally do not have resilient frameworks or a regulatory environment capable of monitoring the complex characteristics of digitalised business models, including their remote presence, reliance on intangibles and data, and widespread user participation.

In view of the limited number of empirical studies that have been conducted on taxing the digital economy, this study assessed the effect of digital developments on tax revenues derived from domestic and cross-border economic activities in 30 Sub-Saharan African countries. Three indicators (share of ICT goods in total merchandise trade, share of digitally delivered services in total services trade, and individuals using the Internet as a share of total population) were used as proxies for digital

developments, while taxes on goods and services, VAT, total excise tax, taxes on international trade and import tax were used as proxies for tax revenues.

Key findings from the descriptive and econometric analyses were that digital developments offer both opportunities and challenges for tax revenue mobilisation, depending on the type of tax indicator. Digital developments, for example, have a significantly negative effect on tax revenues from cross-border trade (international trade taxes and import taxes) but a positive effect on domestic tax revenues (VAT, excise tax and government taxes on goods and services). These results suggest that although governments in Sub-Saharan Africa may be constrained in their ability to mobilise tax revenue from cross-border trade – possibly because of weak policy frameworks and underdeveloped infrastructure, which fail to keep pace with digital developments – they nevertheless have the potential to significantly improve overall domestic tax revenues.

The current trajectory in digital advances may not have universal effects across all tax indicators. As a result, protectionist actions, such as the complete revocation of the moratorium on tariffs imposed on e-commerce transactions and domestic policies that impose excessive restrictions on activities in the digital economy, could be fiscally counterproductive. The relatively smaller decline in trade tax revenue implies that the loss of revenue from imports of ICT goods exceeds the loss in export revenue.

It is therefore important that policymakers in Sub-Saharan African countries identify the various sources of revenue loss associated with digital advances and design appropriate policies to address them. Governments, and in particular, tax administrators, tax compliance officers and allied bodies, must collaborate with regulators in the digital economy, such as providers of digital platforms and telecommunications operators, to ensure proper monitoring of digitally related cross-border transactions to reduce revenue losses.

6.11. Key takeaways from this chapter

- As more and more countries embrace digitalisation as a means through which to formalise their economies and boost job-rich growth, policymakers are faced with a conundrum: how to promote greater data flows and encourage the uptake of digital technologies, while also contributing to government revenue through taxation of data flows and ICT goods and services.
- In Sub-Saharan Africa, the contribution of tax revenues to GDP is very small and thus there is room for much improvement in this area, particularly as public debt levels have reached alarming levels in the wake of COVID-19. However, governments' collection capacity is generally poor. Moreover, as GVCs become increasingly complex and market jurisdictions become less clearly defined, many businesses employ shrewd tactics to avoid or reduce their tax liability.
- From a trade perspective, there are ongoing debates about whether or not owners of digital platforms, like Amazon, Google and Facebook, should be taxed in the countries in which their revenue is generated (which is most countries in the world). Even if governments had the regulatory structures and administrative capacity to tax cross-border data flows, there is currently an international moratorium on the imposition of customs duties on e-commerce, which applies to an extensive range of ICT goods and services. Some countries are, however, circumventing this blanket rule by introducing selective digital taxation measures at a national level.
- While some countries bemoan the loss of potential tax revenue resulting from the moratorium, one could argue that it is in governments' interests to minimise taxes on the digital sector as this will trigger economic activity and revenue spillovers that will be greater than the foregone taxes. This, in turn, should translate into economic growth in the countries concerned. In addition, in a highly technologically driven world

with continuously evolving asset structures and revenue streams, conventional taxation models are possibly becoming somewhat outdated.

- As few empirical studies have been conducted on tax regimes in developing countries, the authors of this chapter conducted a quantitative study to determine the effects of digital developments on tax revenues derived from both domestic and cross-border economic activities in Sub-Saharan Africa. Among the key results were that digital developments have a significantly negative effect on tax revenues from cross-border digital trade (evidenced in international trade taxes and import taxes) but a positive effect on domestic tax revenues (evidenced in VAT, excise tax and government taxes on goods and services). Interestingly, too, the study revealed that although an increase in ICT goods as a share of total merchandise trade contributed to a decrease in both import and export revenues, the impact on import revenue was greater than that on export revenue.
- The results from the study suggest that although governments in the region may be constrained in their ability to mobilise tax revenues from cross-border digital trade (possibly because of inadequate policy frameworks and infrastructure), the potential exists to significantly improve domestic tax revenues.
- The study highlighted the need for African policymakers and tax administrators to look beyond the revenue losses sustained from cross-border digital trade and consider the favourable net effect of digital developments on tax revenues, which should be used as a foundation to stimulate the domestic economy.
- Of course, the effects of digital advances and trade on tax revenues are heavily influenced by a country's level of development and the efficiency and effectiveness of its tax regime. Enhancing the capacity of the relevant authorities to administer the taxation system efficiently and effectively and to ensure tax compliance is therefore of primary importance.

APPENDIX

TABLE 6A-1: List of countries included in the analysis.

No	Country	Freq.	%
1	Benin	17	3.33
2	Botswana	17	3.33
3	Burkina	17	3.33
4	Burundi	17	3.33
5	Cameroon	17	3.33
6	Central African Republic	17	3.33
7	Côte d'Ivoire	17	3.33
8	Ethiopia	17	3.33
9	Gambia	17	3.33
10	Ghana	17	3.33
11	Guinea	17	3.33
12	Kenya	17	3.33
13	Madagascar	17	3.33
14	Malawi	17	3.33
15	Mali	17	3.33
16	Mauritius	17	3.33
17	Mozambique	17	3.33
18	Namibia	17	3.33
19	Niger	17	3.33
20	Nigeria	17	3.33
21	Rwanda	17	3.33
22	Sao Tome and Principe	17	3.33
23	Senegal	17	3.33
24	Seychelles	17	3.33
25	South Africa	17	3.33
26	Tanzania	17	3.33
27	Togo	17	3.33
28	Uganda	17	3.33
29	Zambia	17	3.33
30	Zimbabwe	17	3.33
	Total	**510**	**100.00**
	Number of countries (N)	**30**	**100.00**

Source: Authors' computation based on data from UNU-WIDER (2020), UNCTAD (2019) and the World Bank (2019).

TABLE 6A-2: Correlation coefficients of the variables of interest.

Variables	VAT	Government tax	Excise tax	Trade tax	Import tax
Government taxes	0.6917***				
Excise tax	0.5892***	0.5710***			
Trade tax	–0.1712***	0.1254***	–0.2963***		
Import tax	0.2096***	0.2235***	–0.0214	0.5004***	
Share of ICT goods in total merchandise trade	0.0649	0.1756***	0.3452***	–0.1133**	–0.0678
Share of digitally delivered services in total services trade	0.2141***	0.2362***	0.0779*	–0.0254	–0.0394
Internet users	0.2219***	0.3241***	0.1413***	–0.1078**	–0.0661
GDP per capita growth rate	0.1195**	0.2642***	0.1400***	0.2216***	0.0992**
Share of urban population in total population	0.0126	–0.1974***	0.1553***	–0.4234***	–0.3749***
Real effective exchange rate	0.0882**	0.0513	0.1750***	–0.2065***	–0.2088***
Corruption control	0.1802***	0.3412***	0.1072**	0.3782***	0.2466***
Political instability	0.1640***	0.3219***	0.0183	0.4056***	0.2636***
Life expectancy	0.2543***	0.3572***	0.1216***	0.2041***	0.3213***
FDI net inflows	–0.0232	0.0180	–0.1228**	0.1668***	0.0407

Source: Authors' computation based on data from UNU-WIDER (2020), UNCTAD (2019) and the World Bank (2019).
ICT, information and communication technology; FDI, foreign direct investment; GDP, gross domestic product; VAT, value-added tax.
Robust standard errors in parentheses: ***, $p < 0.01$; **, $p < 0.05$; *, $p < 0.1$.

Chapter 7

Digital technologies: Benefits for transport and trade facilitation in Africa

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7.1. Introduction

The movement of people and goods using different transport modes is one of the cornerstones of economic activity. Indeed, population growth and GDP and international trade trends have all been strongly correlated with the global demand for transport

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(Gurayah 2020). However, as transport expands in many parts of the world and new transport routes open up, countries are becoming increasingly concerned about the impact and potentially disruptive effects of human and cargo movements on the environment (International Transport Forum [ITF] 2019).

Over the past 300 years, transport has undergone several disruptions, such as the transitions from animal to machine traction, from sail to powered navigation and from coal to liquid fossil fuels. The nature of transport today is the result of these kinds of disruptions having evolved over time. By 2050, even more dramatic changes are predicted in the transport sphere, which will influence the ways in which people access work, goods, services and leisure pursuits (ITF 2019). Disruptive episodes can be attributed to a combination of factors, such as the relatively low cost of replacing old technologies with new ones, and old technologies becoming obsolete in a short period of time (ITF 2019). As a result, new (and more efficient) technologies are being developed to minimise the disruptive and potentially harmful effects of expanding transport activity. One example is autonomous, self-driving vehicles that offer relatively stress-free transport, even in very congested traffic conditions. Another example is electric vehicles which use fuel cells that are powered by solar energy, thereby reducing the environmental impact of rising traffic levels in many countries.

With Africa's population expected to increase dramatically by 2050, economic activity is likely to surge on the continent – as will the demand for transport (The Economist 2020). In this regard, African countries will need to innovate and introduce new technologies to remain appealing to trade and investment partners, and to keep up with global competitors. As with other innovations, efficient and environmentally responsible transport products and systems can help to facilitate trade, but they can also have a detrimental effect on other key areas of the economy – notably employment. A balance must therefore be struck between seeking short-term competitiveness and long-term sustainability (Gurayah 2020).

Transportation and logistics are crucial for any business dealing in physical goods – whether they are raw materials, production inputs or final products aimed at end customers. Africa, though, faces significant transport and logistical challenges, resulting in poor integration of supply-chain activities. This is particularly evident at ports and land border posts where there is a lack of integration between the activities of customs authorities and other supply-chain participants (Hoekman 2018). A general view is that most actors in a supply chain organise their activities in relative isolation, trying to optimise that part of the chain that they can control instead of striving for the holistic optimisation of the supply chain, of which they form a part (Hoffman 2019).

What is often lacking is an in-depth understanding of the impact that different supply-chain participants have on one another, and therefore on the efficiency of the supply chain as a total, integrated system. Developed countries have achieved high levels of supply-chain efficiency by integrating not only their customs systems at ports and land border posts (including government agencies sharing transactional data) but also information from other (including private-sector) stakeholders, which is an essential requirement for well-functioning global or regional value chains.

The integration of information and processes for the purpose of supply-chain efficiency is also directly linked to the regulatory environment. Those countries whose regulations encourage rather than hamper competition are likely to demonstrate higher levels of supply-chain efficiency. For example, one would expect to find many competing road and rail operators servicing large ports in Europe, North America and the Far East, with well-established free trade agreements giving momentum to trade. African ports, in contrast, are typically operated by a state-owned monopoly, serviced by a railway operator that is similarly a state-owned monopoly, often operating within a heavily regulated transport industry. Furthermore, goods transported across borders are usually subjected to complicated and time-consuming

customs procedures (ITF 2019). Not surprisingly, Africa's supply-chain efficiency levels are much lower than on other continents.

Practical trade facilitation efforts on the African continent have revealed that one of the biggest challenges to achieving supply-chain efficiency is aligning the motives, objectives and activities of public- and private-sector entities. In most African countries, government agencies still view their role as rigid enforcers of the law (such as preventing customs duty evasion), while the majority of commercial operators expend much time and effort in evading the law for personal gain instead of upholding the law for the common economic good (Moïsé & Sorescu 2019). Added to this is the prevalence of corruption, where government officials often play a rent-seeking role instead of promoting and enforcing legal activities. If this vicious circle is not broken, Africa will fall further and further behind the rest of the global economy, which has largely moved beyond this mindset (Moïsé & Sorescu 2019).

Empirical research on transport processes and systems in Africa provides evidence of the benefits associated with efficient and effective transport and logistics. One of the keys to bringing about improvements in these areas is to use the large volumes of data generated by new-generation ICT systems. By mining such data sets, one can determine if the activities of different participants in a particular supply chain are optimally coordinated, and if and where bottlenecks are occurring. This process allows close monitoring and performance benchmarking of each operation along the chain. The patterns and trends emerging from these data sets will reveal exceptions and deviations in performance as they occur as well as cause–effect relationships, which will allow corrective action to be taken.

Moïsé and Sorescu (2019) point out that the proper examination of the problem of corruption at border posts has until now been hampered by a lack of data. They add that countries whose officials display higher levels of integrity at border posts usually have more efficient border processes, and that higher levels of

integrity can only be assured if better-quality data on border-related activities are available and can be effectively monitored. The same data sets used for performance management, for example, can be used to measure compliance among supply-chain participants. Such compliance is crucial for improving cooperation between public- and private-sector participants.

Economies with the most efficient trade regimes can attribute some of their success to the introduction of authorised economic operator (AEO) programmes. An AEO programme is an operating model that many customs authorities have introduced to facilitate trade and to provide incentives for customs and traders to work in partnership under so-called customs–business partnerships (World Customs Organization [WCO] 2010). The purpose of these programmes is for customs authorities to share the responsibility for security with the private sector, and to encourage the private sector to comply with programme guidelines. Incentives used to induce such compliance include reduced levels of surveillance or control, simplified customs procedures, less frequent reporting requirements and deferred payment.

The foundation of a successful AEO programme is the willingness of commercial operators to have their actions accurately measured so that their levels of compliance with trade regulations can be verified. In return, they enjoy higher levels of freedom or flexibility from the authorities, typically in the form of fewer inspections of goods in transit, thus allowing global supply chains to function with minimal disruption (WCO 2010). This, however, calls for mutually beneficial relationships based on trust and the belief that all will benefit in the long run if everyone adheres to the rules. This is the fundamental premise of the WTO Trade Facilitation Agreement (TFA) and is a goal that Africa should embrace and work towards (WTO 2020a).

Yet successfully incorporating AEO programme ideals and practices into the fabric of its diverse transport and logistics processes is one of the biggest hurdles that Africa needs to clear

in order to become a meaningful player in GVCs and RVCs. In the wake of the COVID-19 pandemic, enhanced integration has become even more crucial as countries continue to depend on efficient trade flows under strict rules and standards.

Data on supply-chain movements and transport corridors in Africa are limited. Only a few studies have been able to pinpoint exactly which activities in specific regional transport corridors are causing the biggest delays or pose the greatest risks. In recognition of this, this chapter aims to provide some insights into the challenges that African countries face in their quest to move goods along transport corridors and manage other supply-chain processes. It suggests a number of ways in which Africa can use ICTs and digital solutions (including data analytics) to better coordinate port and land-border activities and streamline customs-control processes – all with a view to making trade on the continent more competitive. It also highlights how various technologies can lay the foundation for more effective transport in Africa, especially the movement of perishable cargo through cold chains.

The chapter draws from empirically based case studies on selected transport corridors in southern and East Africa. The case studies demonstrate the use of data analytics in probing various practical problems within the broad fields of transport and trade facilitation. Ultimately, the chapter sets out to highlight how data analytics and other technologies can improve decision-making at key points in the supply chain, thus promoting more cooperation between supply-chain participants, shortening lead times and reducing costs.

7.2. The need for enhanced supply-chain efficiency across Africa

In recent decades, globalisation and technological advances have led to the rapid growth and development of global and regional supply chains, with efficient transport and logistics being critical

ingredients in cost-effective supply chain management (Gurayah 2020). Throughout the world, more products have been moving longer distances because of concentrated production facilities in low-cost manufacturing locations. In many countries, road transport is still the dominant mode of transport for goods, but sea and air transport play critical roles in linking different activity points in supply chains (Rushton, Croucher & Baker 2017).

The ITF (2019) predicts that the demand for transport and the mobility of goods and people will continue to grow over the next three decades, and that both passenger and freight demand will triple between 2015 and 2050. This will largely be because of the dramatic growth in global and regional supply chains, which will put even more pressure on trading partners to ensure efficient and mutually beneficial transport and customs systems. While freight transport declined in the early stages of the COVID-19 pandemic in 2020, as economic activity throughout the world contracted and traded products came under more intense scrutiny, many are cautiously optimistic that, as countries' vaccination programmes gain momentum, freight and (especially) passenger transport will recover from 2021 onwards. Moreover, Punte et al. (2020) are of the opinion that if passenger and freight transport become better integrated, these systems will become more efficient and resilient in the face of future shocks.

The transportation of goods (invariably supported by a variety of services) in global or regional supply chains is highly dependent on the efficient functioning of regional transport networks and infrastructure. The largest role players in these networks include ports, road and rail operators, customs authorities and other agencies regulating the movement of goods across borders, transport companies that move goods between locations, and traders (including producers, manufacturers and consumers) (Arvis et al. 2011). However, trade routes can only function efficiently if unnecessary barriers are reduced or eliminated. The forging of targeted infrastructure links between countries to facilitate the physical movement of goods is known as 'spatial integration' (Uszkai 2016).

In the literature, the removal of barriers along trade routes and the streamlining of trade across borders are collectively referred to as trade facilitation. More specifically, the WTO describes trade facilitation as the removal of red tape and delays that add to the burden of moving goods across borders. It includes the simplification, modernisation and harmonisation of trade processes (WTO 2020a).

Simplifying and streamlining processes at borders can contribute to a reduction in transport costs. There is a large body of research focusing on the critical importance of trade costs for the competitiveness of a country or industry. Trade costs cover all those elements that increase the final consumer price of a product in an importing country, such as international transport costs, tariffs, NTMs and 'behind-the-border' costs like the local distribution and business environments (Hoekman & Shepherd 2015). According to the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) (2015), tariffs in the Asia–Pacific region constitute less than 10% of bilateral trade costs, while NTMs constitute as much as 60%–90% of bilateral trade costs. These kinds of studies emphasise the importance of giving strong policy attention to the lowering of trade costs (Hoekman & Shepherd 2015). In the modern context, with online trade flourishing and customers becoming increasingly demanding, this is even more crucial.

African countries have an opportunity to use digital technologies, including digital trade facilitation measures, to reduce trade costs and become more competitive. The estimated value of the African logistics market is US$150bn per year. Recent years have seen the growth of innovations like automation and block chain in southern and eastern Africa (International Finance 2019), while mobile apps and online shopping have gained traction and helped to alleviate some of the traditional supply-chain costs and bottlenecks. Not only have Sub-Saharan African logistics businesses been given a boost in the wake of increased mobile penetration and e-commerce usage, but 'big data' is being increasingly used to aggregate end-to-end haulage

operations and enhance the tracking and tracing of goods in transit.

The WTO has prioritised trade facilitation in recent years, with the TFA, which came into effect in 2017, poised to dissolve some of the recurring trade barriers experienced in Africa (WTO 2020a). Importantly, the TFA contains provisions for speeding up the movement and customs clearance of goods. According to the WTO (2015), the implementation of the TFA would have a more profound effect on global trade than the elimination of all remaining tariffs throughout the world. It has been estimated that the TFA could help to reduce average trade costs by as much as 15% and significantly boost global trade. This is something that African countries cannot afford to ignore (WTO 2015).

Despite these positive developments, driven in particular by large firms, many African importers and exporters still have to contend with variable import tariffs and quotas or all-out bans on certain goods, restrictive rules of origin, price controls, poor Internet connectivity, weak infrastructure, and border and port congestion (International Finance 2019). Africa has not fared well in terms of trade facilitation. In general, African countries have high trade costs, inadequate infrastructure, and complex customs and administrative procedures at borders (UNCTAD 2019). Not only do high trade costs make locally produced goods more expensive, and thus less globally competitive, but they also add to the cost of production inputs that have been imported (Portugal-Perez & Wilson 2008).

Though vast, Africa's market is known for being very fragmented, with cross-border activity hampered by particularly sluggish customs processes (World Bank 2012). Empirical research has shown that customs and border costs in Africa are up to 30% higher, and the processing of documents takes up to 25% longer, than the global average (UNECA 2013). According to Hoffman et al. (2016), the value of exports within the SADC region could grow to US$400m and globally to US$2bn per year if delays at borders were cut by just one day.

This highlights the importance of seeking alternative solutions to Africa's many transport corridor problems, including border post issues, and investigating whether better use could be made of ICT and digital solutions to overcome the hurdles. Jordaan (2014) argues that many African countries are of the view that geographical closeness (or proximity) alone will result in successful economic integration among neighbouring countries. Yet proximity and trade agreements offer few advantages if they are not supported by efficient trade facilitation measures. Enhanced trade facilitation and the implementation of more efficient border procedures will go a long way towards improving African countries' competitive position vis-à-vis regional partners and the rest of the world.

The challenge for the African continent lies in how to overcome the significant, historical backlog of infrastructure and transport-related problems. For example, road transport in Africa accounts for about 80% of all freight moved, but more than 50% of Africa's roads are still unpaved (Infrastructure Consortium for Africa 2017). While the building of additional or overhauling existing infrastructure are often presented as solutions, better use of technology and digital enhancements – for example, improving the accuracy of overload-control measures – could reduce the need for continuous investment in infrastructure. Previous studies have shown that investing in overload-control measures ultimately results in cost savings for road operators and road users that are 20 times greater than the initial cost of implementing such measures (Martinez et al. 2018).

In a recent report produced by the WTO (2020b), it was stated that even though trade restrictions remain widespread, WTO members are increasingly adopting trade facilitation measures across different sectors. These measures are mainly aimed at eliminating or reducing import tariffs and export duties and simplifying customs procedures. Customs authorities are important role players in the context of trade facilitation as they regulate and control the movement of goods between countries

and across borders. Traditionally, customs authorities were tasked with regulating imports and exports through the imposition of tariffs and other taxes and watching out for illegal trading activities, such as smuggling (Truel 2010). However, as global supply chains have evolved and become more complex, customs agencies have become part of the trade facilitation effort by easing the flow of goods across borders, while still implementing revenue-collection and security measures.

The role of customs authorities has therefore become much more complicated, resulting in ICT systems and processes becoming crucial trade facilitation instruments. For example, many customs authorities rely on data on past and current transactions to make relevant, informed decisions about the risks posed by such transactions and the appropriate measures to address these risks. With the impact of the COVID-19 pandemic still being felt around the world, cost-effective customs and trade facilitation processes have never been so important. In a joint statement by the ICC and the WCO in April 2020, the organisations called for cooperation between customs authorities in the face of the crisis, urging open dialogue and a willingness to share data and information (ICC 2020).

7.3. Using ICT and digital solutions to enhance trade facilitation in Africa

The integration of ICT and digital solutions into transport and logistics processes is very important for trade, as it leads to shorter production times, more efficient supply chains and better customer lead times (Ponnan 2020). It is well known that intra-Africa trade is limited because of high trade costs (Hoekman 2018). Reducing trade costs in Africa is partly dependent on increasing productivity in several service sectors, including transport and logistics. The eradication of unnecessary red tape at borders and better use of technology are key components of this process. However, more streamlined logistics will only be

possible if there is better coordination between specific countries' and regional ICT systems.

The world is moving increasingly towards the use of highly connected, intelligent networks that link people to their smart devices. Globally, several advanced technologies, such as autonomous vehicles, high-capacity vehicles, alternative fuel technologies and drones, have opened up new opportunities to streamline the flow of goods through supply chains (ITF 2019). Numerous other technological developments have come into mainstream use, such as radio frequency identification (RFID) tags, satellite tracking and monitoring, smart fuel tags, e-toll tags and satellite navigation (Ponnan 2020).

Technology could play a central role in transforming the way business is conducted across borders in Africa. As the 4IR gains traction on the continent, producers and service providers are under growing pressure to adopt on-demand, personalised and secure modes of doing business. Despite significant advances having been made by large MNEs such as DHL, the African logistics environment continues to lag behind many other countries in terms of physical and digital infrastructure (MEST Africa 2019).

While not discounting the value of more traditional trade facilitation measures, some studies have shown that a combination of digital and traditional trade facilitation measures could have an even greater impact. According to Mbouwé (2020), ICT solutions such as trade information portals, the 'single-window'[55] concept at border posts, automated customs procedures, port information systems and e-payment solutions all help to facilitate trade. Duval and Mengjing (2017) define digital trade facilitation as the use of modern ICT tools to streamline and automate international trade procedures. Duval, Utoktham and Kravchenko (2018), in exploring the impact of cross-border digital trade

55. This is a facility that enables trade and transport entities to submit standardised sets of information and documents via a single, online platform in order to comply with relevant regulatory requirements.

facilitation measures, found that the application of cross-border digital trade facilitation measures in addition to traditional forms of trade facilitation could result in a 26% reduction in trade costs.

Africa already has various digital trade facilitation incentives in place to support trade. For instance, the AU will be launching the African Trade Observatory Dashboard, which is an information platform with continental reach (AU 2019). Furthermore, several African countries have started to implement the single-window system. For instance, Ethiopia implemented an electronic single-window system (eSWS) in order to streamline border processes and cut documentary red tape. The system is estimated to reduce the normal clearance time for traders from 44 to 13 days and compliance costs by an estimated 50% (World Bank 2020). These kinds of initiatives underpin the concept of 'smart borders', which will be discussed below. In addition, several regional payment-system initiatives are being developed, capable of significantly reducing international payment transaction costs. Examples include the SADC Payment Integration System and the EAC Payment and Settlement Systems Integration Project (Mbouwé 2020).

Although there have been a number of success stories in recent years, there is still a great deal of room for Africa to implement digital trade facilitation measures so that government and private-sector organisations, working in partnership, can better coordinate their cross-border activities, reduce trade time and costs, and stimulate regional trade. Long processing times and low infrastructure utilisation levels are mainly caused by lengthy delays at processing points along transport corridors and slow travelling speeds because of missing or badly maintained infrastructure. Improved coordination resulting from the integration of logistics activities can have a notably positive effect. For instance, information drawn from common systems can be used to monitor levels of infrastructure utilisation and maintenance. This is where coordinated border posts or smart borders come in.

7.4. Smart borders

The importance of effective border controls was never so clear as when the COVID-19 pandemic first swept through the world, with enormous pressure suddenly placed on border posts to make rapid adjustments to their administrative processes, under exceptionally difficult (and uncertain) circumstances. As COVID-19 has played out, sea and land border posts have had to adhere to much stricter health and safety regulations, with sanitising and screening procedures taking up a considerable amount of time — all while operating at reduced operational capacity or without a full staff complement. These extraordinary circumstances have brought into sharp relief a number of problems that have beset Africa's sea and land border posts for decades, and which have not yet been addressed.

In many parts of Africa, available resources for the control of cross-border trade have been declining because of shortages of human resources, expertise and funding, among other factors. Given these constraints, African countries could benefit from a more coordinated approach to border control, in which various ICT and digital solutions, including data analytics, are shared among regional partners (Kieck 2010). These types of solutions will allow customs authorities and other supply-chain participants to rely more on technology than on physical inspections when setting out to protect countries against potential risks borne by imported cargo. They will also help to prevent frequent, costly bottlenecks at ports which are the first point of entry for imported cargo intended for various destinations on the continent.

A number of government and private-sector organisations have been calling for the implementation of coordinated border management (CBM) (Polner 2011). The WCO (2008) describes CBM as cooperation among national agencies involved in border security as well as the coordination of regulatory requirements for moving goods across borders. Although the WCO regards these functions as CBM, other institutions make reference to, for

example, smart borders or one-stop border posts (OSBPs) (Polner 2011). Irrespective of the terminology used, the underlying rationale is improved communication and collaboration between role players at border posts, which in turn will enhance border efficiency (Aniszewski 2009).

One-stop border control, or a similar joint-control arrangement, has been adopted by western European countries since the 1960s. Both the SACU (Kieck 2010) and the SADC Cross-Border Road Transport Agency (2017) have long recognised the importance of establishing smart border posts to assist with trade facilitation in the region. An OSBP is currently operational at Chirundu between Zambia and Zimbabwe, which has been successful in reducing cargo-processing times. It is estimated that the establishment of the Chirundu OSBP has produced cost savings of around US$486m per year (UNECA 2013). Estimates also show that the average cross-border transit time per truck narrowed slightly from 39 hours to 35 hours between 2007 and 2012.

Another example is the OSBP agreement signed by South Africa and Mozambique in 2013. The purpose of the agreement was to implement an integrated border management system at common border posts between the two countries. South Africa has also been pursuing a similar arrangement with Zimbabwe with respect to the Beitbridge border post, which is plagued by overcrowding, dysfunctional scanning systems, and poor cargo-tracking and container depot processes (Bowen 2017). However, Africa still faces much criticism over inadequate physical infrastructure, ICT systems and cooperation between government agencies (Woolfrey & Tshuma 2013).

Improved movement of goods across borders and between countries requires a great deal of information. Transactional data can be used to streamline the movement of goods along regional supply chains. Furthermore, the evolving ICT environment has given rise to improved trade facilitation measures as it proceeds

to incorporate an ever-expanding range of networks, hardware, software and other technological applications. In the wake of these developments, virtual customs clearance is now possible in many countries, permitting customs officials and traders to communicate in the absence of any physical interaction (Makunike 2017).

The purpose of introducing more and better ICT in customs systems is to digitise the clearance process and ultimately move to a paperless system (ITC 2018). This will make it much easier to merge countries' transactional data, shorten the clearance time and unblock congested border posts. A transition of this nature requires a common online platform that connects government authorities and enables them to exchange information (ITC 2018). Furthermore, scanning cargo with X-ray security scanners can speed up cargo inspections, while closed-circuit television (CCTV) surveillance systems can be used to enhance inspection efficiency and transparency (ITC 2018). Moreover, the establishment of a shared online platform can help to coordinate and standardise customs law-enforcement measures (ITC 2018).

Notwithstanding all these innovative developments and their time- and cost-saving benefits, very few of the above-mentioned ICT and digital solutions have been implemented in Africa. Even where certain technologies already exist, many customs offices still do 100% physical inspections on imported consumer goods. One of the problems is how to determine at which points (in regional transport networks) ICT/digital solutions should be implemented so that they will have the greatest positive impact on trade.

As advanced ICT/digital solutions are costly and take time to implement, many government organisations are hesitant to initiate such projects. This makes it all the more critical to first establish what the status quo is along specific transport routes and networks in Africa, and then arrive at the optimal solutions.

In some cases, these may come from government; in others, the private sector may also need to get involved.

The authors of this chapter have conducted several studies over a period of time to collect detailed, ground-level data on the movement of goods along some of Africa's transport corridors. The empirical analysis that follows, drawing on selected studies, reveals some of the typical problem areas that the authors have identified along specific transport corridors and routes in Africa.

7.5. Empirical analysis

The authors used data sets obtained during certain studies that they conducted in southern and East Africa. The data were obtained from several role players in the logistics industry and are presented in the form of three different case studies.

The results of the analysis show the inconsistent and problematic logistics environments in specific transport corridors as well as sub-optimal customs processes in Africa, suggesting that better-structured information systems and data analytics could help to reduce current supply-chain inefficiencies and promote stronger cross-border trade.

The three case studies are as follows:

- An analysis of data on the port of Dar-es-Salaam in Tanzania, which reveals delays in processes controlled by the terminal operator and the customs authority.
- An analysis of transactional data exchanged between freight forwarders and customs authorities in South Africa, which reveals the customs processes followed and their risks and shortcomings.
- An analysis of cold-chain profiles of perishable cargo, moving across national boundaries from depots to retail outlets, which reveals varying levels of compliance with service-level agreements (SLAs) and risks of damage to cargo.

7.5.1. Case Study A: Coordinating ports and customs activities: The case of Dar-es-Salaam

Ports constitute a vital economic link between international trading partners located in different parts of the world. While the link between port processes and customs-clearance processes is efficient in most developed countries, the same cannot be said for most developing countries (Arvis et al. 2013). In Sub-Saharan Africa, the port processing time for cargo is still around 20 days, compared to global benchmarks of three to four days (Raballand et al. 2018). Such a long processing time adds to supply-chain costs, with the total cost of landed goods in the Sub-Saharan Africa region being about twice that of many other regions in the world (Portugal-Perez & Wilson 2008). This places Sub-Saharan Africa countries in a disadvantageous position alongside competitors from South America and Australia, which also largely export raw materials and import manufactured goods.

This case study investigated the primary reasons for long delays in the processing of cargo through the port of Dar-es-Salaam in Tanzania (Hoffman 2019). The port forms part of the Dar-es-Salaam corridor, which serves not only Tanzania but also landlocked countries in the region, such as Uganda, Rwanda, Burundi, Malawi, Zambia and the eastern DRC. The challenges experienced at the port of Dar-es-Salaam are typical of trade corridors in the Sub-Saharan Africa region. Data on port processes at Dar-es-Salaam were obtained from the Tanzania International Container Terminal Services (TICTS) and the Tanzania Revenue Authority (TRA) and covered the 2017 calendar year.

The first step in the analysis was to quantify the relative contributions of customs and terminal operations at the port to the processing times of cargo falling under different customs regimes. More specifically, it involved comparing import cargo (i.e. cargo staying in the country of importation) with transit cargo (i.e. cargo re-exported to a neighbouring, landlocked country).

The results were intended to inform policy relating to regulations for the processing of documentation by the customs authority and the physical handling and movement of the cargo from maritime to land-based transport modes by the port authority (Hoffman 2019).

Cargo was categorised according to customs-clearance plans and customs regimes, which have proved to be key determinants of the relative contributions of customs and terminal operations to measured processing times (and delays) (Hoffman 2019). It was apparent from the available data that there were big differences in the way that customs treated cargo consignments falling into the different categories. The focus of the analysis was mainly on inbound cargo as this type of cargo is generally subject to longer delays than outbound cargo.

Customs divided inbound cargo into two customs categories: import (code IM4) and transit (code IM8). Customs further distinguished between several so-called clearance plans, the two most important ones being pre-arrival declarations (PADs) and post-manifest declarations (PMDs). The authors therefore divided cargo consignments into four categories based on these two types of plans and reported results separately for each category. This allowed the reasons for the long processing times/delays in each category to be investigated.

A practical obstacle to the smooth flow of cargo was the prevalence of choke points (or points of congestion), where authorities applied some level of control to ensure compliance with the regulations. The fact that both import and transit goods were processed by the same entities and through the same choke points might have had time-wasting consequences, such as:

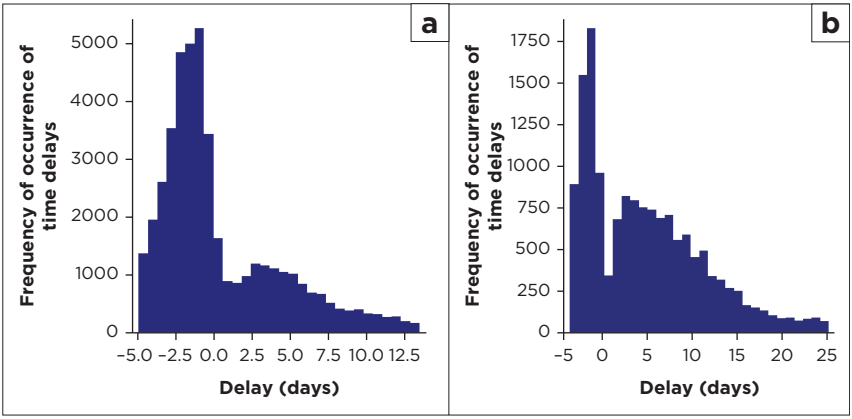
- Transit containers might have had to wait while import containers were scanned at the port's X-ray scanner.
- Trucks collecting transit containers from the port might have had to wait in the same queues as trucks collecting import containers.

- Transit containers already discharged from ships might have had to wait to be taken to the X-ray scanner because the fleet of port trucks was busy offloading import containers.

For this reason, the authors analysed both import and transit traffic to assess the performance of the two cargo streams as well as the possible impact of one performance area on the other (Hoffman 2019).

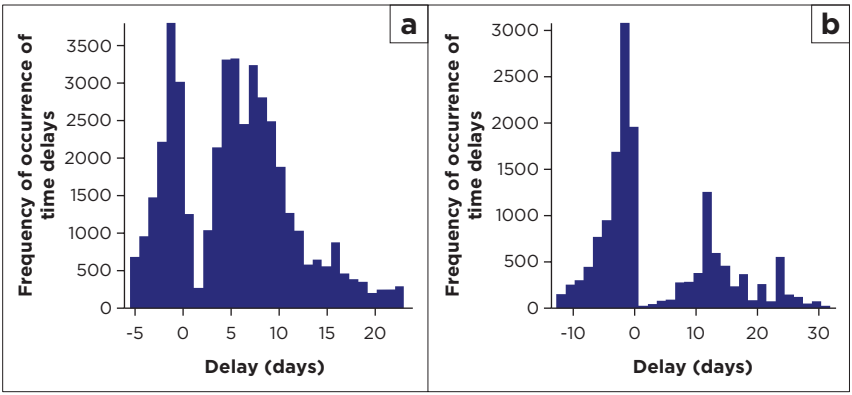
Careful analysis of the data provided conclusive evidence of the following:

- For import and PADs, the customs process was the primary bottleneck as it caused delays well in excess of those caused by the port process, as can be seen in Figure 7.2 (diagram a). This conclusion was reached following a comparison between the time taken for customs clearance and the interval between the payment of the port invoice and the clearance of the cargo. The time taken for the total customs process, from submission of the declaration to clearance, ranged from 14 to 17 days. The time taken to verify and assess the declarations and to physically inspect the cargo represented a significant part of this time period.
- For transit and PMDs, the port process was the primary bottleneck as it caused delays in excess of those caused by the customs process, as can be seen in Figure 7.2 (diagram b). The total port process, from arrival of the vessel until payment of the port invoice, took between 7 and 15 days. The single biggest contributor to port delays was the time from discharge of the cargo to the issuing of an invoice to the importer, as can be seen in Figure 7.1 (diagram b). This appears to be the result of transit cargo being handled mainly by freight agents from neighbouring countries and data on imported cargo not being immediately available to freight agents from outside Tanzania (because they were not allowed to use the eSWS and had to work via Tanzanian agents).



Source: Hoffman (2019).

FIGURE 7.1: Processing time/delay between discharge and payment of port invoice per declaration, based on the (a) pre-arrival declarations (PADs) and (b) post-manifest declarations (PMDs).



Source: Hoffman (2019).

FIGURE 7.2: Processing time between payment of port invoice and customs release for import and transit goods, based on the (a) pre-arrival declarations (PADs) and (b) post-manifest declarations (PMDs).

- While almost no transit cargo was inspected, the large fraction (proportion) of import cargo that underwent inspection, together with the fact that all containers (including all transit containers) had to be X-ray scanned, contributed to congestion

in and around the port and added to the delay in processing both import and transit goods. As the times when the containers went to and returned from the scanner at the port were not available, the magnitude of the delays could not be accurately quantified.

It was clear that many operational aspects in and around the port could be marginally improved, but the long average cargo dwell times in the port were mainly attributable to the following:

- The TRA selected a large fraction of import cargo declarations, specifically PADs, for the 'red lane', which were then subject to physical inspection. This largely defeated efforts by the commercial trade community to expedite the clearance process by arranging pre-arrival customs declarations and also called into question the purpose of having a green/yellow/red lane system. In essence, the green lane is for cargo that moves through the port or across the border without customs stopping or inspecting the goods, as documentary processes were performed before the cargo arrived at the port. Yellow and red lanes are for cargo that did not follow proper customs processes in advance and needs to be detained for document checking or cargo inspection.
- The TRA required all inbound containers to be X-ray scanned, resulting in further delays, even after cargo was released, because of a lack of adequate port–land transport capacity as well as congestion inside the port between the harbour operation and intermodal container depots (ICDs) and long queues at the scanners.
- Foreign freight agents did not have access to the eSWS and thus did not immediately receive invoices from the port once cargo had been discharged.

The better use of technology and efficient data analytics could assist in reducing these problems. The first two problems mentioned above could largely be eliminated by employing a data analytics-based customs risk management system that uses historical data on customs infractions (breaches) to produce a quantified risk figure for cargo before arrival. By using such a

system over a period of time, it should be possible to reduce the fraction of physical inspections from more than 70% to around 1%–2% for high-risk cases and the fraction of scanned containers from 100% to below 25% for moderate-risk cases (Laporte 2011). This should reduce cargo dwell time from around 14 days to less than 3 days on average, in line with international standards, which would benefit the entire regional economy.

It was evident from the analysis that if the TRA were able to use a higher level of automation, including an intelligent risk engine, the processing time of 14 to 17 days could be significantly reduced. It was also clear that implementing a more integrated ICT system or platform could enable local and foreign importers to exchange all the required information with the customs and port authorities through one system. This would prevent the late issuing of port invoices or repeated requests from customs for additional documents. A better risk-profiling system could help to cut back on the scanning of containers to only those deemed high-risk shipments, thereby further reducing the time that transit containers spend at the port.

Information could, in turn, be collected inside the port through the use of smart devices installed in trucks and cranes. Such information could be uploaded to a central system in real time to allow surveillance of field operations and the changing status of the cargo, and any deviations to be immediately detected. On completion, each activity at the port could be logged on the centralised ICT system, whereupon further activities would be activated until the cargo is finally released from the port.

7.5.2. Case Study B: Streamlining customs-control processes: The case of South Africa

Customs authorities in many developing countries carry out large numbers of physical inspections of goods, which disrupt trade flows. Implementing effective risk-management procedures is essential in order to strike a balance between meeting customs-related objectives and ensuring the efficient flow of goods across

borders (Kieck 2010). Most developed countries have moved towards customs risk-management systems that analyse rich data sets to accurately determine the risk posed by consignments of cargo. The adoption of such systems reduces the need for physical inspections, while not increasing the risk of an influx of contraband goods or lost customs revenue.

According to various studies, including those of Laporte (2011), Davaa and Namsrai (2015) and Komarov (2016), the use of data-centric empirical models is the ideal compromise between catering to the interests of customs authorities, on the one hand, and traders, on the other. It also produces cost savings and makes the region more attractive to economic partners globally.

The authors of this chapter obtained data reflecting transactions between the customs division of the South African Revenue Service (SARS) and importers of goods into South Africa from September 2014 to September 2016. The data were supplied by several freight forwarders with permission from the South African Association of Freight Forwarders (SAAFF). The data set comprised approximately 3.5 million transactions for the period in question.

A detailed analysis of the data was conducted by Hoffman et al. (2018) in order to, firstly, quantify the impact of customs delays on imported cargo; secondly, identify the most important factors contributing to lengthy delays and high inspection rates; and, thirdly, extract empirical models that could predict delay times as well as infraction and inspection rates from available input data.

In respect of each transaction, the following information was obtained (Hoffman et al. 2018):

- dates and times of submission of electronic declarations by consignors and receipt by SARS
- the name of the customs office where declarations were submitted
- the Harmonized System (HS) chapter that describes the cargo type

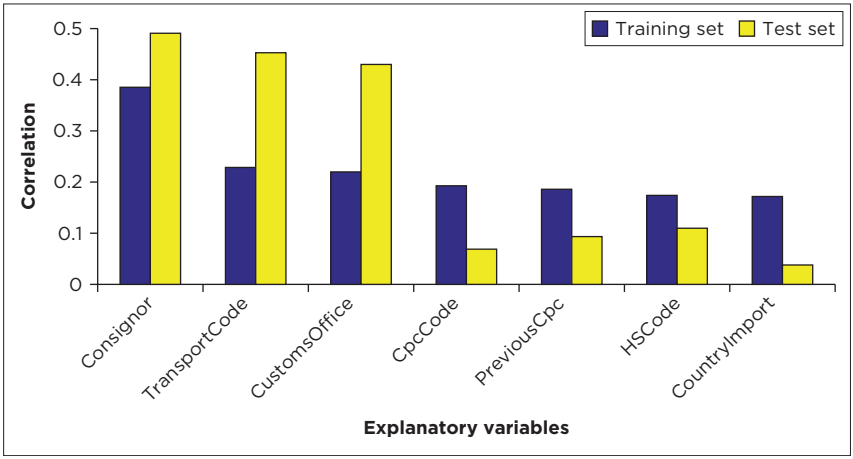
- the customs value of the cargo
- the mode of transport used when the goods entered South Africa
- the customs procedure codes (CPCs) indicating the reasons for the goods being imported into South Africa
- the countries of origin (with some goods in transit pending their despatch to their final destination)
- the code identifying the entity that submitted the customs declaration (it is codified to maintain the declarant's anonymity)
- a set of customs response codes for each transaction, along with the relevant date and time for each code.

In order to compare the different inputs, a linear correlation analysis was performed. It involved the following steps (Hoffman et al. 2018):

1. The accumulated average value of each outcome (e.g. the fraction of customs stops) was calculated as a function of time from the start of the observation period until the end of each month. This was repeated for each category of input factor (e.g. China as the country of origin category). These averages provided the researchers with a pattern of behaviour or characteristics for the respective categories.
2. Each new observation falling within a subsequent month was allocated the accumulated averages for the appropriate categories (e.g. customs office: Durban; HS chapter: textiles; transport mode: maritime), as determined at the end of the previous month. Each of the observations thus received the characteristics of the categories to which it belonged. As these characteristics were continuous variables, the observations could be used as the basis for the correlation analysis.
3. The Pearson correlation was then calculated between the appearance of an eventuality of a specific consignment (e.g. whether an infraction or customs stop occurred) and the historical trend for the same eventuality within the specific category (e.g. Durban). This was repeated for each new

observation and each input factor (e.g. customs office). If the respective categorisation had no impact on that eventuality, then a close-to-zero correlation would be obtained. However, if the historical behaviour within that category continued, a positive correlation value would be obtained.

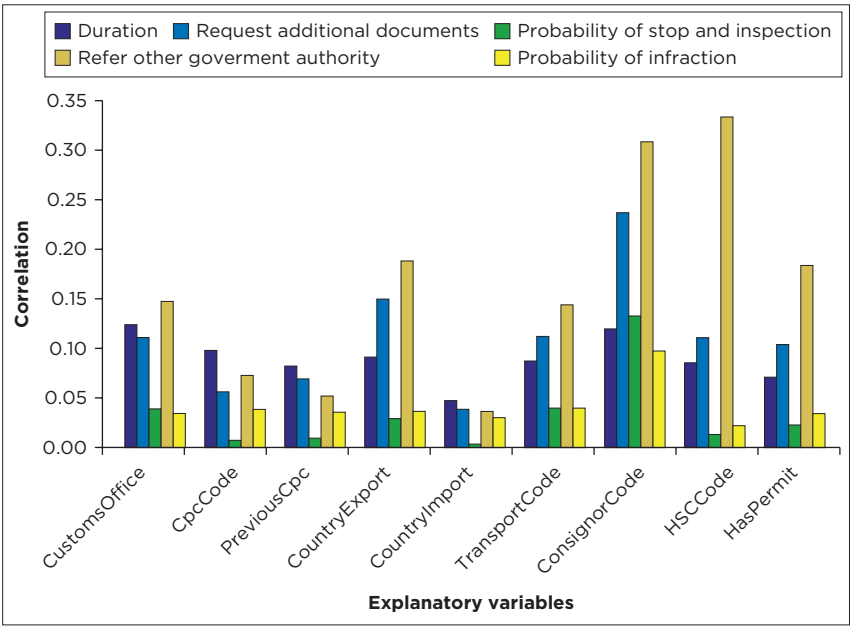
The results of this analysis are displayed in Figure 7.3 (also see Hoffman et al. 2018 for more detailed results). To investigate the degree to which the relationships between inputs and outcomes remained constant over time, the calculations were performed separately for a training set (the first 50% of all weighted observations) and a test set (the last 50% of all weighted observations). The explanatory variables were then ranked based on the size of the correlation coefficient in the training set. While this ranking was mostly retained in the test set, there were significant differences in some categories, such as the CPC and the country of import. It is therefore evident that a model extracted from the training set will not always perform as well in the test set.



Source: Hoffman et al. (2018).
Note: Input output correlations over training and test sets for target variable infractions.

FIGURE 7.3: Weighted correlation between probability of infraction and explanatory variables.

In similar correlations calculated for other customs outcomes, the same input factors dominated, but the correlations were significantly larger, as indicated in Figure 7.4. This provides evidence that, while customs appear to use consignor identity as the primary determinant of cargo stops and inspections, together with requests for additional documents from the consignor, this strategy does not seem to have much success when customs authorities are trying to identify potentially fraudulent activity. It could therefore happen that some consignors are singled out by customs and might be subjected to unnecessary time delays because of unjustified customs stops or inspections. The correlation analysis supported the results obtained for the average historical incidence of eventualities, with the consignor again being the most significant explanatory variable.



Source: Hoffman et al. (2018).

FIGURE 7.4: Correlation between the explanatory variables.

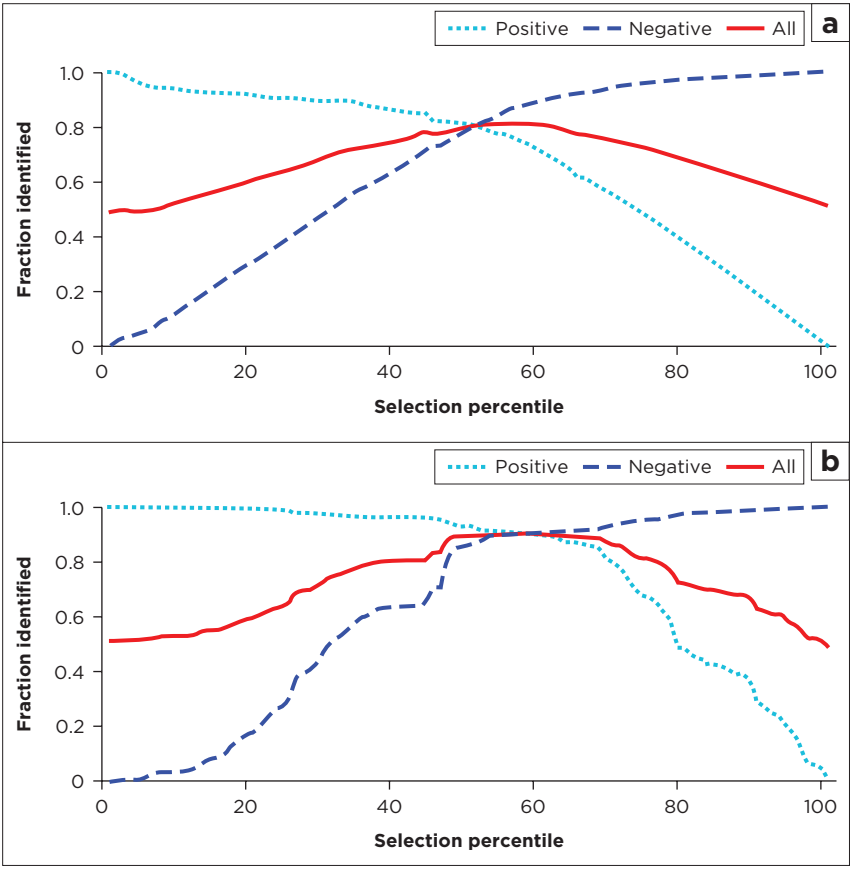
In order to predict outcomes from the explanatory variables, various modelling techniques[56] were implemented to determine if more sophisticated modelling techniques could improve the performance of simpler modelling techniques.

To apply models that produce continuous variables for the prediction of categorical outcomes, it is necessary to set a threshold level against which the model outcome is compared. A typical result is displayed in Figure 7.5. It can be seen that there is an optimal value for the threshold to obtain maximum, overall classification accuracy. Table 7.1 compares the results achieved through the various regression techniques, while Table 7.2 displays the results for the decision trees.

The analysis produced the following conclusions and recommendations (Hoffman et al. 2018):

1. *Ability of specific input factors to predict possible customs outcomes*: The results shown in Figure 7.4 quantify this ability. The explanatory variable containing the most predictive ability was the consignor's identity, which is clearly important for customs authorities' decision-making.
2. *Combined input factors that offer the best risk-prediction capabilities*: Besides consignor identity, other important inputs were the country of origin, the CPC and the transport mode (which, in the case of the data set, was also closely related to the customs office, since one transport mode essentially served the two largest customs offices). Increasing the number of explanatory variables to a maximum of nine did not significantly enhance the predictive capacity of the model.

56. These modelling techniques included the following: linear regression, which extracts a linear relationship between explanatory variables and outcome; logistic regression, which extracts linear relationships between explanatory variables and the logarithm of the odds to model the probability of outcomes; neural network-based models, which use non-linear relationships to classify outcomes based on explanatory variables; and decision trees, which use an optimal set of branching points, based on threshold values for explanatory variables, to predict outcomes. These can be further divided into regression trees and classification trees.



Source: Hoffman et al. (2018).

FIGURE 7.5: Fraction of stopped consignments correctly identified by the logistic-regression model as a function of the fraction selected, according to a (a) fraction correct training set using logistic regression model for stopped events and a (b) fraction correct testing set using logistic regression model for stopped events.

3. *Most appropriate modelling technique*: Neural networks moderately outperformed the regression models, but classification trees delivered the most satisfactory performance in the set of alternative techniques that were applied. As was expected, the ability to accurately anticipate the result of the

TABLE 7.1: Classification of results predicting customs stops using different model types.

Model type: Fraction of infractions found	Fraction of observations inspected					
	Linear regression		Logistic regression		Neural network	
	Train	Test	Train	Test	Train	Test
50	0.27	0.22	0.30	0.21	0.26	0.20
80	0.49	0.34	0.65	0.30	0.49	0.29
90	0.68	0.42	0.81	0.83	0.68	0.39
95	0.74	0.65	0.99	0.53	0.77	0.57
R^2	**0.16**	**0.26**	**0.39**	**0.61**	**0.43**	**0.66**

Source: Hoffman et al. (2018).

TABLE 7.2: Classification of results for customs stops using classification trees.

Tree levels	Classification	1	2	3	15	20	104	456
Training	Fraction selected	0.00	0.25	0.23	0.17	0.16	0.10	0.08
	Fraction correct	0.51	0.86	0.87	0.89	0.90	0.94	0.96
	Fraction correct, no event	1.00	0.75	0.77	0.83	0.84	0.90	0.92
	Fraction correct, event	0.00	0.97	0.97	0.96	0.96	0.99	0.99
Validation	Fraction correct	0.51	0.86	0.84	0.82	0.83	0.79	0.68
	Fraction correct, no event	1.00	0.75	0.77	0.83	0.84	0.90	0.92
	Fraction correct, event	0.00	0.98	0.91	0.81	0.82	0.68	0.43
Testing	Fraction selected	0.00	0.17	0.16	0.14	0.13	0.09	0.06
	Fraction correct	0.49	0.89	0.88	0.86	0.86	0.77	0.63
	Fraction correct, no event	1.00	0.83	0.84	0.87	0.87	0.91	0.94
	Fraction correct, event	0.00	0.94	0.93	0.86	0.86	0.63	0.34

Source: Hoffman et al. (2018).

customs process was far greater than the ability to anticipate the frequency of infractions.

4. *Prospects of enhancing the South African customs decision-making process*: The results showed that if the correct risk models are applied by customs, it could improve their processes as they all produced infraction incidence rates in the highest-risk categories that were much higher than the

rates in the lowest-risk categories. The extent of improvement would depend on the minimum accuracy required to find infractions. From the results, one could assume that the main limitation to extracting accurate empirical models for use in a customs risk engine is the quality of the infraction incidence data, which are generated by historical customs processes.

5. *Ideal methodology to be adopted*: If it is necessary to accurately control the proportion of consignments selected for inspection purposes, then a neural network-based model – combined with the setting of an optimal risk-score threshold value – is the most appropriate methodology. If it is necessary to select the smallest proportion of consignments for reasonably high selection accuracy, then a classification tree may be the best option. The proposed methods should be repeated regularly, as the underlying relationships evidently underwent a marked change over time.

Overall, the analysis was useful for two reasons. Firstly, it helped to clearly identify the problems occurring in the customs-clearance process in South Africa. More than 90% of the delays might have been reduced or avoided if the shipments had been screened differently. The time taken up in unjustifiable customs stops and cargo screenings means that there is much room for improvement in customs' current approach to risk analysis.

Secondly, the data analysis constituted one of very few attempts to analyse customs processes at a transactional level. Laporte (2011) conducted one of the first studies to analyse customs processes in detail, at which point it became clear that there was still much room for improvement in South Africa's and other countries' customs processes. This could be achieved by better utilising data analytics as part of a process of enhancing and improving customs-clearance processes, which in turn will streamline the movement of goods through the supply chain.

7.5.3. Case Study C: Enhancing the movement of perishable cargo through cold chains

The international cold-chain logistics (CCL) industry has grown substantially over the years, making a significant contribution to many countries' GDP (Bekker & Mostert 2005). However, it is still characterised by poorly managed SLAs, insufficient cold-chain visibility and significant cargo losses (approximately 35% of fruits and vegetables are lost) (Vega 2008). This is especially pronounced in the African context and is another area where better use of technologies could help to reduce delays and losses.

Losses are partly the result of a lack of data on the status of cargo as it moves through the transport chain, as well as an inadequate understanding of the potentially adverse impact that supply-chain incidents can have on the quality of traded goods. In the case of fresh produce, which has a limited shelf life, transport constitutes a very large proportion of the overall landed cost of goods consignments (Seiler 2012). This is owing to the often great distances separating the places of production and consumption, and the special conditions that must be maintained throughout transit to preserve the condition of the goods. If quality is compromised, it will have a major impact on the value of the delivered goods and might even lead to the consignment having to be scrapped altogether (Texas Instruments 2012).

For the purpose of the analysis, the researchers obtained data from trucks moving reefer containers between Gauteng province in South Africa to Lusaka in Zambia during the period 2014–2016 (Emenike, Van Eyk & Hoffman 2016). Temperature profiles were measured for the entire transit period (in more than 10 complete trips), from the time the container was first loaded in South Africa until the time it was unloaded at destination in Zambia and then from the time it was reloaded in Zambia with new cargo until its arrival back South Africa.

A total of five experiments were conducted to demonstrate typical cold-chain operations, involving refrigerated 15.32 m trailers, each carrying a full load of 25 pallets. The reefer containers were loaded with fruits and vegetables and each container was operated at a set temperature of 2 °C. The trailers were filled up to the so-called 'red line' 1.8 m above the floor level, thus allowing cooled air to flow over the cargo, originating in the chilling units in the front. The trailers were loaded to full capacity for the South Africa–Zambia leg and were a quarter full for the return leg from Zambia to South Africa. Each trip ranged from 6 to 10 days. The experiments were conducted between February and November in order to cover all seasons and weather conditions (typically hot weather during summer and moderate weather during winter) (Emenike et al. 2016).

A total of 53 LogTag data loggers and 20 CAEN RFID sensors were used during each experimental trip. In order to extract behavioural models or patterns, each trailer was split into five sections or 'tiers', each with a length of about 3 m. A total of 57 sensors were installed on the periphery of the trailer within each tier and at various heights, while 13 to 15 sensors were embedded in the cargo, with at least two sensors within each tier. A research assistant accompanied each consignment to ensure that the sensors were correctly placed and later recovered. The research assistant also recorded the sequence of events as they occurred, including the times of loading and sealing the containers, departure times, arrival times at border posts, the duration of any interruption to the journeys, arrival times at the destination, and the time taken to open the doors and offload (Emenike et al. 2016).

The data were initially captured and stored in a databank. Thereafter, the data were synchronised with the recorded times of the various events that took place during each trip. This allowed for specific segments of the data to be used to train specific models and for the models to be exposed to various kinds of behaviour or patterns that could reasonably be anticipated during the trips.

To facilitate the model-extraction process described below, spatial and temporal temperature profiles were captured at the periphery of the trailer and inside the cargo during transit. They were then collated, extracted from experimental data sets into specific formats and then further analysed. In order to interpret the temperature deviations from the set temperature of 2 °C, the researchers expressed the deviations as a percentage of the range of permissible temperatures (4 °C). Higher temperatures of 10 °C were observed at the doors (corresponding with position 0.0 m) while lower temperatures (1.7 °C–3.5 °C) were observed closer to the vent.

The results showed that cargo placed within 5 m of the vent was usually within the temperature set point, cargo placed 7 m from the vent showed an approximately 100% temperature set-point deviation, cargo placed 10 m away showed a 200% temperature set-point deviation, and cargo placed 10 m–15 m away showed a 400% temperature set-point deviation (Emenike et al. 2016).

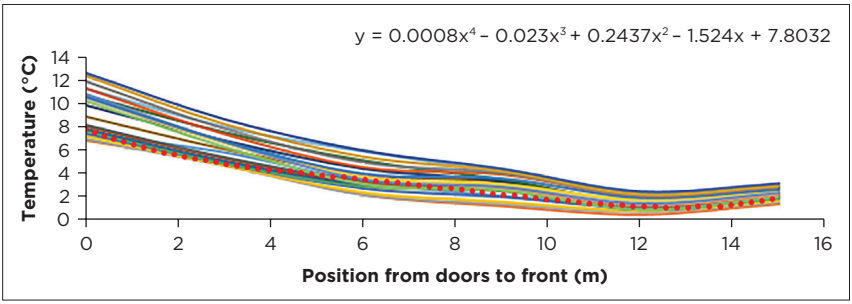
The need for improved monitoring must be reconciled with the need for a cost-effective approach to handling different operational circumstances. This can be achieved by using only a few sensors and deriving temperatures at other locations from these measurements. For this study, two types of modelling were used: (1) modelling temperature as a function of distance from the chilling unit, and (2) modelling temperature at locations where it was operationally difficult to place sensors and thus using temperatures measured at locations where it was more practical to permanently place sensors.

Firstly, the cargo temperature was modelled according to the position along the length of the trailer, from the chilling unit to the doors. The accuracy of this spatial model would determine how few points of physical monitoring were required across the different tiers to estimate the anticipated worst-case conditions. For this scenario, it was assumed that the cargo was stable and that time fluctuations did not play a major role (Emenike et al. 2016). The inputs for the model were based on the average of all

periphery temperatures in a tier at various distances from the chilling unit. The outputs from the model were the temperatures in between the centre points of the various tiers. It emerged that a fourth-order polynomial was sufficiently accurate to provide an acceptable approximation of actual temperature as a function of location, shown as the dotted red line in Figures 7.6 and 7.7.

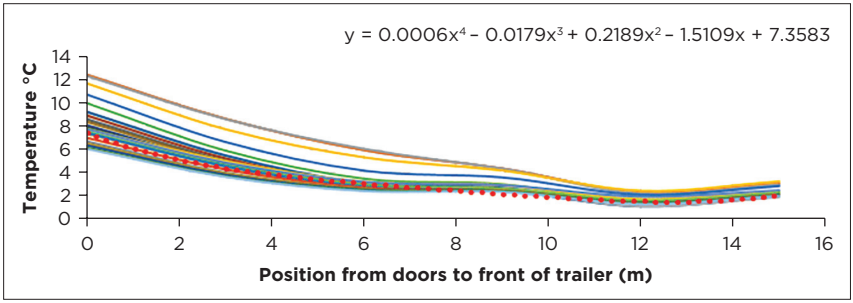
The data showed that the worst-case temperature at the doors varied a great deal from one trip to the next, ranging from 6 °C (which would result in very few or no cargo losses) to up to 12 °C or more (which suggests that temperature-sensitive cargo in the last tier could be lost). As the differences in cold-chain performance were the result of different events occurring during the trips, there is a need for a temporal model that can anticipate future temperature fluctuations, using historical temperature patterns, once an event occurs that may adversely affect the cargo (Emenike et al. 2016).

Secondly, it was determined how accurately temperatures at different points within the cargo (which may not be practical to monitor on a permanent basis) could be determined from temperatures in other locations where sensors could be permanently installed. It was assumed that it would normally be impractical to place sensors within the cargo during normal operations and that physical sensing might therefore involve only



Source: Emenike et al. (2016).
Note: The differently coloured graphs were captured during different trips. Trend lines are depicted, specific colour key unavailable.

FIGURE 7.6: 12-hour day temperature readings as a function of location in the trailer.

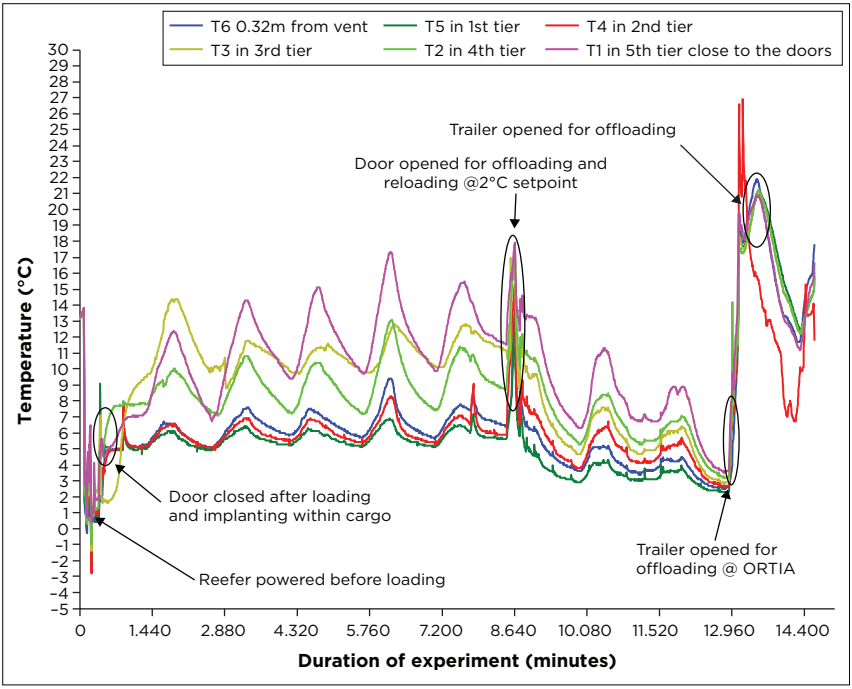


Source: Emenike et al. (2016).
Note: The differently coloured graphs were captured during different trips. Trend lines are depicted, specific colour key unavailable.
FIGURE 7.7: 12-hour night temperature readings as a function of location in the trailer.

a few sensors attached to the inside of the trailer (Emenike et al. 2016). This implies the need for a computerised mathematical model that accepts temperatures measured in a limited number of locations as inputs, and then predicts temperatures in locations where no sensors are present, as outputs.

The data collected during the various trips were investigated in order to identify which temperatures represented worst-case, unknown temperatures. Figure 7.8 and Figure 7.9 represent typical time graphs of temperatures that were measured at the periphery of the trailer within the different tiers, and temperatures that could be measured deep inside the cargo within the same tiers. As the thermal inertia of the cargo caused slow changes in temperature because of the high thermal capacity of the cargo, the temperatures deep inside the cargo were much more stable than temperatures at the periphery of the trailer. It was also observed that in most cases, the permissible temperature thresholds were crossed along the sides or roof of a trailer, which was to be expected given the sun's warming effects.

The practical research conducted provided evidence of the need to derive the worst-case, in-cargo temperatures from temperatures measured along the periphery of the trailer, while also predicting future cargo temperatures from current

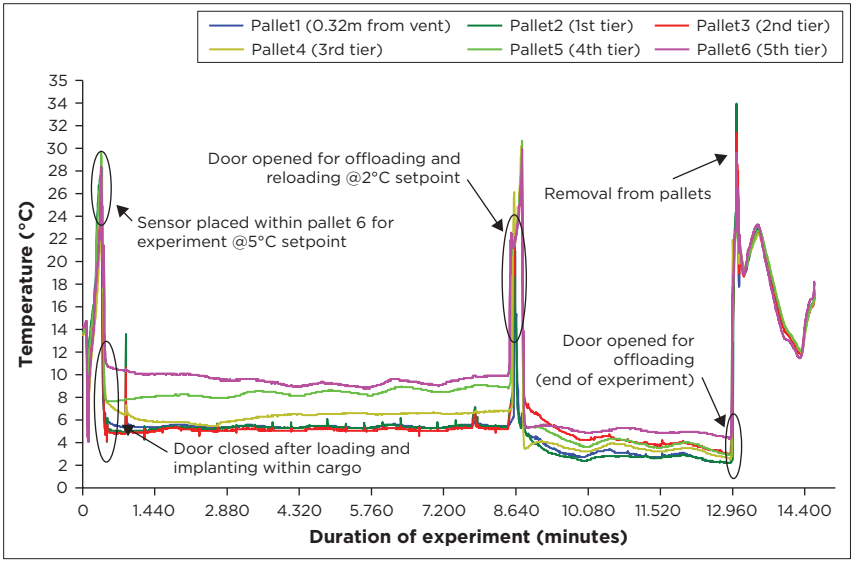


Source: Emenike et al. (2016).
ORTIA, OR Tambo International Airport.

FIGURE 7.8: Example of temperatures measured at the periphery of the trailer for the duration of the trip.

temperatures so as to proactively prevent situations that could lead to significant cargo losses. It was demonstrated that neural-regression models are sufficiently accurate to allow worst-case, in-cargo temperatures to be confidently estimated from temperatures that can be measured using only a few permanently installed sensors (Emenike et al. 2016).

This case study reinforced the need to make better use of technology throughout the cold chain so as to improve the movement of cargo and reduce cargo losses. Although not directly related to customs procedures, any delays at border posts will exacerbate potential problems along cold chains. The use of efficient technology and the analysis of captured data can do much to improve both the management of perishable



Source: Emenike et al. (2016).

FIGURE 7.9: Example of temperatures measured within the cargo for the duration of the trip.

goods in transit and overall supply-chain efficiency. Data can also be shared with customs authorities to facilitate advance clearance of goods and more streamlined movement across borders.

7.6. Conclusion

The transportation of freight is one of the key elements contributing not only to efficiently functioning supply chains but also to economic growth and development along various transport corridors in different parts of the world. This chapter set out to show that trade and transport in Africa are still plagued by various inefficiencies and that most of these inefficiencies could be reduced through the more innovative and productive use of technologies, which in turn underpin a broad trade (and especially digital trade) facilitation strategy.

The different scenarios and analyses presented via the three case studies highlighted how different supply-chain participants,

such as port and customs authorities, road transporters and cold chain operators, should focus on better integrating their respective processes in the interests of enhanced overall efficiency. In particular, data analytics makes it possible to identify specific time-consuming (and often time-wasting) elements along transport corridors that need attention and for regional customs authorities to adopt a more harmonised, data-sharing approach. These are just some ways to reduce trade costs, which for years have dealt a serious blow to African competitiveness.

7.7. Key takeaways from this chapter

- With Africa's population predicted to expand dramatically over the next two to three decades, the demand for transport on the continent will also rise. However, Africa faces immense transport and logistical challenges, not least of which is the fact that customs processes are poorly integrated with supply chains. This is often because of regulatory barriers, inefficient border procedures and corruption. These and other problems, including inadequate infrastructure and poor Internet connectivity, contribute to the high cost of trading on the continent.
- Clearly, Africa needs cost-effective solutions to its many transport and logistics problems, particularly in the face of acute shortages of human resources, expertise and funding. In this regard, there is much scope for African countries to use ICTs and digital applications (including data analytics) to streamline their port and land-border activities and customs processes, thereby reducing costs and improving competitiveness.
- Examples of digital trade facilitation tools include trade information portals, automated customs procedures, e-payment systems and the single-window concept. Some African countries have already started to implement single-window systems to address the problem of onerous documentary requirements, excessive physical inspections of cargoes and a lack of coordination between border agencies.

If successfully rolled out, the single-window system will go a long way towards preventing frequent, costly bottlenecks at ports and land borders.

- The integration of ICT and digital solutions into transport and logistics processes in Africa will help to shorten production times and make supply chains more efficient. Yet trading partners' ICT systems need to be aligned and information efficiently exchanged if digitalisation is to produce the desired benefits. The concepts of CBM, 'smart borders' and 'one-stop borders' all suggest improved coordination between the various role players who – with the help of technology – can optimise clearance procedures at borders and reduce processing times.
- Traditionally, customs authorities were primarily tasked with imposing duties and other taxes on goods and keeping a lookout for smuggling and other illicit trading activity. However, as supply chains have become more complex, customs authorities are playing a stronger trade facilitation role, while not eschewing their revenue-collection and policing duties. This partnership approach could and should be encouraged in Africa.
- Notwithstanding the ability of digital solutions to deliver time- and cost-saving benefits, few have been introduced in Africa. Even where certain technologies are already in place, many customs offices still do 100% physical inspections of imported goods, suggesting a reluctance to move away from tradition. Another obstacle is that, given the cost and time involved in implementing digital trade facilitation measures, many governments are hesitant about embracing a more technological approach to logistics management and border control. In this regard, the private sector could help to influence a change in mindset.
- Looking ahead, Africa cannot solve its well-entrenched problems of low competitiveness, high trade costs and limited intraregional trade unless it takes steps to seriously enhance its transport and logistics and border management capacity. This includes carefully determining what technological innovations are most needed, and where.

Chapter 8

Protecting Africa's digital future through effective regulation

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8.1. Introduction

Given the speed and breadth of digital advances in the world today, it follows that there must be laws and regulations that permit innovation and the expansion of digital technologies, but also protect people from harm. Yet achieving both objectives is often easier said than done.

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The digital age has given rise to untold legal complexities, particularly as data flows do not lend themselves to clear standards or trade rules, while the matter of data ownership is often far from clear (OECD 2019a, 2019b). Not only do countries' digital policies and regulatory frameworks differ from one another, but it is often difficult to establish jurisdiction in an increasingly borderless world (Goel 2018). This adds to the uncertainty and risk associated with cross-border trade. Ironically, though, there is an element of universality about data and digital applications, which automatically connect people in a legal sense, whether they are conscious of it or not.

Given Africa's economic development challenges, it is unclear how Africa's digital future will unfold. Although there are many legal blueprints from which African countries can draw when crafting technology-friendly policies and legislation (see also ch. 1), the reality is that millions of Africans lack access to even the simplest tools of digital development, such as smartphones and Internet access (see also ch. 2). In contrast, however, there are large numbers of individuals, businesses and communities across the continent who are tech-savvy and are leveraging the power of digital technologies to improve their efficiency levels, marketability and quality of life (Hartzenberg 2021). From a policy and regulatory standpoint, a careful balance needs to be struck so that the interests of one group are not advanced at the expense of another.

This chapter explores some of the legal complexities associated with the fast-digitalising world and why African countries, working together, need to navigate both the opportunities and contradictions that the digital age presents if they are to move forward on their intended inclusive growth and development paths. The chapter also looks at the theme of regulation from a national digital economy perspective, from a digital trade policy perspective (at the national, regional and multilateral levels) and also from a developmental perspective.

8.2. Africa's digital divide: Is the regulatory environment to blame?

To a large extent, Africa's future depends on how well the continent integrates digital technologies into its economic and trade activities. However, this is not a distant reality. Few industries have been left untouched by digital advances and 'every industry is now a digital industry' (Ahmed 2019:s99; Weiler 2017). This has been driven home recently by the speed and ferocity with which COVID-19 descended on the world, forcing people to quickly adapt to more virtual ways of working and communicating. It is encouraging that many already had access to digital devices, the Internet and data services, which helped to facilitate the rapid transition to increased online activity. However, the fact that so many did not have such access is lamentable. This has been particularly evident in Africa. Where many parts of the world could quickly adopt a 'business-as-usual' approach, Africa was not so fortunate.

The pronounced 'digital divide' in Africa is often attributed to the failure of governments to create a regulatory environment that encourages innovation and facilitates cost-effective access to digital devices and services. Instead, regulations are often opaque or complex, and seemingly straightforward tasks like registering a company or applying for a trading licence are weighed down by excessive red tape (Soininen 2016). Not only does this suggest that efficient, digitalised systems are being eschewed in favour of laborious, manual systems, but also that the spirit of the digital age – evidenced in speed, efficiency and productivity – is not being embraced.

If a difficult regulatory environment is indeed one of the leading causes of Africa's slow response to ongoing digital developments, one should ask: are the regulations themselves problematic, or the implementation thereof? However well informed and crafted they may be, policies and regulations will

have little value unless they are effectively implemented and adhered to. They also need to remain relevant, which calls for frequent reviews in the light of ever-changing political, economic, technological and social conditions.

Other chapters in this book highlight how Africa has been undergoing a mobile revolution in recent years and is regarded as a global hub for mobile money transactions. Innovation or tech hubs are also springing up in many African countries (usually led by the private sector, with international financial and technical assistance), with many urban centres being digitally on a par with their counterparts in other emerging markets. However, these positive developments are juxtaposed with serious underinvestment in ICT infrastructure, connectivity and skills development in many parts of the continent. Clearly, the business opportunities are there, but the policy and regulatory environments (which should trigger much-needed development finance and investment) have not caught up.

The terms 'regulations' and 'regulatory framework' are frequently referred to in a policy or legal context, but their respective meanings are not always clear – particularly where digital trade is concerned. For the purposes of this chapter, 'regulation' refers to any policy instrument (legislation, trade rule, standard, trade agreement or policy document) that aims to promote and nurture digital trade by permitting and actively facilitating the movement of data across borders, while also leaving sufficient scope for governments to regulate digital activity to achieve legitimate public policy objectives in the interests of national security or public morals. A 'regulatory framework', in turn, refers to a network of actors and a collection of instruments that have varying levels of power either to bind or to persuade (WTO n.d.).

The fact that African countries are at very different stages of digital development and preparedness makes it difficult to regulate cross-border data flows and ICT goods and services trade.

According to Daza Jaller, Gaillard and Molinuevo (2020), this is largely because of regulatory differences between countries, a frequent lack of consumer trust in online transactions and the inherent challenges of trading internationally, leading to varied approaches. The increased demand for digital services and the bundling of services with physical goods have also given rise to heightened regulatory complexity (see González & Jouanjean 2017). According to Daza Jaller et al. (2020), regulation has the potential to smooth over some of these country differences because it can:

> [*P*]rovide the legal tools necessary for remote contracts, clarify the rights and obligations of the multiple actors involved in digital transactions, and establish a framework that promotes consumer trust in digital markets, even when the consumer does not know the merchant or when the merchant is in a different country. (p. 2)

One of the major challenges associated with regulation in a digital trade context is that it serves in some cases to restrict transactions or data flows, while in other cases it allows cross-border transactions to flourish (Daza Jaller et al. 2020). Aaronson (2019) refers to the former as 'digital protectionism', which is any government effort designed to restrict or prevent information flows in order to deter competition. Digital protectionism should be avoided, as it is a short-sighted strategy that can do more harm than good. According to Aaronson (2019), countries should only impose restrictions on cross-border information flows if the measures are aimed at serving the national or public interest. The problem, however, is that it is difficult to determine what has an underlying protectionist motive and what constitutes a valid, well-meaning policy.

Whether digital trade should be liberalised or whether it warrants selective restrictions is a question that has been circulating for many years and features strongly in the literature (see, for example, Meltzer 2019; Wolfe 2019). This liberalisation versus protectionism debate is particularly prominent in the context of data-localisation laws (Ahmed 2019; Chander 2019; Meltzer 2019; Wolfe 2019).

Proponents of a liberalised approach to digital trade cite the speed of innovation and the nebulous character of data flows and some data services (and the fact that a variety of actors control Internet access) as reasons why protectionism is a misplaced strategy in the digital age (Aaronson 2019). However, Meltzer (2019) offers the contrary view that unfettered data flows under the banner of trade liberalisation expose individuals in target countries to the risk of their personal details being mined for unscrupulous reasons. In addition, in the event of infringement of people's rights to protection of information, assets and reputation, affected parties do not have any recourse to the usual legal remedies because local courts lack the necessary jurisdiction – the data essentially being owned by foreign entities. On this basis, several governments advocate the introduction of data-localisation laws, which means that data-related disputes would fall within the ambit of national legal systems (Meltzer 2019).

The literature on regulation in the digital economy typically focuses on cross-border data flows (see, for instance, Daza Jaller et al. 2020; Franc 2019; González & Jouanjean 2017; Kumar 2016; Wu 2017), with little attention given to regulation at a domestic level, which may have a more developmental intent. Both types of regulation have their place, though, and there must be synergy between them. For example, whether or not heightened digital trade expands or threatens domestic employment opportunities, and therefore has regulatory implications, is a particularly interesting – and until now little-researched – topic. It is explored in Chapter 6 with the help of a comprehensive quantitative analysis.

At a national level, one of the difficulties in formulating new legislation and regulations in response to industry and market changes is that establishing legal precedent is jurisdiction-specific; one cannot, for example, simply legislate across an entire industry all in one go. Precedent is gradually extended to cover the national context. This slow process often appears to be

incompatible with the digital economy's quick-response culture. In the context of digital trade, national governments have the additional burden of modifying their policies and regulatory frameworks (both for national and cross-border application) to fit the digitalised world, which demands speed and efficiency (Franc 2019).

Ten years ago, some of the technologies in use today would have been inconceivable to many people. One of the challenges typically associated with the digital age is that the quick pace of technological change makes it very difficult for the legal fraternity and industry regulators to ensure that applicable laws, rules and guidelines keep pace with evolving industry and market trends (Kahn 2016; Malan 2018). For example, the global scramble for effective COVID-19 vaccines is putting pressure on traditionally elongated R&D processes and drug-approval protocols. Interestingly, when circumstances demand it, traditionally circuitous legal procedures can sometimes be shortened. For example, with South Africa officially having the highest COVID-19 infection rate in Africa, the standard drug-testing protocols were short-circuited when the government decided to start administering a new, US-produced vaccine to health workers before the drug had been formally registered. The thinking behind this move was that the scale of the emergency warranted the taking of some moderate risks if the country as a whole would ultimately benefit.

Instances of misalignment between legislation and regulations, on the one hand, and industry and market dynamics, on the other, have been in evidence for many years, and no country has been immune. Digital advances have exacerbated the problem. Clearly, if innovators continue to outpace lawmakers and regulators, who are tasked with establishing national and industry norms and standards and preventing unfettered or unfair competition, the broader development potential of digitalisation may remain largely untapped. The mismatch between industry dynamics and regulatory frameworks also creates a breeding ground for cyber

sleuths and criminals. Unsavoury characters like these, who appear to be multiplying across the world, employ all sorts of nefarious tactics to obtain unauthorised access to data, which they then exploit in dubious ways. In extreme cases, they may use the digital space to threaten people's livelihoods or lives.

The lesson in this is that there is probably an optimal middle ground between the traditionally rather pedantic law-making process and the volatile, often unpredictable commercial environment, which prioritises competitiveness and speed to market.

8.3. The role of regulation and its link to development

A regulation is created for the purpose of controlling certain behaviours and when it comes to regulation at a national level it usually involves a country's population. It creates rights and obligations and defines the consequences of acting outside the parameters of such rights and obligations – which could include infringing the rights of others protected by the same regulation. The consequences of acting outside the prescribed regulatory boundaries could range from minimally disruptive (such as receiving a fine) to severe (such as being charged criminally and receiving an onerous sentence, such as a prison term).

A regulation does not in itself prevent illegal acts from occurring (such as an infringement of someone's intellectual property rights). Rather, it is intended to provide clear guidance on what would be considered an offence and what the legal consequences would be if such an offence were committed. Whether or not someone who has been charged with an offence will ultimately be convicted depends on various other factors. A regulation can also be used to encourage compliance and strong performance. Similarly, though, good performance cannot simply be legislated into existence – other forces are at play.

A sound regulatory framework (whether it is national or regional/international) can be a valuable developmental tool because it can facilitate access to information about sectoral performance, trade and investment flows, and tax compliance levels, among many other things (UNDESA 2014). 'Development', of course, tends to be in the eye of the beholder and can manifest in a variety of ways. However, a common aspiration in countries' development plans is that their populations will enjoy equal access to educational opportunities, healthcare and economic opportunities in line with their skills levels, and that their human rights will be upheld and protected. A regulatory framework cannot directly change people's behaviour, but it can help people to understand why rules and regulations are in place, and what the consequences of their actions will be.

In the digital age, with data powering much economic and trade activity, regulation remains critically important in modulating economic and trade activity and maintaining acceptable standards of performance across a range of industry sectors. However, with advancing digitalisation, more and more economic and trading activity will escape the eye of the authorities as it goes online, making it increasingly difficult to ensure that laws are obeyed, operational standards are upheld and deviant behaviour is addressed. It is not that most individuals and businesses deliberately set out to conceal their actions and evade their responsibilities. In the digital age, regulatory systems also need to evolve to ensure high levels of compliance.

Some years ago, SARS launched its eFiling system, which enables taxpayers to submit their tax returns online and receive instant, electronically generated assessments. The fact that SARS' systems are linked to those of local and international financial institutions helps to encourage greater transparency in financial reporting and higher tax compliance levels. This technological development vastly improved efficiency levels at SARS, boosted tax revenues for the government and made life considerably easier for individuals and businesses alike. This is an

example of a regulatory process keeping up with the times and working in the interests of the population – which is clearly a developmental 'win-win' (SARS n.d.).

When used optimally, regulations ensure certainty, uphold people's rights, counter injustices and provide the framework for resolving disputes – all of which are cornerstones of a country's development process. However, a regulation does not in itself stimulate development if it is not inherently pro-development. A regulation does not put up infrastructure, for example. It may *guide* who should develop infrastructure, and where and in what manner. But it cannot determine the end result. Furthermore, even the most well-intentioned and eloquently expressed regulations will do little to enhance a country's development if they are not applied in a manner that is ultimately for the common good and fairly enforced. For example, the fact that regulations are often ill-suited to the specific needs and constraints of SMEs is a sign that regulations' developmental role has been overlooked.

Regulations are only as effective as they are relevant (including being up to date), have sufficient scope and are enforceable. Regulations cannot guarantee performance, but they can offer recourse in the event of non-compliance. In this regard, a key challenge in the digital age is to isolate (in complex and sometimes virtual international supply chains) specific sources of non-compliance and apply appropriate remedies. This is where regional and international trade protocols and agreements play an important role as they provide a framework within which cross-border transactions can be broadly monitored for compliance. Regional and international cooperation can also alert authorities to regulatory or procedural bottlenecks that need to be addressed (UNCTAD 2016; WTO 2018, 2019).

Another challenge in formulating and applying regulations is that economic activity in a country is characterised by multiple

disciplines that frequently overlap. This is not unique to the digital economy. There are very few fields of law that are not required to follow a cross-cutting approach when determining regulatory structures and framing legal arguments, which considers the varying rights, obligations and circumstances of different segments of society.

According to Froese (2019):

> Digital trade is a hybrid practice composed of new modes of delivery for goods and services and new forms of social activity that are capitalized upon in novel ways to develop entirely new categories of economic activity. (p. 38)

He proceeds to explain that the process of constructing a regulatory framework for digital trade is often difficult because the digital economy has become so multi-faceted that:

> [*A*]ny attempt to regulate it at the multilateral level is bound to run up against issues relating to social inclusion, development, poverty reduction, gender, and individual rights and freedoms. (p. 38)

The highly complex and interrelated nature of digital technologies and regulations start to become apparent when one considers all the stakeholders and role players involved, and the supporting infrastructure, services, and knowledge and skills needed to deliver sustainable value. In Africa, socioeconomic realities and development patterns vary widely, both between and within countries, which influences people's perceptions of what is more or less important. For example, could the installation of cell phone masts and the laying of telecommunications cables in rural areas impinge on communities' right to undisturbed land usage or cause environmental damage or visual pollution? Likewise, could the automation of various government services deprive people of their livelihoods if they have not received training to facilitate their redeployment to other positions? Perceptions also differ from one profession to the next, in line with varying frames of reference and experiences.

8.4. What does Africa's digital trade policy agenda look like?

Recent years have been characterised by many attempts to shift elements of 'Internet governance' or regulation into the international realm and to ensure that digital trade is subject to stronger rules (see Azmeh, Foster & Echavarri 2020). This has created some problems. As explained in Chapter 1, different countries differ on the matter of how (and where) cross-border data flows and ICT goods and services trade should be regulated and what role government should play in this regard. These differences are complicating the formulation and enforcement of digital trade rules and will continue to do so in the future (see Azmeh et al. 2020).

As outlined in Chapter 1, Hillman (2018) groups countries into three broad categories on the basis of their views of how liberal or restricted trade policies and regulations should be: the 'liberalisers', which favour unrestricted data flows across borders and the removal of any barriers to the trade in ICT goods and services; the 'regulators', which (like the liberalisers) favour unrestricted cross-border flows of data and ICT goods and services, but also advocate strict regulations to ensure personal data privacy and protection; and the 'mercantilists', which are in favour of the selective use of protectionist measures to regulate data flows and ICT goods and services trade to support countries' industrialisation drives. Such measures include data-localisation laws, technology transfer and source code-disclosure requirements (Hillman 2018).

It is difficult to determine at this stage which of the three positions Africa will take, but there are signs that at the multilateral level, Africa is leaning towards a mercantilist position, while at the continental and regional levels, it is displaying more liberaliser or regulator tendencies. As Africa's regional integration plans progress under the AfCFTA and as the digital economy gains traction on the continent, these apparent anomalies will need to be addressed.

8.5. What role will the World Trade Organization play in regulating digital trade in the future?

There is much uncertainty surrounding the current and future role of the WTO as the global body mandated to ensure member countries' adherence to multilateral trade rules (see also ch. 1). Advances in digital trade have created additional challenges. The WTO's Declaration on Global Electronic Commerce, which is currently underpinned by a moratorium on the charging of import duty on ICT goods and services among WTO members, deserves some attention here.

According to the WTO (2020), the Declaration is the premier instrument governing e-commerce (or digital trade) at the multilateral level. However, WTO members have been unable to reach consensus on whether the moratorium should continue or be lifted, which has resulted in the status quo merely being retained (Janow & Mavroidis 2019):

> There is renewed commitment every two years to continue negotiating, and every two years recognition is given to the fact that nothing much has happened in the previous two years. (p. 2)

Developed-country members of the WTO are largely in favour of the moratorium remaining in force, while developing-country members generally argue for its removal as it deprives them of potential tax revenue and gives them less policy space to accelerate their industrialisation programmes at a national level.

Furthermore, WTO negotiations in recent years have been wracked by disagreements between developed and developing countries over what constitute global priorities and acceptable levels of trade liberalisation. It is therefore unclear if and how the impasse relating to the moratorium relating to e-commerce will be resolved. What is particularly worrying is that a multilateral agreement covering such a crucial aspect of trade is essentially in limbo, when it has the potential to be used as a driver of inclusive trade and development. As a result, 'provisions related

to digital technology remain particularly heterogeneous in terms of structure, language and scope' (Smeets 2021:345).

More generally, there are concerns that the WTO's General Agreement on Tariffs and Trade (GATT) and General Agreement on Trade in Services (GATS) – the multilateral trade rules governing goods and services, respectively – do not adequately cater for the fast-digitalising world, especially as the distinction between goods and services is becoming increasingly blurred (Janow & Mavroidis 2019). For example, 3D printing is an example of a technology that interferes with the notion of a clear dichotomy between goods and services. In practical terms, 3D printing turns a product (good) into a service and then relies on connectivity and data flows to deliver it (Meltzer 2019; Miroudot & Cadestin 2017). The IoT is another technology that has merged goods and services into integrated offerings (Chander 2019; Janow & Mavroidis 2019). Janow and Mavroidis (2019:s1) go on to claim that 'the world trading system has shown a remarkable inability to adjust to modern business realities in its multilateral rule architecture'.

It should be stressed that the WTO was established in the 1990s when geopolitical and geo-economic relations were very different from the way they are today. China, for example, has become very powerful both economically and politically, while Europe and the US have seen their influence wane to some extent. Emerging markets like India, in turn, have become formidable negotiators in multilateral circles. Moreover, digital technologies were far more rudimentary in the early days of the WTO and their uptake was comparatively limited. As the years have passed and the geopolitical and geo-economic landscape has changed, the GATT and GATS have inevitably started to show their age (Ahmed 2019).

It is up to the highly diverse WTO membership to negotiate more fit-for-purpose agreements, but there seems little political will to do so. As a result, the role and relevance of the WTO have been questioned – at a time when the world should be pulling

together in a more coherent fashion to tackle trade imbalances, health and climate crises, and widespread economic exclusion – all of which have global repercussions. Two recent, significant developments, however, have the potential to change the mood within the WTO membership and hopefully stimulate a desire to get back to the negotiating table: the election of Joe Biden as US president after the Trump years and the appointment of Ngozi Okonjo-Iweala as the new WTO director-general. Both these leaders advocate unity and cooperation in global affairs, yet they understand the value of regional diversity and healthy competition.

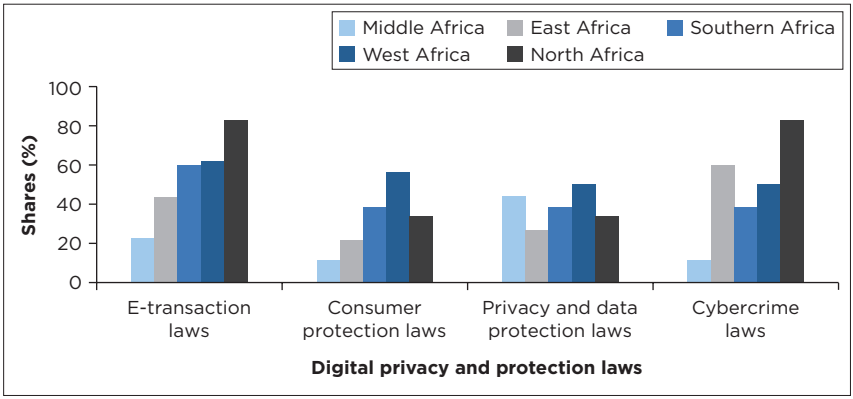
8.6. Ensuring data privacy and security in Africa

Data privacy and security are of growing concern in the world today, as digital advances have greatly increased the risk of proprietary and sensitive information being unlawfully extracted from online systems and used to prey on people and commit crimes. In some cases, such activity amounts to an invasion of privacy which causes great irritation; in other cases, the consequences are far more severe.

As digital trade expands and accelerates, the issue of how (and where) to regulate data as it crosses borders is becoming increasingly important – to policymakers and regulators as well as to traders who in theory own the information (Aaronson 2019; OECD 2012). Figure 8.1 illustrates the legislative steps that African countries have taken to regulate and protect cross-border information flows (AU 2019).

For example, Africa has launched a number of initiatives to promote cyber security.[57] One example is the AU Convention on Cyber Security and Personal Data Protection, which requires

57. Cyber security in this context refers to the use of various technologies, processes and controls to protect systems, networks, programs, devices and data from cyber attacks (IT Governance 2020; Stokdyk 2021).



Source: AU (2019).

FIGURE 8.1: Types and shares (%) of digital privacy and protection laws in different African regions (2017).

signatories to implement policy and regulatory measures to uphold strong cyber security governance and control cybercrime (AU 2014). Unfortunately, the impact of this convention has been weakened by the low rate of ratification and the fact that it offers no new avenues for dispute resolution, over and above those that already exist within the AU framework, which include the usual options of direct negotiation, mediation and conciliation.

Another promising cyber security instrument for Africa is UNCTAD's CyberLaw Tracker, which is an online tool that provides accurate descriptions of legislation pertaining to e-commerce, consumer protection, data privacy and protection, and cybercrime (UNCTAD 2020). According to UNCTAD (2020), of the 54 countries in Africa, 33 have legislation regulating electronic trade.

At a national level, some of the legislation introduced by African countries to guard against cybercrime includes: South Africa's *Electronic Communications Act* 36 of 2005 and *Protection of Personal Information Act* 4 of 2013; Rwanda's *Law No. 18/2010 of 1/05/2010 Relating to Electronic Messages, Electronic Signatures and Electronic Transactions*; and Kenya's *Cybercrime*

and Computer-Related Crimes Act of 2017 and *Data Protection Act* of 2019 (Muendo 2018).

8.7. Dispute resolution in the digital age: Options and challenges for Africa

Disputes are an unfortunate, but all-too-frequent, occurrence in business. When disputes arise between business partners residing in different countries, the difference in legal systems, as well as the geographical distance that separates them, can be stumbling blocks to dispute resolution. To a large extent, regulations are designed to ensure compliance in specific areas and to discourage deviation from prescribed rules and codes of behaviour. However, in the event of a dispute occurring, there should be formal means at the parties' disposal to resolve it. Furthermore, the final decision or judgment following a dispute hearing should be enforceable.

According to Meltzer (2015), digitally enabled international trade requires a new kind of dispute-settlement approach. He asserts that this is important because digitalisation is expected to promote more trade transactions involving low-value goods, which do not lend themselves to traditional, expensive approaches to dispute resolution, such as litigation. Furthermore, Meltzer (2015) points out that as most online trade disputes today are the result of interactions between individual consumers – and not countries – the continued relevance of the WTO's dispute-settlement mechanism appears questionable.

According to Teh and Monteiro (2017) and Wu (2017), many RTAs currently in force cover e-commerce activity at the regional level together with domestic issues, such as electronic signature authentication, consumer protection, personal information protection and paperless trading, usually with provision for dispute resolution (Teh & Monteiro 2017; Wu 2017). However, as

no country in Sub-Saharan Africa has become a signatory to an RTA with a standalone e-commerce chapter (Wu 2017), RTAs are not helpful vehicles for digital trade disputes at the regional level in Africa. Other options are needed. The dispute-settlement facility within the AfCFTA would not be a viable alternative as it would simply be the continental equivalent of the multilateral dispute-settlement process, which caters for disputes between countries only and not the 'new kind of dispute settlement approach' advocated by Meltzer (2015).

The OECD (2007) published a paper some years ago in which it urged governments to establish voluntary mechanisms to enable businesses and consumers to effectively resolve digital trade disputes. The OECD suggested that governments establish so-called online dispute resolution (ODR) mechanisms. The online company eBay (eBay Inc. 2021) has adopted such an approach. eBay Inc. (2021) advertises its unbiased, ODR facility which enables parties to a dispute to attempt to resolve their differences independently using a free web-based forum or, alternatively, to use the services of a professional mediator (eBay Inc. 2021). Meltzer (2015) supports both these options.

In order to determine if a new and quite different approach is required in Africa, it is useful to examine how most commercial disputes are currently addressed. At present, parties currently have three dispute-resolution options open to them: litigation, mediation and arbitration (Onyema 2019). According to Onyema (2019), litigation is costly and time-consuming. It is also largely a product of the colonial justice system which has undergone little modernisation. Hence, cases are judged according to three primary legal systems: civil law, common law or Roman-Dutch law. Furthermore, court cases are usually conducted in French, Portuguese, English or Arabic (again, a throwback to the colonial era) – rarely indigenous languages – which can create language barriers between the parties and/or with their respective legal counsels. Litigation also takes place in the country of one of the parties, according to that country's national legal system, which can be a complicating factor for the other party.

Mediation is a less acrimonious option, which involves the parties attempting to resolve the dispute themselves and agreeing a settlement, with the assistance of an objective third party who acts as a facilitator. Mediation can take place in any location that is agreeable to the parties. A drawback of mediation is that there are no legal means to enforce the final agreement or settlement (Onyema 2019).

With arbitration, a dispute is heard by one or more people acting as the arbitrator(s), who then arrive(s) at a final, legally binding decision. A potential disadvantage of arbitration is that it is not necessarily quicker or cheaper than litigation (Onyema 2019), and so the process can be punitive for SMEs (Onyema 2019). Arbitration is often preferable to mediation because although the proceedings are conducted outside of the court system, the final decision is legally enforceable by a court.

Given the cost and time involved in each of the above-mentioned traditional (contact-only) options, an ODR approach appears to be far preferable in Africa's case. Meetings or hearings can be conducted virtually, which would lead to major time and cost savings. Potential language barriers could be averted by including language experts/interpreters in the virtual interactive sessions. While it is always preferable for parties to try and resolve their disputes independently (using, say, an online forum like that provided by eBay), the mediation and arbitration options could also be accommodated in a virtual setting, with the help of professional mediators and arbitrators.

Sometimes the dispute-resolution process is particularly challenging because the subject matter of the dispute is highly technical (e.g. of a scientific nature) or involves one or more digital dimensions (such as big data analytics, cloud computing or the IoT), which are not well catered for in statutes and legal precedents (UNCTAD 2016). In such cases, relevant experts can also be included in the online dispute-settlement proceedings. Naturally, the online process would apply in the case of both tangible goods and services, such as online accounting or

architectural services or digitally delivered services like music downloads.

Whichever ODR approach is chosen, it will not be without its weaknesses and challenges. One complication is that the Internet is borderless (Ahmed 2019; UNCTAD 2016; Wolfe 2019). Therefore, in the case of an international dispute, it can be difficult to establish jurisdiction and the specific law that should apply. For instance, some digital applications or 'apps' make it difficult for subscribers to cancel their credit card payments after the current subscription period has come to an end. The question is: if this app was downloaded through, say, Apple's iTunes platform, can iTunes or Apple then be held liable for this administrative oversight, deliberate or otherwise? According to Apple's terms of purchase, all transactions in the US are final (which means that Apple escapes further liability), but other countries might have different laws. Apple might therefore be unwilling to grant a refund to someone in the US but might consider doing so if the subscriber lives elsewhere.

Even if, under the chosen dispute-settlement process, jurisdiction and the applicable law can be established and a judgment is handed down, enforcement can be a challenge. Enforceability depends to a large extent on whether or not there are consequences for non-compliance (UNCTAD 2016).

8.8. Digital development in Africa: What would an optimal regulatory framework look like?

It is dangerous to generalise about how Africa should respond to the many digital opportunities and challenges that lie in its path. Similarly, there is no one-size-fits-all regulatory framework that can be adopted, which will contain all the necessary checks and balances, while also encouraging innovation. Africa may be a poor continent with a marked digital divide, but the countries making up this vast territory are extremely diverse in their

economic make-up, political leanings, cultural orientations and technological readiness. Consequently, an optimal regulatory framework for digitally supported development needs to be context-specific. It is for this reason that lifting another region's regulatory structures and solutions and attempting to paste them into the African context is not advisable (WTO 2013).

This is not to say that African countries should operate in isolation, formulating their own digital optimisation policies and regulations. African countries' socioeconomic well-being depends to a large extent on their regional and international partners for trade, investment, knowledge sharing, and technology and skills transfer. Therefore, economic and trade agreements and initiatives at the regional, continental, bilateral and multilateral levels all need to be factored into the design of countries' regulatory frameworks for digital development.

Below are some broad concepts that African countries can bear in mind when plotting their course for a more digitally rich future and establishing the regulatory parameters to ensure an orderly and inclusive approach to development.

8.8.1. Predictability and stability

In its 2015 *Global information technology report*, the WEF listed the provision of 'a stable regulatory environment' as one of the three main ways of facilitating investment (WEF 2015). Although the report was specifically referring to the challenges associated with attracting private investment for Internet infrastructure projects, the message was clear, particularly its applicability to digital trade regulation. Predictability and stability are among the cornerstones of an effective legislative or regulatory framework. In a digital context, predictability and stability do not only have financial connotations. They also relate to policy certainty and transparency, and to a climate in which individuals and businesses have the assurance that their personal, intellectual property and other rights will be protected (WEF 2015). At this stage, African countries do not have

common policies when it comes to regulating cross-border digital trade, nor the means to enforce the various policies that are in existence. This will continue to hinder attempts to adopt a regional/continental approach to trade regulation as time goes by.

8.8.2. Political will

Very little happens at government level unless there is the political will to spend the money, implement the plans, make the changes and so on – in the broad interests of the country.

Whether or not a government demonstrates political will has a strong influence on how well laws and regulations are conceptualised, implemented and enforced. As mentioned earlier in this chapter, even the most skilfully crafted regulations will fall on fallow ground if there is insufficient political will to drive – and hold people accountable for – their implementation and maintenance. Unfortunately, the absence of political will is all too common in many African countries, with the result that good ideas and promising initiatives often come to naught (see, for instance, Persson & Sjöstedt 2012).

The untimely disbanding of the SADC tribunal in 2014 is a good example of what can go wrong when there is an absence of political will – or political will is applied in a partial manner (Nathan 2013). The Windhoek-based tribunal used to have the power to adjudicate complaints brought by individual citizens within SADC against their own or other governments. Then, in the late 2000s, the tribunal declared that the seizure of white-owned farms in Zimbabwe by President Robert Mugabe was illegal. An enraged Mugabe launched a campaign to solicit regional support to shut down the tribunal. South Africa's president at the time, Jacob Zuma, and all the other SADC leaders signed a protocol in 2014 to relieve the tribunal of its power to hear human rights cases brought by SADC citizens. This meant that the tribunal was left merely with an inter-state

dispute-settlement function. With its wings radically clipped, the tribunal today hardly functions. Although there have been calls for the tribunal to be revitalised and its original mandates restored, little progress has been made (Fabricius 2019).

The SADC tribunal could have been an effective forum for resolving regional disputes, including those with a digital trade element. In its original form, the tribunal's jurisdiction stretched to disputes between member states at the government level, and also disputes involving governments, businesses and ordinary citizens in the SADC region. This provided ample scope for resolving cross-border legal problems between entities from different segments of society. It is far more common for disputes to arise between private entities than between public entities (Onyema 2019), which would have made the tribunal a valuable resource as digital trade expands in the SADC region.

8.8.3. Equal opportunity

Africa has one of the highest rates of inequality in the world – not only between countries but also within countries. The origins of inequality in Africa and in many other parts of the world are complex. Also worrying is the fact that the phenomenon is spreading.

Inequality takes different forms, but for the purpose of this chapter it broadly refers to significant differences in economic opportunities among members of the population (UNDESA 2020). IZA World of Labor (n.d.) defines economic inequality as:

> [*T*]he unequal distribution of income and opportunity between different groups in society. It is a concern in almost all countries around the world and often people are trapped in poverty with little chance to climb up the social ladder. (n.p.)

On the one hand, many able-bodied people are deprived of the opportunity to work in meaningful jobs or at all and are likely to be classified as poor. Growing up in poor households in neglected

areas and being unable to access a good education are contributing factors. This is in stark contrast to those who (perhaps owing to better education and historical advantage) are productively employed and well remunerated.

Digital advances have the potential to close or at least alleviate the inequality gap in Africa by giving more people the tools to work, and to work productively. This needs to be at the centre of a regulatory framework. For example, it is well known that millions of Africans would enthusiastically use digital tools to improve their quality of life if they had affordable access to them. A regulatory framework should, at the very least, help to tackle the digital divide by driving better connectivity, more accessible and affordable services and devices, and education and training systems and technologies that fast-track young and older people's transition into the digital economy while also futureproofing their knowledge and skill sets against possible redundancy.

8.8.4. Cross-cutting issues

In Chapter 1, it was emphasised that digital regulations need to take many other technical and trade issues into account because the digital economy is tightly woven into the fabric of the economy as a whole.

Among the cross-cutting issues that should feature in or be linked to a country's digital regulations are: geography, spatial development, transport and logistics, physical and ICT infrastructure, energy, current trade partners, tariffs and NTBs, trade volumes and values, economic growth and development trends, foreign investment climate, investment in R&D, human capital and education and skills levels, employment levels and trends, quality of public and private institutions, sectoral performance, policy environment, political structures, fiscal space, the legal system and the rule of law.

8.8.5. Borrowing from other legal frameworks

When tasked with designing an appropriate regulatory framework to oversee digital applications and trade from a national base, it can happen that policymakers and regulators are unable to find suitably compelling rules or guidelines – which were produced elsewhere – from which they can extract key elements. In such a case, the norm would be to look to other fields where similar challenges and legal complexities have been experienced (though not necessarily directly related to the digital economy) and borrow relevant insights and solutions – supplemented by additional, fresh research on the issues at hand.

8.8.6. The human impact

It is important to remember that any regulation will personally impact the people for whom it was designed. Although their underlying purpose may be sound, regulations sometimes fail to take into account people's particular circumstances, world views or feelings. For example, when regulations pertain to various digital technologies and how they can be used to drive higher levels of productivity, it is possible that people affected by the regulations will feel nervous or dispirited. In the digital age specifically, few people relish the prospect of losing their job to a robot or having to learn new skills later in life in order to remain employable. Importantly, too, many people view regulations and regulatory compliance as very onerous, time-consuming and costly. The financial implications of regulations are a particularly important consideration.

Those tasked with drafting policies and regulations for the digital age have a unique opportunity to do so from a human standpoint, where transparency and clarity are fundamental features. A regulation should not confuse or obfuscate – as legal texts sometimes do – but rather pave the way for willing and

cost-effective compliance. In this regard, Eisenach and Soria (2016) warn against ongoing reliance on sub-optimal legacy regulations that fail to take current circumstances into account.

8.8.7. Consult, consult, consult

As with so many things in life, a lack of engagement with the various stakeholders and role players in the broader digital economy ecosystem could have dire consequences for the effectiveness of regulatory frameworks, including compliance levels (Ahmed 2019). With any transformation exercise, the temptation is not to consult, or not to consult very widely, for fear of encountering resistance to new, potentially threatening ideas and paradigms. Yet, when accompanied by the other elements discussed above – from paying attention to cross-cutting issues and the human element to ensuring a transparent, well-informed approach – the act of consultation will pay dividends in the long run.

8.9. Conclusion

There is no single set of principles or regulatory framework that can be adopted in Africa to marshal the innumerable relationships, activities and resources that together make up the digital economy. Many different configurations of these elements are possible. This presents African policymakers and regulators with a quandary. To escape the indecision that potentially consumes them, they should be guided by the overarching principle that the expansion of the digital economy can, given the right regulatory environment, act as a strong lever for development. In any event, digital advances are a reality that cannot be airbrushed away or relegated to matters of secondary importance.

Ultimately, Africa's digital future will depend on whether countries take a proactive approach, using regulation as a means to extract maximum benefit from digital applications in the interests of society as a whole, or instead adopt a defensive

position, using regulation to maintain the status quo for as long as possible and restrict regional and international engagement and competition in the belief that this will expand local industry and preserve jobs.

8.10. Key takeaways from this chapter

- Laws and regulations are necessary to ensure that there is order in society, and that personal and commercial interests are promoted and protected. Although the digital age heralds untold new economic opportunities, especially for the economically marginalised, it has also made the regulatory process much more complex.
- A key factor contributing to Africa's digital divide is the failure of governments to create regulatory environments that are both responsive to changing market and industry conditions, and also encourage active compliance among both commercial entities and individuals. This has often led to a misalignment between what markets and industries expect and what legislation and regulatory frameworks are able to deliver. Not only does this create regulatory loopholes which can be exploited, but it also dampens the prospects of digital regulation being used as a lever to enhance a country's development.
- One of the most strident debates in trade policy circles is the extent to which digital trade (covering cross-border data flows and ICT goods and services trade) should be subject to regulation or restriction. Depending on their views on this matter, countries fall into one of three main groups: the 'liberalisers', which favour unrestricted digital trade; the 'regulators', which favour unrestricted digital trade but with the proviso that personal data must be vigorously protected; and the 'mercantilists', which advocate some protectionist measures to help build or strengthen their industrial base. Africa appears to side with the mercantilists when it comes to

trade beyond the continent's borders but is more closely aligned with the regulators or liberalisers in the case of trade at a regional or continental level.

- A challenge that African countries face in formulating digital trade regulations is that they cannot piggyback on existing frameworks at the multilateral or regional level. For example, within the WTO system, the regulatory instrument governing digital trade – the Declaration on Global Electronic Commerce – is effectively in limbo. The main hurdle is the moratorium on taxing e-commerce, which continues to be rolled over in the absence of a clear path to resolving the impasse. Similarly, RTAs in Africa have no dedicated e-commerce chapter which could be adapted for use at the bilateral or continental level.
- There is no one, ideal regulatory framework for Africa's digital trade. While regional trading partners should aim to harmonise their regulations to facilitate cross-border trade, country-specific features are still needed to support local development efforts. An effective regulatory framework has the following features: it is stable and predictable, it takes cross-cutting issues into consideration, it is premised on the importance of equal opportunity and human rights, and it is the result of extensive consultation among relevant stakeholders and is supported by strong political will.
- Disputes are a fact of life and business, and the resolution thereof can be costly and time-consuming – particularly when the parties reside in different countries with different laws and judicial processes. Digital trade adds a new layer of complexity to dispute resolution because of the (often) intangible nature of the subject matter of the dispute and the difficulty of determining the jurisdiction and applicable law to govern the proceedings.
- Traditional approaches to dispute resolution, such as litigation, mediation and arbitration (with direct contact between the parties), are not well suited to the digital age, which is increasingly characterised by low-value domestic and

international transactions. Dispute resolution needs to adapt accordingly. Interesting alternative (and economical) options include parties airing their grievances and arriving at solutions via online platforms, perhaps in the company of facilitators who could act as mediators or arbitrators. Of course, the matter of enforcement remains a critical, but challenging, goal.

Chapter 9

Rethinking Africa's education ecosystem: Why all economic sectors need to be digitally responsive

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9.1. Introduction

Education is widely viewed as the bedrock of economic development and well-being. A good education gives young people a promising start in life and a set of values and prepares them for the world of work. It also opens up various professional pathways and opportunities for them to contribute to the economy and society as a whole.

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Education was traditionally associated with the knowledge and competencies imparted at schools, universities and other tertiary institutions. However, the term is now often used to denote a broad range of intellectual achievements – including new knowledge and skills acquired through external and in-house training programmes, self-paced learning sessions and periodic refresher courses in various fields as part of a process of continuing professional development. For the purposes of this chapter, education is used in the broadest sense of the word.

Technological advances have increasingly blurred the lines between what used to be formal education and the many flexible teaching and learning options seen today – which have rapidly gained ground since the advent of COVID-19 when conventional contact sessions suddenly had to give way to online equivalents. Even when COVID-19 eventually retreats, many countries will see a permanently altered education landscape, with flexible, online teaching and learning remaining a popular route to developing competence in a host of fields. However, COVID-19 has also laid bare the consequences of countries neglecting to invest in their digital development, with a lack of Internet connectivity, digital devices and digital skills depriving many of the opportunity to teach or learn remotely (Ghanem 2020; World Wide Web Foundation 2020). This is particularly pronounced in Africa. According to the Alliance for Affordable Internet (2020), the cost of 1 gigabyte of data is disproportionately high in Africa – about 7% of the average monthly salary, making it unaffordable for large numbers of people. Moreover, more than 1 billion people in Africa lack a fast broadband connection (World Bank 2019b). In many ways, digital exclusion is helping to reinforce economic exclusion.

As the so-called 4IR or digital age gathers momentum, educational content is becoming increasingly intertwined with and dependent on educational delivery methods. Although education is a recognised field with different professional pathways that facilitate teaching and learning, it also straddles all economic sectors. Therefore, education needs to be as creative and technologically responsive as the sectors that it supports.

However, Africa lags far behind the rest of the world in terms of educational achievement and skills levels. Moreover, there is also often a mismatch between what people learn and the skills required in business, which adversely impacts their employability and renders affected countries less productive and competitive.

Even if they suddenly had the necessary resources, how could African countries catch up with counterparts in other parts of the world that have long benefited from effective national education systems? Might 'leapfrogging' be the answer? Leapfrogging relates to the uptake of various technologies in an effort to accelerate the acquisition of knowledge and skills in various fields (see also ch. 2). With Africa's education and skills levels falling well short of international norms, leapfrogging appears to offer a partial solution to a long-entrenched problem – especially given the ubiquity of smartphones on the continent, which could aid teaching and learning. Yet leapfrogging, given its technological demands, is itself challenging and requires strong policy and regulatory frameworks, good infrastructure, affordable Internet connectivity (and a regular power supply to drive it) and skills – all of which call for substantial investment and a level of capacity (particularly within government) that many African countries currently lack.

It is important to see leapfrogging in the right context. Some people regard leapfrogging as the opportunity to 'skip' a traditional stage in a country's development (such as moving from agriculture to high-level services and bypassing the manufacturing phase), thereby making up for lost time and catching up with more developed regions. Certain countries have indeed transitioned from low-productivity to higher-productivity economic activity, but usually this has occurred in specific sectors that have clear competitive advantages or are of strategic importance (such as the move, with government support, from wood power to solar energy). In other words, it is more common for countries to adopt an incremental approach to their industrial development, using the leapfrogging approach in a targeted or selective manner. This means that the progress that African

countries make in embracing digital technologies will inevitably take time and will not be even.

As the digital economy waits for no one, Africa urgently needs an education system that prepares both young and older people for the future, while also addressing current shortcomings, including the ever-widening digital divide. Clearly, an education system on its own is not enough to absorb the high numbers of young people who enter the job market every year or who remain unemployed for lengthy periods because of a lack of economic opportunity. A whole education 'ecosystem', with multiple stakeholders and activities, is responsible for creating the environment in which educational supply should be able to satisfy commercial demand.

This chapter explores the role of the education ecosystem in an African context, the knowledge and skills that are needed to be 4IR-ready and some of the challenges that are likely to be encountered along the way. It also discusses some policy imperatives for African countries as they contemplate their digital future.

9.2. Quality education: An elusive goal in Africa?

A 'quality education' means different things to different people, but in essence it means building a solid foundation that enables people to succeed at work and in life in general. Education cannot provide all the answers, but it should encourage people to think, recognise opportunities, confront challenges and find solutions to problems.

Access to inclusive and equitable education is a global imperative. In Africa, however, educational access remains a serious challenge. Africa has the lowest secondary and tertiary enrolment figures in the world (Ndung'u & Signé 2020), while Sub-Saharan Africa, in particular, displays the highest rates of educational exclusion. According to the UNESCO Institute for Statistics (UIS), of the 59 million children of primary school-going

age globally who are not attending school, 32 million live in Sub-Saharan Africa. In percentage terms, about 19% of children at the primary school level in Sub-Saharan Africa are denied the right to go to school, while in North Africa the figure is 9% (UIS 2019). According to the UN, only about 4% of children in Africa will move on to higher education graduate programmes once they complete secondary school (UN 2018).

The main contributing factors to this alarming state of affairs are a shortage of teachers, poor teacher quality, a low level of school attendance by girls and poor educational infrastructure. Low educational standards and achievement levels are typically associated with poverty. According to the World Bank (2015), for example, Sub-Saharan Africa has a disproportionately large share of the world's poor.

Understandably, there is growing scepticism about whether Africa will be able to meet UN SDG4, which is: 'Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all' (UNDESA: Sustainable Development n.d.; UN Division for Sustainable Growth 2020; UNESCO 2018). One of the specific targets of SDG4 is: 'Equal access to affordable and quality technical, vocational and tertiary education, including university for all by 2030' (UN Division for Sustainable Growth 2020). The UN adopted the SDGs in 2015 as part of its 2030 Agenda for Sustainable Development to address global priorities such as education, poverty, climate change and the environment, with a view to achieving a better, more sustainable future for all.

The SDGs are highly interconnected and interdependent, and education, inclusiveness and innovation are important themes. Digital inclusion is a critical enabler of sustainable development, but, as mentioned earlier, limited Internet access is a fundamental obstacle to the realisation of this goal in Africa. The main causes of limited Internet access are unaffordability (cost of devices, energy and data), a lack of digital literacy, a lack of content in local languages and inadequate coverage (Alliance for Affordable Internet 2020). Africa has extensive rural populations with low

per capita income and ineffective or non-existent infrastructure in places, as well as formal education systems that are still largely rooted in the 20th century. These are major hurdles to Africa's quest to participate meaningfully in and benefit from the 4IR.

9.3. The education ecosystem

An ecosystem can be defined as a 'complex network or interconnecting system' (Oxford Dictionary 2020). It is used to describe the interactions among the different components making up the broader environment as applied to different disciplines, such as education, science or business (Daily et al. 2009). An education ecosystem refers to a collection of stakeholders that are active participants in the education process through teaching and learning (or the facilitation thereof), and that have an interest in the relevance and quality of education provided (Naudé 2017).

An education ecosystem comprises elements that are internal and external to an educational institution/entity. Internal elements include teachers/educators, management, and marketing, finance and technical staff. External elements include the government (policymakers and regulators), private businesses (service providers and employers), business associations, funders and investors, students and entrepreneurs, and civil society organisations (Campbell & Rozsnyai 2002; Mueller & Toutain 2015; Naudé 2017). There are also inanimate elements, such as infrastructure (communication networks, buildings and equipment), technologies, intellectual property/content, finance and regulations. Together these internal and external elements sit within a broad, multi-dimensional environment.

A well-functioning digital education ecosystem allows the responsibility for knowledge and skills development to be spread across a range of stakeholders, with different (but integrated) strategies, instruments and technologies used to achieve the desired results (see Figure 9.1). Although, in the 4IR age, the scope for self-learning has become practically limitless, good

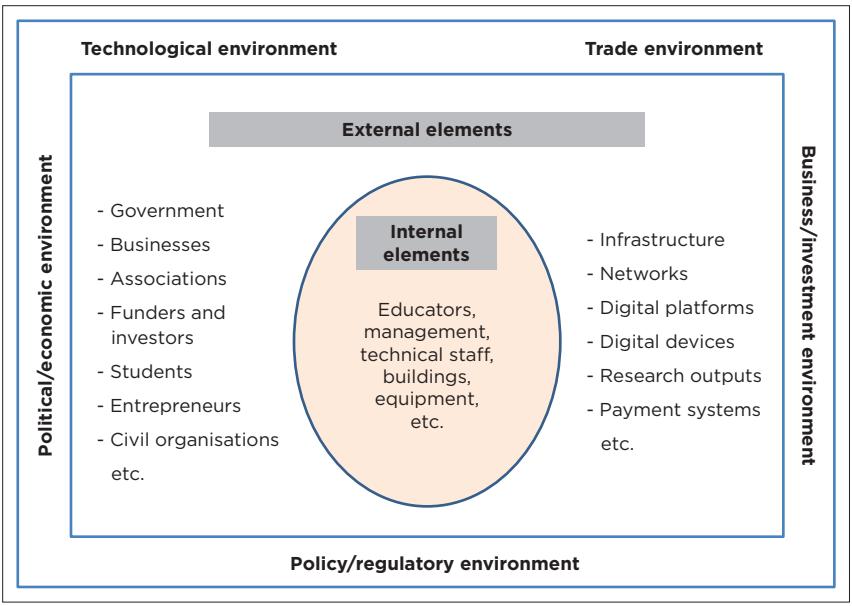

FIGURE 9.1: Stakeholders in a digital education ecosystem.

policy and regulatory frameworks are still essential. In this regard, for example, the importance of having the fundamentals in place (like a reliable power supply, ICT infrastructure and Internet connectivity) cannot be stressed enough. Parry et al. (2021) emphasise that:

> [*T*]he necessary foundations need to be in place before a digital policy framework can be formulated and successfully implemented. It is like building a house – without solid foundations and a sturdy, supporting structure, the house will be inherently weak and it will be difficult for it to withstand external pressures. (p. 293)

In addition, appropriate regulations must be in place to encourage both high standards of operation and quality outputs and to discourage unscrupulous behaviour and unfair competition.

Naudé (2017) argues that education ecosystems today need to promote and secure the content and develop the skills necessary to participate meaningfully in the 4IR. In particular,

there should be strong and ongoing engagement and alignment between employers across all economic sectors and educators to determine the skills needed to ensure that students and programme participants are employable – and productively so. Such alignment prepares the ground for an innovative culture to take root, to grow and to permeate society (Campbell & Rozsnyai 2002; Mueller & Toutain 2015).

Education ecosystems globally are presenting new opportunities for knowledge and skills acquisition – with concepts such as experiential teaching, blended learning, adaptive learning and flipped lecture rooms having entered the lexicon. Digital technologies enable instructors to use web-based content, online collaboration tools, e-books, smartphones and tablets, and e-portfolios as teaching and learning tools (Zeleza 2019). A significant development in recent years has been the growth of so-called massive open online courses (MOOCs), highlighting the fact that there really are no restrictions to teaching and learning. Even before the advent of COVID-19, hybrid approaches to education and training (combining contact sessions with various distance or online instructional models) were gaining in popularity in many parts of the world. The pandemic, though, reinforced the possibilities for, and value of, online education – which has proven to be a convenient companion to remote work.

9.3.1. Technology and innovation ecosystems/hubs in Africa

In Africa, some sectors are recognised as moving more quickly towards digital adoption than others, such as financial services, health services, mining, agriculture and education. One could argue that these sectors have seen more rapid digital adoption out of necessity, because of their prior weaknesses (impacted, e.g. by difficult geography), which called for innovative, technological solutions to traditional operational constraints. The World Bank suggests that the relative success of certain African education and training hubs 'can be attributed to the establishment

of organic multi-stakeholder ecosystems, which are more effective than initiatives led only by the government or the private sector or academia' (Liu 2019).

Most technology and innovation ecosystems or hubs in Africa are currently in South Africa, Kenya, Nigeria, Egypt, Ghana and Morocco (GSM Association 2019). Activities range from providing basic support to start-ups to providing more advanced support in the form of R&D and training. At the end of 2019, there were close to 630 technology hubs across Africa, which included incubators, accelerators, university-based innovation centres, maker spaces, technology parks and co-working spaces. The growth in hubs has been fuelled by a combination of investor funds and development finance, corporate involvement and increased community acceptance (GSM Association 2019).

For example, Fablabs (part of the Fablab program run by MIT in the US), with one in South Africa, are workshops established as prototyping platforms to encourage local entrepreneurship (Fab Foundation 2018). They have expanded to universities and other higher education institutions to provide practical, incubated training in various fields. Living Labs, in turn, with one in Mozambique, are environments in which prototypes developed by entrepreneurs, companies, universities and members of the public are tested and refined (World Bank n.d.).

Google started its first African AI centre in Ghana in order to address the country's socioeconomic and technological weaknesses by driving digital transformation through higher Internet usage. Ghana was also selected as the location for Google's first African Institute for Mathematical Sciences (AIMS), which was established in 2012. The AIMS model has since been introduced in other African countries, including South Africa, Rwanda and Senegal. In another initiative, a crowdfunding campaign led to the donation of laptops, solar panels and ICT equipment to the refugee camp in Kakuma in Kenya so that volunteer teachers could be connected to refugee children in the camp. The initiative expanded and today some 350 teachers,

working through a network of innovation lab schools in various African and Latin American countries, teach mathematics and science remotely to refugee children (WEF 2019).

Complementing this, the Kalobeyei Integrated Social and Economic Development Programme (KISEDP), a public–private partnership led by the government of Kenya, the United Nations High Commissioner for Refugees (UNHCR) and other partners such as Mastercard, mobilises and communicates marketing opportunities to both refugees and host communities, and provides other forms of support to encourage self-reliance among refugees. Strong emphasis is placed on the need for connectivity, digital tools (for payments and delivery of services) and access to energy (renewables rather than diesel generators in the camps) (Betts et al. 2019).

The e-Madina smart city cluster in Casablanca in Morocco is a project involving several companies that are collaborating to make the city an investment destination. The emphasis is on building digitally connected services among government and private-sector employees and city dwellers. In Kenya, Konza City is a digital hub for tech businesses, including Google, Intel, Microsoft, IBM, Samsung and Nokia, and around 250 start-ups, incubators and universities. Benin took advantage of its geographical location as the landing point for undersea cables serving the global Internet. It established the Benin Smart City which is intended to become a 'city of knowledge', featuring an innovation campus, among other facilities (The Agility Effect, n.d.). Various online (e-commerce) ventures have sprung up that cut across several disciplines, for example, education, agriculture, healthcare, logistics and travel. For example, the online store Jumia in Nigeria has partnered with selected African companies to facilitate shipment and delivery of packages to buyers in other markets on the continent, using an online payment platform.

Other initiatives aimed at driving inclusivity in education ecosystems include the Broadband Commission for Sustainable Development (a joint venture between the ITU and UNESCO), the

World Bank's Digital Development Partnership and Moonshot for Africa, the Alliance for Affordable Internet (a global coalition) and the Digital Economy Task Force (an EU–AU initiative) (World Bank 2019a). The WEF, in turn, spearheaded the Internet for All global initiative which aims to cultivate a shared, trusted and inclusive digital environment, in partnership with Smart Africa and the Inter-American Development Bank.

Examples of large corporates setting up incubators include Standard Chartered Bank (which established the eXellerator incubator in Kenya) and Airbus (which established its Bizlap aerospace accelerator as part of the #African4Future initiative in partnership with GIZ make-IT in Africa, MEST and Innocircle) (Briter Bridges n.d.). In 2019, Nestlé, together with Kinaya Ventures, launched an R&D initiative to identify and scale innovative ideas related to sustainable food packaging, distribution and nutrition.

The rollout of technology hubs in Africa dovetails with countries' rate of digital adoption. According to Mastercard's African Leapfrog Index (ALI), South Africa, Kenya, Rwanda, Nigeria and Egypt are the leaders in terms of digital adoption on the continent. South Africa and Kenya are considered to be early adopters and spearheaders, while Rwanda is performing above expectations. Egypt and Nigeria are seen to have the most untapped potential for growth, while Ethiopia is regarded as having the greatest potential for digital gains (Mastercard Center for Inclusive Growth 2019).

9.3.2. Key players in the digital education ecosystem in Africa

In any education ecosystem, government has a central role to play. Its contribution is mainly regulatory in nature, which might include prescribing operational parameters and output standards. A suitably flexible and dynamic regulatory system is a critical enabler of an efficient and growing digital education ecosystem

(Naudé 2017; WEF 2020c). The role of government is largely to create an enabling environment that remains relevant and is continually responsive to digital developments, both locally and internationally.

Among the key features of such an environment are an investment- and business-friendly regulatory framework and opportunities for cooperation and collaboration across national borders (Travaly & Muvunyi 2020). In this regard, the environment should make provision for various financing mechanisms and public–private partnerships (Naudé 2017).

It is important that government does not hamper the adoption of various technologies simply because they may threaten jobs. Instead, it should promote technology supplementation with a view to strengthening a country's digital capacity. Failure by government to create an environment that supports innovation and the building of skills required by business and the investment community will simply deter investment and result in the departure of high-end jobs and skilled people to regions where they are in demand (Naudé 2017). Of course, there will be ongoing development and progress, with or without government's active involvement – although without government, educational offerings and outcomes run the risk of being less inclusive.

Investors and funders also have critical roles to play, as building the infrastructure and systems needed to create a digitally enabled economy is a costly affair. While investment in infrastructure, educational facilities (schools, campuses and innovation hubs), digital platforms and staffing automatically come to mind, research is sometimes overlooked. Yet ongoing research, often conducted by universities, is an important driver of innovation and should be undertaken in partnership with both government and the private sector (Travaly & Muvunyi 2020). Important areas of research include testing innovations and digital business models as well as identifying optimal skill sets (technical and managerial) for the public and private sectors.

Educational service providers (universities, technical and vocational colleges, business schools, training institutions and digital content providers) have the primary task of equipping their students and participants with knowledge and skills that make them employable (or, if employed, transferable to other jobs or professions in the interests of personal growth and advancement). According to the AfDB, less than 4% of Africans have a university degree. Another worrying trend is that education in science, technology, engineering and mathematics (STEM), which are key to innovation, are lagging (AfDB 2020). This will hamper efforts to address the skills mismatch between what industry requires and what the (at least formal) education system is currently delivering.

Hopefully the innovative education and training initiatives discussed above will multiply and African countries' formal education systems will be able to adapt to the rapidly evolving digital environment. In this regard, there are some encouraging developments. The AfDB, in collaboration with Microsoft, has launched its Coding for Employment initiative as part of its Jobs for Youth in Africa strategy for young people between the ages of 15 and 35 to improve their digital literacy. The initiative has seen computing equipment installed at universities and training colleges, with the business community getting involved to ensure that the training content and standards are in line with industry requirements. Other business interventions include teaching students about business and management and offering internships and permanent employment opportunities (Morsy 2020; WEF 2020a).

The private sector is a critical stakeholder in the digital education ecosystem because it is the main source of employment in a country. It is also the main driver of technology uptake and should therefore strongly influence digital policy. Mobile network providers, manufacturers of technological devices, infrastructure specialists and software developers are all part of the extended private sector. There is evidence that the strong business- and

industry-driven approach has been the major force behind the establishment of technology hubs in Africa, many of which have scalability potential. Communities, in turn, comprise students and their family members, alumni, trainees and programme participants, and civil society organisations whose primary goal is to improve their current socioeconomic circumstances (such as escaping the poverty trap) and make a meaningful economic contribution (Zeleza 2019).

9.4. Digital technologies in use or on the horizon in Africa

Digital technologies are constantly evolving and transforming every environment that they touch. This section briefly surveys some of the main digital technologies commonly associated with the 4IR which, to a greater or lesser extent, are or will be part of the industrial and educational landscapes in Africa:

- **Artificial intelligence.** Artificial intelligence is typically associated with automation and machine learning. Machine learning refers to the ability of computers to teach themselves to reason, plan and act in various ways when exposed to data. Artificial intelligence is used in innumerable applications, such as vehicle navigation, energy optimisation, disease detection, and many other time- and cost-saving tasks.

  Although AI is making certain jobs redundant, such as call centre consultants or bank tellers, it is also helping to embellish existing jobs and create new ones geared towards promoting, applying and controlling AI and machine learning technologies. For example, jobs involving machine learning, such as robotic architects and engineers, are among the most popular new job categories advertised on LinkedIn these days. Existing job categories that are set to evolve and expand include cyber security, business analytics, financial analysis and data science, and those that involve the integration of data science with various business practices (Deloitte n.d.; WEF 2020d).

Predicted high-growth industries for AI are computer sciences, ICT, consumer electronics and higher education.

There is also great scope for AI to play a key role in Africa's agricultural sector, which provides more than 60% of the jobs on the continent and accounts for 36% of African GDP (Deloitte n.d.; Travaly 2020). Artificial intelligence clearly has significant implications for both formal (foundational) and continuous education across the continent.

- **Internet of things.** Another ubiquitous digital technology is the IoT, which broadly refers to a network of devices (such as smartphones and tablets, computers, vehicles and appliances) that carry sensors and software and have the computing capacity to collect, exchange and act on data – usually without any human intervention (IoT For All 2021). Many of the devices have an in-built connection to the Internet and to one another. For example, people can remotely open and lock their vehicles, call an Uber, track their fitness levels, and activate or deactivate their home security system from another town, or even another country. Drones and drone technology are also part of the IoT and have multiple applications, including commercial and crime-prevention surveillance, cinematography, sport photography, news reporting, livestock health management, medical product distribution and disaster response (Dugall 2020).

  The IoT offers numerous opportunities to enhance education delivery and outcomes. For example, it allows universities and other institutions to acquire real-time insights into student or participant performance, which can be used to improve instructional content and modes of delivery. Linked to this is the concept of 'nudge technology' which allows timely, personalised interactions between students and educators in order to enhance students' study habits or learning outcomes. The IoT has been one of the drivers behind the 'unbundled university' (Caruso 2018), where education has been disaggregated into components, often in partnership with the private sector. This has contributed to the emergence of new teaching and learning pathways and the growth of 'micro-credentials' (mini-qualifications) that are

sometimes more industry-responsive (and more easily obtained) than traditional, long-term degrees and diplomas (Czerniewics et al. 2014; Walji 2019).

Developments in the IoT sphere could be educational and professional game changers for geographically excluded communities in Africa. However, ensuring that communities have affordable access to the Internet (including access to laptops and other devices) and fast broadband remains top priorities, failing which these technological advances in education will not gain the necessary traction.

- **Robotic process automation.** Robotic process automation (RPA) refers to the automation of jobs (mainly those involving repetitive tasks) using digitally powered robots, bots and chatbots. Robots are programmed to automate specific business processes, such as data-processing, data mining, transaction processing and sending of automated email responses. Bots are autonomous programs commonly used in the call centre industry that allow callers to select from an array of automated service options when seeking information or assistance. Not surprisingly, call centre jobs are among the most threatened by advancing technology (Chui, Manyika & Miremadi 2015). Other RPA-rich job categories include software architects and engineers, software developers and programmes (coders), and project managers and consultants.
- **Cloud computing.** Cloud computing refers to the delivery of computing services, such as server management, systems networking, data storage and data analytics, in the cloud 'to offer faster innovation, flexible resources, and economies of scale' (Microsoft 2020). Cloud computing could bring much value to education ecosystems in Africa, particularly where budgets for localised ICT platform development and management are constrained. Cloud computing offers considerable scope to move services 'above the campus'. For example, it enables universities and colleges to provide wireless services to students and faculty members working on different campuses and in off-campus locations and also

enables students to learn using any (well-powered) digital device, anywhere (Hayhurst 2020).

- **Virtual reality and augmented reality.** Virtual reality (VR) and augmented reality (AR) are sometimes used interchangeably, but they are different concepts. With VR, someone (wearing, say, a VR headset) steps into another world, one that is different from the real world to which they are accustomed. They are able to see and participate in this virtual, fabricated environment, which could appear as a windswept beach or the cockpit of a fighter jet. Augmented reality, in contrast, adds to someone's vision of the world as viewed through their smartphone or other digital device. The additional visual element could be as simple as today's date appearing on the screen or as complicated as a floating hologram or some other three-dimensional image entering the picture. Augmented reality is used, for instance, to help warehouse employees process orders more effectively and electricians to do repairs with a high level of precision.

  Both VR and AR could (in their own ways) bring value to the education and training space in Africa by, for example, exposing doctors to simulated medical procedures and pilots to simulated flights, and by creating virtual or augmented classrooms for those teaching and studying remotely (Mavundza 2020).
- **Blockchain.** Blockchain technology is a decentralised, secure, distributed and public digital ledger (consisting of blocks) that is used to record transactions across many different computers. It is secure because no record can be altered once entered without all subsequent blocks being altered. Blockchain technology is particularly valuable in the fight against cybercrime, computer hacking and fraud as well as in tracking cargo as it proceeds through the logistics supply chain. It can also be used for tracking commodity prices, registering land ownership, facilitating online payments using Bitcoin, connecting farmers to markets and managing student records in an educational context (Thayer et al. 2019).

As digital technologies mature and gain wider acceptance, they will increasingly help to drive innovation and the growth of various economic sectors. When combined, integrated and converted, technologies give rise to powerful applications that are greater than the sum of their parts (Ndung'u & Signé 2020; PricewaterhouseCoopers 2020). For example, a 'smart campus' is an environment in which physical and digital elements are integrated in order to optimise learning experiences and outcomes. In the commercial world, an AI-powered 3D printer could be configured to automatically modify an object's design while printing it, or a drone could be enabled to follow a moving vehicle or person autonomously. A more knowledge-rich and optimally functioning world should benefit all segments of society.

There is enormous scope for digital technologies to enhance educational content (which is often sector-specific) and educational delivery methods in Africa, and in the process meaningfully confront longstanding economic challenges, including economic exclusion. However, driving greater economic inclusiveness means tackling the fundamentals that have created and continue to exacerbate the digital divide on the continent.

9.5. Looking ahead: Emerging digital jobs and skills requirements

Advancing digitalisation is having a profound effect on the job market, with the potential to both create new employment opportunities and destroy existing jobs because of their high cost or obsolescence. In this regard, education ecosystems throughout Africa have a crucial role to play in preparing people for the changing workplace. Adaptation needs to be the core maxim of policymakers, regulators, educators, businesspeople and those in the market for education services.

In general, the majority of new jobs are expected in the green economy, engineering, AI, cloud computing and product development fields. Other fields that will see job growth include care services, marketing and sales, and content development

(WEF 2020c). Jobs that are able to be automated will in time become redundant and will be phased out (Dahlin 2019; Petrone 2017). Globally, it has been estimated that the adoption of digital technologies will radically transform more than 1 billion jobs by 2030, with about half of all basic skills requirements changing by as early as 2022. However, the net result will be more jobs rather than fewer jobs (Blackman 2020).

Even in the face of dramatic advances in digitalisation, global unemployment in 2018 fell by 5.2%, highlighting how technological transformation and healthy employment levels can coexist. Before the pandemic, the WEF predicted that global growth in jobs would outweigh job losses in the face of digital advances (WEF 2018). However, the unexpected, corrosive effects of COVID-19 (a black-swan event) may be felt for some time to come. African countries lack the financial safety nets (such as social welfare systems) that are common in developed countries, and so their populations are vulnerable to upheavals that lead to reduced economic activity and job losses.

Although there is unlikely to be a shortage of jobs in the future, there is a strong risk that there will be a shortage of skilled people to fill those jobs. Moreover, OECD data indicate that some highly specialised technical jobs undergo significant transformation every couple of years, which makes it extremely difficult for job incumbents to continue to meet the job requirements and for businesses to meet the high cost of ongoing training.

It is now conventional wisdom that digital technologies such as automation, robotics and various AI applications will radically alter the work environment for everyone from blue-collar, factory workers to high-level, white-collar professionals like lawyers and accountants (Muro, Whiton & Maxim 2019). As jobs become more sophisticated, the need for cognitive skills (such as thinking, remembering and reasoning) and non-cognitive skills (such as displaying attitudes and behaviours) will grow, as will high-level skills such as problem-solving, critical thinking, creativity, teamwork and conflict resolution. This will place increasing pressure on stakeholders in education ecosystems to tackle the problem of skills mismatches (WEF 2020b).

The WEF (2017) reports that up to 20 million educated job seekers will enter the African job market every year until 2050, and countries will need to deliver quality jobs to reap the benefits of this demographic dividend. At the same time, about 50% of jobs in Africa will be impacted by automation (WEF 2017). If the problem is not proactively addressed, large numbers of inadequately skilled workers will be a significant deterrent to businesses investing in African countries.

9.5.1. Jobs and job clusters in the digital age

Table 9.1 lists the jobs that are the least and most threatened by digital advances (WEF 2017), while Table 9.2 lists the professional clusters or industries that are predicted to create the most jobs as the 4IR advances and accelerates (LinkedIn 2020; WEF 2020b).

Table 9.3, in turn, lists those jobs displaying the strongest growth globally and the professional clusters with which they are associated (LinkedIn 2020).

From Table 9.1 to Table 9.3, it is clear that the jobs of the future are not only heavily geared towards digital applications but also require strong cognitive abilities (reasoning, analytical and quantitative skills, decision-making and problem-solving), combined with creativity and intellectual discernment.

TABLE 9.1: Jobs most and least threatened by the 4IR (globally).

Most-threatened jobs	Least-threatened jobs
Tax auditor	Healthcare professional
Call centre operator	Computer programmer; analyst
Legal secretary	ICT engineer; architect
Real estate agent	Sales manager
Farm labourer (e.g. pickers and sorters)	Chief executive officer
Secretary; administrative assistant	Carer
Insurance assessor; underwriter	Mental health professional; psychiatrist
Data capturer	Emergency service worker
Telemarketer	Teacher; educator

Source: WEF (2016).
ICT, information and communication technology.

TABLE 9.2: Top professional clusters for new job opportunities (globally).

Professional cluster/industry	No. of opportunities per 10 000 people in the labour market[a]	
	2020	2022
Data and AI	78	123
Engineering and cloud computing	60	91
People and culture	47	58
Product development	32	44
Sales, marketing and content development	87	125

Source: LinkedIn (2020); WEF (2020b).
AI, artificial intelligence.
[a], Calculated as the compound average annual growth rate.

TABLE 9.3: Jobs showing the strongest growth, 2015–2019.

Rank	Job/job title	% annual growth rate	Professional cluster/industry
1	Artificial intelligence specialist (e.g. researcher)	74	Computer software, Internet, information technology and services, higher education and consumer electronics
2	Robotics engineer	40	Information technology and services, industrial automation, computer software, financial services and automotive
3	Data scientist	37	Information technology and services, computer software, Internet, financial services and higher education
4	Full-stack engineer (i.e. web developer or engineer)	35	Computer software, information technology and services, Internet, financial services and higher education
5	Site reliability engineer	34	Internet, computer software, information technology services, marketing and advertising and financial services
6	Customer success specialist	34	Computer software, Internet, information technology and services, marketing and advertising and financial services
7	Sales development representative	34	Computer software, Internet, information technology and services, marketing and advertising, computer and network security
8	Data engineer	33	Information technology and services, Internet, computer software, financial services, hospital and healthcare

Table 9.3 continues on the next page→

TABLE 9.3 (Continues...): Jobs showing the strongest growth, 2015–2019.

Rank	Job/job title	% annual growth rate	Professional cluster/industry
9	Behavioural health technician	32	Mental healthcare, hospital and healthcare, individual and family services, education management, health, wellness and fitness
10	Cyber security specialist	30	Information technology and services, defence and space, computer network and security, management consulting and financial services
11	Back-end developer	30	Computer software, Internet, information technology and services, marketing and advertising and financial services
12	Chief revenue officer (e.g. vice president of revenue operations)	28	Computer software, information technology and services, marketing and advertising, Internet and financial services
13	Cloud engineer	27	Information technology and services, computer software, financial services, Internet and telecommunications
14	JavaScript developer	25	Computer software, information technology and services, Internet, financial services, marketing and advertising
15	Product owner	24	Information technology and services, financial services, computer software, insurance, hospital and healthcare

Source: Akhtar (2019); LinkedIn (2020).

Some jobs appear to demand 'all-rounders' who have both technical skills and 'soft skills', which then need to be blended and applied to given circumstances. Interestingly, several of the least-at-risk jobs involve a great deal of human interaction, understanding and empathy – aimed at helping or guiding others (such as CEOs, carers, educators and health professionals).

Currently trending jobs in Africa include creative artists, food technologists, 3D designers, data centre workers, healthcare workers and educators. There are also good job prospects in the areas of infrastructure development, ICT (especially design and engineering) and the green economy (WEF 2017). The fact that

technology hubs are gaining traction in several African countries augers well for the expansion of the digital economy, although closing the digital divide will be an enormous undertaking.

9.5.2. Specific skills and attributes required in the digital age

Just as the 4IR is changing the jobs that are in demand, both presently and in the future, so too is there an evolution in the skills and attributes needed to become or remain employable. Employability – both formal employment and self-employment – demands more than simply technical skills. It also relates to attributes, capabilities and behaviours (Yorke & Knight 2006). Typically, these are higher-order thinking skills, personal skills, social skills, generic skills and personal perceptions about one's own employability (Hendrawan & Daryanto 2019; Römgens, Scoupe & Beausaert 2019).

As time goes by, more and more jobs will require people to be adept at complex networking and interpersonal engagement, and to display perseverance, adaptability and flexibility. Having said that, a lack of relevant technical skills will pose a significant threat to African countries' development efforts because it will leave them unable to harness the full potential of transformative technologies (Travaly & Muvunyi 2020) (Zeleza 2019):

> In a world of rapidly changing occupations, the hybridisation of skills, competencies, and literacies, together with lifelong learning, will become assets. In a digitalised economy, routine tasks will be more prone to automation than highly skilled non-routine jobs. Successful universities will include those that impart academic and experiential learning to both traditional students and older students seeking retraining. (n.p.)

People acquire skills through work, education and training (qualifications and competency assessments) and work/life experiences. The WEF (2016) distinguishes between attributes, basic skills and cross-functional skills. Basic skills include content

skills and process skills, while cross-functional skills include social skills, systems skills, complex problem-solving skills, resource management skills and technical skills.

Basic skills include: the ability to speak, read, comprehend and write; 'active learning' (understanding the implications of new information) and 'active listening' (giving full attention to what other people are saying); critical thinking; ICT literacy (ability to access, integrate and manage digitally generated information); and self-management (e.g. time management) (WEF 2016). Cross-functional skills – also called specialist generalist skills, which involve solving new, ill-defined problems in complicated settings – include: reaching out to help others; managing resources (such as people and finances); idea generation; analysis and interpretation; and mathematical reasoning (WEF 2016). Basic skills are traditionally acquired through formal education, but the 4IR has also given rise to the need for innumerable cross-functional skills across all economic sectors.

In contrast to skills, attributes are personal, inherent qualities related to people's distinctive character, such as interpersonal skills and intellectual prowess (Gilkison et al. 2017). Attributes underlie all basic and cross-functional skills and are either acquired through work and life experiences or are part of people's inherent nature. They comprise 'cognitive abilities (flexibility, creativity, logical reasoning and problem sensitivity) and physical abilities (physical strength and manual dexterity)' (WEF 2016:21).

While most jobs require wide-ranging skills, different professions call for specific attributes and competencies. For example, health workers would need to have skills such as resourcefulness and the ability to develop nurturing relationships with patients, while veterinary surgeons would need to be confident, socially responsible and polite, be able to direct and/or work in teams and have excellent practical skills (Klibi & Oussii 2013; Mellanby et al. 2011). Against the backdrop of the unfolding digital age, Table 9.4 lists the top 15 high-growth technology jobs and the associated technical skills needed for competency in such jobs.

TABLE 9.4: High-growth technology jobs and required technical skills.

Rank	New and emerging technology jobs	Required technical skills
1	Artificial intelligence specialist	Machine learning, deep learning, Python and natural language processing
2	Robotics engineer	Robotic process automation (Blue Prism, Automation Anywhere) and robotics
3	Data scientist	Machine learning, data science, Python, R and Apache Spark
4	Full-stack engineer	React.js, Node.js , JavaScript, AngularJS and Cascading Style Sheets (CSS)
5	Site reliability engineer	Amazon Web Services, Ansible, Kubernetes, Docker products and Terraform
6	Customer success engineer	Software as a service (SaaS), Salesforce and customer relationship management
7	Sales development representative	Salesforce, cold calling, software as a service (SaaS), lead generation and sales
8	Data engineer	Apache Spark, Python, extract/transform/load and Amazon Web Services
9	Behavioural health technician	Applied behaviour analysis, autism spectrum disorders and behavioural health
10	Cyber security specialist	Cyber security, information and network security and vulnerability assessment
11	Back-end developer	Node.js, JavaScript, Amazon Web Services, Git and MongoDB
12	Chief revenue officer	Strategic partnerships, start-ups, software as a service (SaaS), go-to-market strategy and executive management
13	Cloud engineer	Amazon Web Services, cloud computing, Docker products, Ansible and Jenkins
14	JavaScript developer	React.js, Node.js, AngularJS, JavaScript and Cascading Style Sheets (CSS)
15	Product owner	Agile methodologies, Scrum, product management and software development

Source: Akhtar (2019); LinkedIn (2020).

9.6. Conclusion

Education demands a highly cooperative approach, with education specialists, industry representatives, policymakers and many other stakeholders working together to ensure that a country's teaching and learning efforts lead to economic opportunities, decent work, and sustainable and inclusive development. In many ways, education is the foundation of a

stable, well-functioning society and now that the digital age is advancing rapidly, education – in all its manifestations, from formal qualification-based programmes to quick but intensive skills programmes and refresher courses – needs to leverage the powers of digitalisation in order to reach more people in innovative, cost-effective ways.

The challenges that Africa faces in catching up and keeping up on the education and skills development front are immense. Leapfrogging has been spoken about as a partial solution, but it cannot compensate for general development failures and can at best be promoted in targeted areas, with the help of focused support measures. To suggest that Africa can make up for its educational shortcomings of the past by 'going digital' sounds appealing. While the digital age has greatly expanded the scope for people to acquire knowledge and skills, they need the right infrastructure and tools (and indeed knowledge) to access and capitalise on opportunities. These are often in short supply in Africa, which means that for many, the 4IR is passing them by. If the digital divide persists, socioeconomic divisions will persist.

Effective educational delivery methods (from contact sessions to online teaching and self-paced learning) are critical, but education is also about *content* – which depends on the quality of the teaching and the relevance of the subject matter being imparted. If, as this chapter has shown, high-growth jobs include ICT specialists, salespeople and behavioural health experts, the programmes on offer should cater to this demand. Africa's formal education systems, in particular, need a rethink. If young (and older) people are to be employable, they need skill sets that allow them to function in highly dynamic, data-driven environments. Fortunately, the workplace of the future will continue to depend on human-centred skills, but there will be a growing demand for higher-level cognitive thinking and problem-solving, with work lending itself to standardisation being relegated, to an increasing extent, to machines (see also ch. 4).

Clearly, if African countries do not prepare for the changing world of work, the digital and economic divide will continue to

widen, with devastating consequences. It does not have to be that way. Sometimes it takes a crisis (in this case, COVID-19) to jolt people into a different mindset. The pandemic has brought into sharp relief the fact that digitalisation is not a future consideration; it is very much part of the present. It is in this context that the concept of an education ecosystem is so important, as it combines the views, experiences and resources of a broad cross-section of actors who, working together, will achieve much more than if they worked in silos.

The skills mismatch that is frequently spoken about and that plagues many economies is an excellent example of what happens when education and skills programmes are not aligned to industry requirements or do not prepare entrepreneurs for commercial success. Part of the problem is that the different actors simply do not talk to each other. If they did, they would undoubtedly find that they had much common ground.

Policy imperatives for Africa include the following:

- Governments in Africa need to recognise the value of, and actively promote, the education ecosystem concept. Productive partnerships between government (policymakers and regulators) and the private sector (employers and service providers) are essential to ensure that skills mismatches become a thing of the past and that sectors with digital potential attract adequate investment. Just as the COVID-19 crisis has demanded a multi-pronged and multi-party approach, so the education and skills crisis facing Africa needs collaboration from different quarters.
- There is much to learn from the education and skills development approaches followed in advanced countries, which have sophisticated digital economies. For example, Finland's system of transversal skills acquisition, multi-disciplinary learning, student involvement and government support provides a useful, high-level benchmark. Africa has many success stories in the technology hub space (largely private sector-driven) which can act as spawning grounds for

more focused public–private sector efforts to extend the reach of technology-infused education and training. At the heart of these success stories are sound infrastructure and equipment, digital connectivity and strong teaching/training models – often borrowed or adapted from abroad.

- Developing human capital is non-negotiable. Teachers, educators, trainers, skills development facilitators and content developers need to have the opportunity to acquire the necessary expertise and continuously refine their skills, while also being judged according to relevant professional standards. Often, educators and training practitioners in developing countries (including Africa) are not suitably qualified for their jobs, thus negatively impacting the knowledge and skills acquired by students and participants. This inevitably leads to a widening skills gap, which has serious repercussions for the economy as a whole.

  Again, greater government–private sector collaboration can help to heal both the digital and economic divides. For example, the WEF's Closing the Skills Gap Accelerator, launched in 2020, is a global initiative aimed at creating national and global public–private sector collaboration platforms (mainly comprising ministers and CEOs) to address skills gaps and to reconfigure education and training for the future). Four key focus areas are: 'lifelong learning and upskilling; proactive redeployment and re-employment; innovative skills funding models; and skills anticipation and job market insights' (WEF n.d.). So far, South Africa is the only African country to have joined the initiative (WEF 2020b).
- If governments are to adopt a targeted leapfrogging approach to education, it is important that they prioritise specific economic sectors that would most clearly benefit and allocate resources accordingly. When it comes to ensuring that education is fit-for-purpose and future-ready, the need to capacitate government is often overlooked. Yet government is responsible for policymaking, setting standards and devising

appropriate regulatory frameworks, which includes upholding consumers' rights to privacy and fighting cybercrime. Government is also in charge of trade policy, which has a significant bearing on the products and services imported to support a technological transformation strategy. Importantly, policies, regulations and standards should provide a fair and transparent operational framework for industry but not be so rigid as to discourage competition. In performing its core function of creating an enabling environment, government also needs to be innovative, particularly in the use of technology to deliver its own services.

- As the 4IR accelerates, it is becoming more and more evident that knowledge and skills acquisition knows no boundaries. In fact, the massive quantities of information at people's fingertips (via the Internet) mean that information per se is no longer the competitive advantage it once was. It is what individuals, companies, industries and countries *do* with information that sets them apart at the local, regional, continental and global levels. Africa's regional economic groupings, such as SADC, the EAC and COMESA, provide useful platforms through which member countries can share educational expertise and expand their respective markets – especially where their respective offerings are delivered virtually.

  Developing education products and services at scale would be an important step towards catching up with other parts of the world. The AfCFTA offers even greater scope for the development of Africa-wide educational value chains, although significant differences in countries' policy and regulatory environments, and the presence of many NTBs (like the uneven rollout of digital infrastructure and connectivity), are likely to remain obstacles for some time to come.
- The need for good infrastructure and connectivity (including affordable devices and data) to support digital transformation in Africa cannot be overemphasised, given the pronounced digital divide on the continent (notably between urban centres

and rural communities). Without this fundamental building block in place, progress cannot be made on the education front as digital teaching and learning are here to stay – particularly in the area of continuing professional development – and synergies in national and cross-border education ecosystems will need to be tapped. At an even more basic level is the need for a secure and inclusive electricity supply. As with many things in life, neglect of the basics can derail even the most carefully crafted strategies and plans. It would probably not be an exaggeration to say that inadequate infrastructure and connectivity remain Africa's most serious impediments to being able to capitalise on the fruits of the digital economy and require considerable investment and expertise to fix and thereafter maintain.

Certain sectors in Africa hold particular potential for digital transformation, such as agriculture, healthcare and financial services, but they need to be well-resourced if they are to drive industrialisation on the continent and reduce poverty. At present, many markets are fragmented, and there are pockets of excellence rather than critical mass. This is all the more reason why broad-based collaboration is necessary, allowing costs and responsibilities to be effectively shared.

Like the other revolutions before it, the 4IR has been and will continue to be disruptive, and in the process it is changing the landscape forever. Africa has a choice – to embrace and help shape the future or remain on the sidelines, denying many people the opportunity to make a contribution to their countries' and the continent's upliftment.

Such an important opportunity may not come again. While it has become a bit of a cliché to say that Africa is standing at a crossroads, it nevertheless aptly describes the situation at present: take the familiar but lonely path, or take the more popular path which, while challenging, will have better scenery along the way and will help to build the confidence to continue to explore ever-new paths.

9.7. Key takeaways from this chapter

- Education, in the broadest sense of the word, is the foundation of a stable, well-functioning society. With the digital age upon us, the education profession has both an opportunity and an obligation to impart knowledge and skills to young and older people to ensure that they are well prepared for a changing workplace. Teaching and learning need to be highly adaptable.
- Africa lags well behind the rest of the world in terms of its educational achievement levels – the result of policy shortcomings, and a lack of investment in physical, technological and human resources. Although Africa has a laudable mobile phone culture, the Internet remains inaccessible to many on the continent. Moreover, a misalignment between what the formal education system often delivers and what the business sector expects leaves many people unemployable, with economy-wide implications. There is also an expanding digital divide, which makes any intended technological catch-up increasingly difficult.
- Leapfrogging is often touted as a means of accelerating Africa's industrial development, with the education and training sectors regarded as convenient launching pads. Yet developing an economy is not a quick process. A leapfrogging strategy can be selectively applied to drive the transition from low-productivity to high-productivity economic activity (such as moving from coal power to solar energy). Moreover, the agricultural, healthcare and financial services sectors in Africa are well-placed to adopt such an approach. However, leapfrogging should not be seen as a wholesale solution to countries' accumulated development failures.
- One of the problems with traditional education (and to some extent training) systems is that stakeholders (education and training institutions, policymakers, regulators, employers and funders) tend to operate in isolation from one another. What Africa needs is for all interested parties to collaborate in a broad education 'ecosystem' so that issues of educational

content and quality, professional standards, job relevance and sustainability can be addressed in a more holistic manner, through ongoing consultation.

- Encouragingly, technology and innovation hubs have been springing up in many African countries. Many of these hubs enjoy the financial backing and expertise of global tech giants such as Google, Microsoft, Amazon and Samsung, and are also supported by large players in the global development community, such as the World Bank and the UN. However, African governments – working with the private sector – have a critical role to play in creating an investment-/business-friendly environment and devising regulatory frameworks that allow innovation to flourish, while also deterring commercial exploitation – domestically, regionally and internationally.
- Advancing digitalisation is having a profound effect on the job market, with the potential to both create and destroy employment opportunities (the latter occurring when manual work can be automated, or certain products and services reach the end of their natural lifecycles). Sectors with high (new) job potential include the green economy, engineering, ICT, product development, marketing, healthcare and education.
- While machines continue to take over routine work, people will increasingly be called upon to display high-level cognitive abilities, such as analytical, quantitative and problem-solving skills. There will also be a need for people to network and engage interpersonally in a variety of settings. In many ways, the ideal leaders and employees of the future are 'all-rounders' who have both technical and soft skills, not least of which is an ability to adapt to varying circumstances. This will also ensure that different career paths will remain open to them.
- As digital advances cut a swathe through traditional ways of working and living, Africa should not be cowed into timidity. In fact, it now has an unparalleled opportunity to shape its future for the better.

Chapter 10

Turning theory into action: The power is in Africa's hands

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10.1. Introduction

What recent events in the world have highlighted is that Africa may be falling behind, but it is not alone. There is immense potential for Africa to engage with other countries and regions, sharing knowledge and expertise and working together to find solutions to its own as well as regional and global challenges.

COVID-19 has been an especially powerful reminder that all countries have to navigate turbulent seas and occasionally deal with giant, unexpected waves. Moreover, a crisis that affects everyone means that everyone needs to work together to find a safe passage through the storm. COVID-19 ripped through the

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world at breath-taking speed, knocking all countries off course. While no one could have anticipated the ferocity of the virus and the impact it would have on economies, livelihoods and lives, it is telling that some countries were able to take corrective action more quickly than others. The world has seen many crises in its long history and will see many more. It is therefore important to expect the unexpected and be in a state of preparedness for unseen future events. The goal should be to ride the waves, not just keep one's head above water.

Africa has an opportunity to leverage its regional and international partnerships and the considerable resources it has on the continent to accelerate its development and catch up with the rest of the world, notwithstanding ongoing global volatility and uncertainty. Traditional development strategies over the years may not have produced the desired results, but the digital age provides new and unprecedented opportunities for African countries to level the socioeconomic playing fields and plot a route towards a more digitally rich future.

Although to some African countries such a future may seem far off, the reality is that the future does not just happen – it is created. Africa, therefore, needs to move beyond good ideas and theory and start to make things happen in the interests of long-term, sustainable development. Digital technologies are the perfect tools with which to create a new and better-looking landscape, which should borrow from other countries' insights and experiences but still have a distinctly African flavour.

This final chapter looks at some of the highlights from the book and identifies certain priority areas that policymakers, the research and academic communities, businesses and other stakeholders should focus on to ensure that Africa is equipped both to tackle ongoing challenges and to convert opportunities into visible results that will deliver benefits to all.

It was not the intention to travel the full length and breadth of Africa's development challenges over the years, the many digital technologies that have been developed or how digital

trade is changing the complexion of the global economy. Rather, the chapters set out to paint a broad picture of some of the main issues that African countries need to confront as the 4IR unfolds, which will act as useful signposts as they journey into the future.

10.2. The global storm: A heady mix of geopolitics, geo-economics and changing trade dynamics

The world is experiencing great upheaval in the geopolitical and geo-economic arenas (Woodley 2015). Rising tensions between two superpowers, the US and China (Letzing 2019), ongoing ideological differences between developed and developing countries, and growing populism (Greven 2016) and anti-globalisation sentiment (Peters 2018) have all contributed to an increasingly volatile and at times hostile global atmosphere. In addition, the disruptive influence of digital advances and their potential to drive a wedge between countries and regions cannot be downplayed.

Geopolitical and geo-economic tensions inevitably spill over into the global trade arena. As ructions between developed and developing countries have intensified over the years, WTO members' ability and willingness to conclude long-overdue multilateral trade negotiations have waned. The consensus-driven multilateral trade order is under significant threat and the WTO's role and relevance have come to be questioned (Laborde et al. 2019; The Conversation Africa Inc. 2019). So far, however, no one has come up with a viable alternative to the rules-based trading system, with a body such as the WTO at the helm to coordinate discussions, negotiations and agreements, and adjudicate disputes between countries or regions.

With a new director-general having taken up the reins at the WTO and with the US potentially adopting a more outward, conciliatory stance under the Biden administration, it is possible

that multilateral trade talks will once again feature more prominently on countries' agendas. However, agreements such as the GATT and GATS are clearly due for an overhaul in the light of the blurring of the lines between goods and services and the growing influence of digitalisation in all spheres of economic activity (Janow & Mavroidis 2019). Furthermore, the fact that the WTO membership is so clearly divided over whether or not digital trade should be open or subject to restrictions is particularly worrying, given the ongoing repercussions of the impasse (Aaronson 2019; Janow & Mavroidis 2019). This is an area that needs priority attention.

Even if the WTO's multilateral trade agreements are revitalised, countries will continue to devote time and resources to building and strengthening bilateral and regional trade ties, and so they should. Geographical proximity and historical and cultural affinity often make regional economic groupings particularly good vehicles for trade and investment. Notwithstanding the UK's dramatic departure from the EU in 2020, the move does not portend the bloc's imminent or even eventual demise. Regional partners do periodically have their ups and downs. However, Brexit sent a signal to the world that globalisation has not delivered what many people had hoped for in terms of economic opportunities; for some, the liberal trade order has opened the door to uncomfortable levels of foreign influence and competition for jobs (Calhoun 2016; Luo 2017). Despite these loud rumblings, intraregional trade and investment figures remain strong in many parts of the world, and the regional integration model looks set to stand the test of time.

A number of RECs are in operation in Africa, but intraregional trade falls far short of its potential. Contributing factors include transport and logistics bottlenecks, onerous customs procedures, and inconsistent trade regulations and standards, which together translate into high trade costs (Hoekman & Shephard 2015). The AfCFTA is an unusually ambitious integration project in a world that has become more circumspect in recent years, especially in

the wake of COVID-19. Yet it has the potential to prise open trade on the continent and activate RVCs, which would help to inflate the volume and value of African trade (World Bank 2017). It could also lay the foundation for digital expansion in Africa. However, significant harmonisation of existing policies and regulations is required if this route is to be successfully followed – covering tariff schedules, rules of origin, product standards, customs procedures, data and intellectual property protection provisions, and many other issues.

10.3. The Fourth Industrial Revolution is here: How prepared is Africa?

The quickening pace of digitalisation has been a disruptive influence throughout the world, with many countries wondering how much, or how little, to invest in new technologies in view of the likely impact on their employment levels, trade volumes and overall development prospects.

It is indisputable that the digital age (also referred to as the Fourth Industrial Revolution or the 4IR) is changing the way people live, interact and work, and that there is no turning back to a more sedate era when technology was a useful companion to, rather than a driver of, economic activity. The digital economy *is* the economy, according to many commentators (Anderson & Wladawsky-Berger 2016). For example, the advent of COVID-19 and the lockdown measures that ensued clearly demonstrated how important it was for countries to have efficient digital communication channels in place so that life and work could go on, albeit at a distance.

Of all world regions, Africa has the most pronounced 'digital divide' (Fuchs & Horak 2008; Sarkar, Pick & Johnson 2015), characterised by millions of people across the continent lacking access to digital devices, services and training opportunities, who as a result are unable to reap the benefits of the geography-defying online world. Much of the problem can be attributed to

government inaction or neglect – evidenced in widespread failure to invest adequately in ICT infrastructure and services, Internet (especially fast broadband) connectivity that is accessible and affordable, and even reliable sources of energy to power Internet usage and enable the application of digital technologies in various forms of economic activity (Ndung'u & Signé 2020). Furthermore, people's level of education is a strong determinant of whether, even if they have access to the Internet, they use their online experience to further their skills or earn a living, or simply for amusement (Gillwald & Mothobi 2019). In many parts of Africa, educational standards leave much to be desired, which does little to nurture entrepreneurial mindsets and the desire to use technology to pursue professional dreams.

Despite the debilitating effects of the digital divide in Africa, which is evident both between and within countries on the continent, there are encouraging signs that African countries have some of the technological stepping stones in place that are needed to achieve more sustainable growth and development. The fact that Africa has undergone a so-called 'mobile revolution' in recent years and has been called the epicentre of the global mobile money industry is an example of what can be done in difficult circumstances. Admittedly, Africa's mobile revolution has largely been private sector driven, with satellites providing the connectivity that has in many cases not yet been facilitated on the ground. Nevertheless, Africa's mobile culture provides an important foundation for more advanced digital growth and development.

The private sector and international development community have also been active in establishing innovation and tech hubs in a number of African countries aimed at harnessing entrepreneurial talent and providing a springboard into formal business ventures that have the potential to provide meaningful employment to many (Liu 2019).

Africa's high levels of unemployment, particularly among young people, have been called both a youth dividend (UNDESA, Population Division 2019) and a ticking time bomb. If African countries truly wish their youth to deliver dividends, they need to invest in them; otherwise, if left unattended, the ticking time bomb will eventually go off, with devastating consequences. There is one school of thought that digital developments, particularly robotics and automation, pose a serious threat to existing jobs. Indeed, such a risk will prevail if nothing is done to compensate for – or, better still, leverage – ongoing digital developments.

10.4. Industrialisation through digitalisation: An option for Africa?

Much of the conversation in policy circles on the continent revolves around the need for African countries to add fuel to their industrialisation drives and diversify out of their traditional dependence on subsistence agriculture and mining. Industrialisation is imperative for Africa, as it is only by making the transition from low-productivity to higher-productivity, value-added economic activity (McMillan, Rodrik & Verduzco-Gallo 2014; Newman et al. 2016; Rodrik 2016) that the continent will be able to address its legacy problems of poverty, high unemployment and inequality and shake off its longstanding dependence on foreign aid, which is not a satisfactory or sustainable developmental lever.

One of the impediments to industrialisation in Africa is the high cost of investing in the establishment or expansion of various industries, ranging from developing the necessary infrastructure to developing an adequate skills base. There is also the equally important and costly matter of clearing existing hurdles to the industrialisation process, which can often be traced to the policy and regulatory environment.

With its emphasis on efficiency, productivity and cost-cutting, industrialisation can also inadvertently threaten less-productive types of work and less-productive people. If African countries are to pursue industrialisation strategies, they need to do so in ways that do not put large numbers of people out of work. Therefore, they need to take steps to offer redeployment opportunities or help people pursue alternative career paths with the help of additional training and development initiatives. This is in line with the growing emphasis in education and training circles on the importance of lifelong learning and continuing professional development.

Industrial transformation does not lend itself to quick fixes; it is a multi-faceted, elongated process. Having said that, there is also no single industrialisation formula; every country needs to adopt the optimal approach, with realistic timelines. In Africa, where many countries have both developed and underdeveloped sectors, it may be prudent to combine different types of industrialisation, such as labour-intensive manufacturing, a selection of high-potential service sectors and some high-tech manufacturing, supported by automation, AI and other digital applications (Naudé 2019). Such an approach harnesses available resources while also building expertise in new areas. It is a way of leveraging digital technologies at an appropriate pace, given countries' particular circumstances, which should then progressively diffuse more broadly into other sectors. The latter is important for achieving inclusive growth, trade and development at the national level and across the continent.

A measured, well-informed approach to industrial development will also enable countries to play a more active role in RVCs and GVCs, where there are plenty of entry points for competitively priced intermediate goods and services. Large companies are the main drivers of and participants in GVCs and RVCs (Antràs & Rossi-Hansberg 2009; Matthee et al. 2018), but there are still opportunities for SMEs to participate indirectly, by supplying intermediate goods and services to exporting firms.

When it comes to competitiveness, Africa's labour markets are characterised by high wage-to-productivity ratios. Thus, countries' industrialisation efforts need to incorporate productivity enhancement and labour-market reform. According to historian and modern-day philosopher Yuval Noah Harari, the traditional notion of competitiveness – which is linked to the availability of capital and efficient production methods – will in time be repurposed to prioritise the speed and availability of data, and the ingenuity with which traded goods and services are packaged to appeal to different market segments.

No discussion on industrialisation in Africa would be complete without reference to the 'leapfrogging' phenomenon and whether it can be used to hasten the industrialisation process (Winthrop & Ziegler 2019). Although, as has been discussed, the idea has merit and can be successfully applied in certain areas where there is clear market potential and pathways for public- or private-sector support, leapfrogging cannot compensate for general developmental bottlenecks or failures in a country – especially when these relate to institutional capacity, regulatory frameworks, infrastructure and education/skills development. From a broad developmental perspective, leapfrogging is more about giving high-potential sectors a strong push from behind and less about facilitating the skipping or glossing over of critical development stages, such as ensuring that all school-leavers are literate and numerate, and providing quality healthcare for all.

The question as to whether industrial policy should constitute the foundation of trade policy, or vice versa, has attracted a fair amount of debate. Irrespective of people's precise views on the matter, there is no doubt that industrial policy and trade policy must work together in Africa, offering blended solutions to countries' development challenges and striking a careful balance between building local industrial capacity and promoting external trade, on which much of the success of an industrialisation drive depends.

10.5. Digital trade: Implications for employment on the continent

When asked how the 4IR is affecting the economy and life in general, many people automatically think about its actual or perceived impact on jobs.

Interestingly, international studies have shown that in advanced economies, ongoing digital advances have led to the erosion of 'middle-skilled' jobs, which are routine in nature and lend themselves to automation (Autor, Levy & Murnane 2003). However, this has not been very apparent in Africa where, because of lower levels of industrialisation and fewer (e.g. manufacturing) jobs of a repetitive, routine nature, the risk of machines displacing middle-skilled workers is far lower. Instead, the application of digital technologies generally has job-creating effects among the high-, middle- and low-skilled segments of the population, because the technologies are often accompaniments to FDI and offshoring. In theory, therefore, digital technologies in Africa have the potential to be labour-compensating rather than labour-displacing. As a result, African countries should not experience the same labour-market polarisation and 'technology anxiety' that are apparent in other parts of the world.

Although the employment effects of trade in goods and services have been well researched, little formal research attention has been given to the employment effects of *digital* trade (Fayyaz 2018). Those few studies that have looked at the effects of e-commerce (digital trade) on employment have done so mainly from a developed-country perspective. The authors of Chapter 3 reported on their empirical analysis of the effects of digital trade on the quantity and quality of jobs in Sub-Saharan Africa. Although many factors were considered – not all of which were directly measurable – some broad trends emerged. For example, an increase in ICT goods trade was associated with an increase in total employment and a decrease in vulnerable

employment. Conversely, an increase in digitally delivered services trade was associated with a decrease in total employment and an increase in vulnerable employment. This dichotomy warrants further investigation in order to better inform policy positions on ICT goods and services trade.

A good education (which includes skills training and on-the-job mentorship) positively impacts people's mindsets and skill sets, affording them the opportunity of pursuing rewarding careers while also contributing to their countries' socioeconomic development. Although there is an unmistakable link between educational achievement and employment prospects in the digital age, the empirical analysis revealed that higher education levels are associated with a decrease in employment in the agricultural sector in Africa and an increase in employment in the industry and services sectors – signalling migration to the urban areas where industry and services sector jobs are more likely to be found. However, uncontrolled urbanisation is a problem in Africa because the demand for work in the cities exceeds the supply, leading to rising unemployment (or at least vulnerable or informal employment) and various other forms of social malaise (Zhai & Wang 2002). Meanwhile, the potential of the agricultural sector is being eroded, where it could form the basis of stronger agro-processing drives and value-chain activity.

It is understandable that African governments' main preoccupation is to grow the *number* of jobs rather than focus on the *quality* of jobs, as the latter might be considered a luxury when so many people are unemployed. However, the general dearth of meaningful or 'decent' work is a serious constraint to competitiveness and innovation, which are two of the hallmarks of the digital age. Consequently, there needs to be a comfortable balance between the number and types of jobs created, with the application of appropriate digital technologies having the potential to drive growth in both areas.

10.6. The high cost of trading in Africa: Can digital developments reverse this trend?

There is a general consensus in policy, academic and business circles that the cost of trading in Africa is very high and constitutes one of the biggest stumbling blocks to intraregional trade and the activation of RVCs.

Africa's comparatively low level of intraregional trade by global standards means that most countries on the continent have found it difficult to diversify into progressively more value-added economic activity, in keeping with their industrialisation aspirations. Instead, there is still a heavy reliance on extractive industries to generate export revenues, leaving little room for entrepreneurs and small businesses to play a significant role in countries' cross-border trade. Although many African countries have seen significant growth in their services sectors in recent years, the services in question have tended to be of a fairly low value, including small-scale retailing. It is difficult to scale up and professionalise these activities in order to make them more appealing to regional buyers.

Poor – or a lack of – infrastructure (roads, bridges, facilities at ports, airports and land border posts, telecommunication networks and so on) is one of the leading causes of the high cost of trading in Africa (Hoekman 2018). High costs go hand in hand with the excessive time involved in executing different tasks in the supply chain – such as transporting goods along certain routes, inspecting goods and performing customs clearance at border posts, transhipping cargo from one transport mode to another and effecting various types of payment. Time is, literally, money in the trade arena, with excessive time spent in navigating physical hurdles and red tape (Soininen 2016) being the death knell of productivity and international competitiveness.

The physical and administrative infrastructure and processing problems in Africa are not always attributable to a lack of money.

Stories abound of gleaming new roads and bridges being built, only to be abandoned because the countries sharing the resource cannot agree on a suitable regulatory framework to delineate responsibilities for ongoing management and maintenance. In other words, the real problem is often at the policy level.

Developed countries have achieved high levels of supply-chain efficiency by using digital technologies to integrate customs systems at ports and land border posts with information supplied by a range of stakeholders, including transport operators, logistics service providers, inspection agencies, tax authorities and others. This not only streamlines processes and cuts down on the time involved; it also reduces the potential for corruption. Corruption flourishes in an environment where data are unreliable or missing and is a scourge of cross-border trade in Africa (Moïsé & Sorescu 2019). Much research is needed to pinpoint serious trouble spots in Africa's transport corridors and customs systems. However, there is emerging evidence that African countries can (and are already starting to) use various digital solutions, including the use of big data and data analytics, to better coordinate transport, logistics and customs-clearance procedures. If rolled out on a grand scale, these could go a long way towards boosting countries' trade facilitation efforts.

Another significant cost factor when it comes to trade in Africa is the quality of the business environment, where the cost of real estate, electricity and water, ICT services, business services and distribution all have a bearing on how competitively priced goods and services are and whether they represent value for money. The general business environment also influences whether or not investors and funders will have the appetite to participate in infrastructure development projects on the continent, including those aimed at enhancing Internet connectivity and other, high-level digital services.

Buildings can be erected, transport routes can be cleared and digitally enhanced systems can be installed. However, a conducive environment must be created to mobilise economic activity and

ensure that it leads to sustainable development. That is true trade facilitation.

10.7. North, south, east or west: Which way should Africa's digital trade policy go?

As Africa contemplates its digital future, it has important decisions to make. All African countries have, at least in principle, embraced the idea that the 4IR has the potential to deliver more job-rich growth, more sustainable development and more inclusive societies. Yet it is up to policymakers, working in partnership with many other stakeholders, to create the right conditions so that this envisaged future can materialise.

Effective policymaking is challenging. It requires consolidating the views and opinions of a wide variety of stakeholders and grafting these onto the day-to-day realities experienced by different groups in society. The policymaking process in the digital age is even more complex than in years gone by because of the speed with which new technologies are being introduced and industries and markets are changing.

In this book, a digital trade policy was referred to as any domestic, regional or international policy, rule or intervention that is designed to encourage the flow of data or ICT goods or services across national borders (Aaronson 2019). However, in Africa's case, the legacy problems of poverty, unemployment and infrastructural weaknesses also need to be taken into account so that a firm foundation can be built for digital developments going forward. Africa's digital trade policy therefore needs to have a developmental dimension, but one that is forward-looking and invites innovation.

In this regard, regulation has an important role to play because it brings order and certainty to regional and international trade activities (Daza Jaller, Gaillard & Molinuevo 2020).

However, resorting to digital protectionism, for example, in an attempt to preserve employment and subdue foreign influence, is ultimately an exercise in futility as in the process it limits a country's access to new ideas, expertise, technologies, goods and services, and trade and investment opportunities – which ultimately stunt countries' growth and development. It amounts to (as the saying goes) throwing the baby out with the bathwater.

With some exceptions, most African countries' export baskets show little variety and are dominated by products from the extractive and agricultural sectors. Furthermore, the low value-added nature of these exports is a reflection of the generally low levels of industrialisation on the continent, which means that producers are confined to a small number of export markets. A lack of economic diversification and limited export opportunities keep countries in a continual cycle of uncompetitiveness and underdevelopment. Africa has frequently borne the brunt of falling or subdued commodity prices, which makes African countries' reliance on a narrow export basket all the more ill-advised. Even during periods of high commodity prices, which deliver very welcome short-term gains, there is the temptation to ignore the need to plan for leaner times, which is an important part of the sustainable development process. With greater economic and export diversification, external shocks like commodity cycle swings will have a less disruptive effect.

An outward-looking digital trade policy has the potential to unleash new opportunities for African countries to establish simple manufacturing operations and sell intermediate products (with some service elements) to regional and international value chains (Ganne & Lundquist 2019). In the process, it has the potential to create more jobs domestically and expand the tax base. Although African countries will benefit from enhanced intraregional trade, it is important that they maintain or strengthen bilateral trading relationships. Several African countries have strong trade ties with European countries (i.e. France, Portugal, Germany and England) which date back to colonial times.

Many African countries also have very strong trade and investment ties with China and other developed and developing countries, which have helped to bolster development efforts on the continent. Of course, the unfolding digital age should also be a source of trade opportunities with countries in hitherto untapped regions.

10.8. Conclusion

Digital developments are like waves on a beach – some are more unpredictable and powerful than others, but they are inevitable. Failure to grasp the inevitability of the 4IR will, like those who resisted or attempted to postpone the changes wrought by the other three industrial revolutions, put people at a disadvantage alongside those who have adopted a more proactive, forward-looking approach. Moreover, although it is primarily the responsibility of policymakers to 'set the sails', all the other relevant role players need to be on board as well.

Inaction, passivity and fear all contribute to the state of being left behind. The power is in Africa's hands to create a new reality.

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Chapter 1

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Africa's Digital Future: From Theory to Action makes a timeous and significant contribution to the current literature on Africa. Each chapter is well researched and provides a rich panoply of views and findings on how Africa is faring in the fast-changing digital age and how (using a nautical theme) the ability to withstand headwinds and turbulence depends on how well policymakers and decision makers 'set the sails'. Among the book's strengths are its hands-on analysis and blending of theory and practice. It also offers specific ideas on what African countries need to do to benefit from digital technologies, particularly in positioning themselves more prominently within the global economy, while creating sustainable industries and jobs at home. With its holistic and forward-looking approach, *Africa's Digital Future* makes for interesting reading, for economists especially.

Assoc. Prof. Dr Maarten Smeets, Saint Petersburg State University, Saint Petersburg, Russia; World Trade Institute, University of Bern, Bern, Switzerland

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Africa's Digital Future: From Theory to Action is essential reading for anyone who is familiar with the global discourse on inclusive development but has always found it wanting in relation to Africa. The value in this book lies in the way the authors systematically analyse global trends in manufacturing, logistics, labour markets, technology and trade in the light of Africa's specific circumstances – something that is rarely done in depth. Moreover, the book's mixed economic/political analysis is really unique and provides insights that I have not seen in other publications. *Africa's Digital Future* serves as an analytical playbook for African experts in multilateral and bilateral aid organisations and the broader research community.

Mr Andrew Crosby, Asian Trade Centre, Singapore

Africa's Digital Future: From Theory to Action makes a solid contribution – through nuanced insights and pertinent summaries – to the conversation about digital developments and how they influence economic performance. The book covers a wide range of topics, from the digital divide and what it means for Africa's industrialisation prospects, to trade in the digital age and how this will shape Africa's economic plans and performance going forward. The book is essential reading for academics, as it provides skilfully crafted guidance on these very important matters.

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