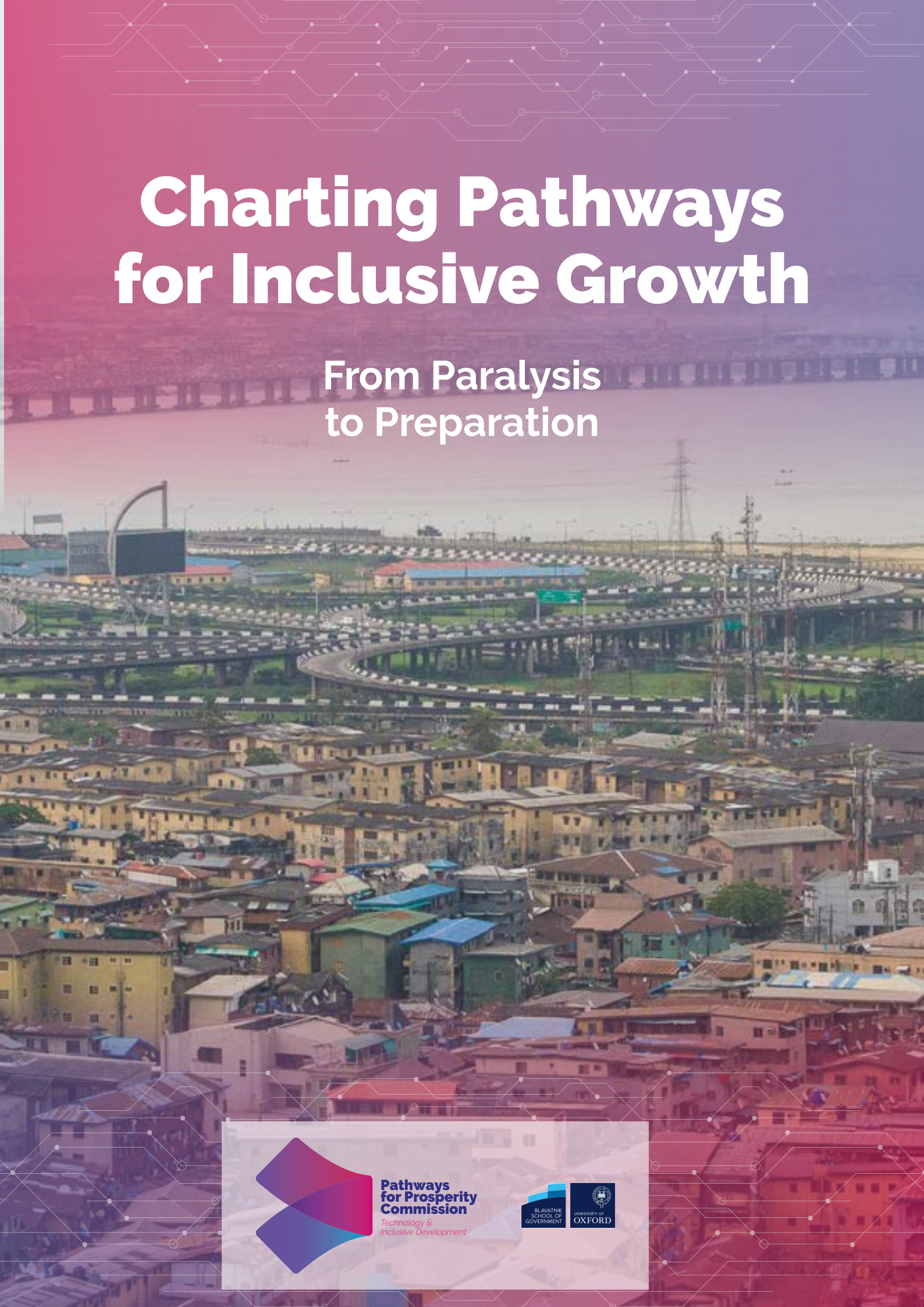
Charting Pathways for Inclusive Growth

From Paralysis to Preparation



Pathways for Prosperity Commission
Technology & Inclusive Development

Blavatnik School of Government
University of Oxford

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FOREWORD

We are living through a moment in which new technologies are radically transforming lives across the world in ways that would have been difficult to imagine even a few years ago. The actions we take today will determine whether these technologies are ultimately an asset or a liability for people and economies in developing countries.

As co-chairs of the Pathways for Prosperity Commission on Technology and Inclusive Development, we are proud to be working with a talented and diverse group of global leaders in government, the private sector and academia who are advancing a practical set of policies designed to ensure that digital technology is inclusive, transformative, and widely accessible.

The Commission's new report, *Charting Pathways for Inclusive Growth: From Paralysis to Preparation*, examines the impact of technological innovation on growth, jobs and livelihoods in developing economies. We believe it makes a persuasive case that emerging technologies – when coupled with sound policy choices – have the potential to open new pathways for prosperity by reducing the costs of production, trade and innovation. Most importantly, this report explains why dialogue and co-operation between governments, technologists, citizens and business leaders will be essential to delivering inclusive growth in the digital age. The onus must be on ensuring that these new pathways are truly inclusive.

Ultimately, the Commission's findings leave us optimistic. Technological progress by its very nature is disruptive, and anxiety about the future is understandable. That said, history has demonstrated that technology can, and most often does, enhance human prosperity and well-being while unlocking enormous individual and social potential. This report explains why we believe that progress will continue.

Melinda Gates **Sri Mulyani Indrawati** **Strive Masiyiwa**

ACKNOWLEDGEMENTS

The co-chairs and commissioners would like to extend their thanks and acknowledge the dedicated people that made this report possible. It was drafted by a team led by Commission academic directors Professor Stefan Dercon and Professor Benno Ndulu, and the secretariat's head of research and policy, Toby Phillips. Invaluable contributions to this report were made by the Pathways secretariat headed by Rafat Al-Akhali, with research and policy officers Tebello Qhotsokoane and Sophie Ochmann, and head of communications and events, Meena Bhandari. The report's production was supported by the communications and events team Philippa King and Assistant Emily Cracknell. A team of researchers also supported the process: Sakhe Mkosi, Lena Anayi, Christopher Eleftheriades, Brendan Kilpatrick, Fairoz Ahmed, and Pieter Sayer. Special thanks go to Eleanor Shawcross Wolfson. The team greatly benefited from the advice of Dean Ngaire Woods, of the Blavatnik School of Government, University of Oxford, together with the faculty and staff.

For their helpful and stimulating conversations, the team would particularly like to thank Stephan Malherbe, Shankar Maruwada, Pramod Varma, John Norris, Gargee Ghosh, Mary Hallward-Driemeier, and the people who participated in our workshops on fintech (Nairobi), digital ID (New Delhi), e-government (Oxford and Abuja), ed-tech (New Delhi), structural transformation (Dar Es Salaam and Jakarta) and agriculture (Kigali).

The depth of the report is thanks in part to independent research and analysis conducted for the Commission by Dani Rodrik, Douglas Gollin, Jenny Aker, Raphael Kaplinsky, Karishma Banga, Dirk Willem te Velde, Olly Buston, Matthew Fenech, Nika Strukelj, Jonathan Greenacre, Sigfried Eisenmeier, Nicolas Lippolis, Stevan Lee, Umar Salam, Vanessa Fullerton, Yasmina Yusuf, Mark Henstridge, Priya Jaisinghani Vora, Kay McGowan, Matthew Homer, Jonathan Dolan, Bernard Naughton, Chris Paton, Naomi Muinga, Prakhar Misra, Dario Guiliani and Michael Green.

Finally, Box 3 of the report explores the aspirations and livelihoods of young people. This was made possible through a collaboration with U-Report (run by UNICEF and partners), who polled 100,000 youth around the world for the Pathways for Prosperity Commission. More detailed results from this exercise will be published separately.

ABOUT THE PATHWAYS COMMISSION

The Pathways for Prosperity Commission on Technology and Inclusive Development is proud to work with a talented and diverse group of commissioners who are global leaders from government, the private sector and academia.

Hosted and managed by Oxford University's Blavatnik School of Government, the Commission collaborates with international development partners, developing country governments, private sector leaders, emerging entrepreneurs and civil society.

The Commission aims to catalyse new conversations and to encourage the co-design of country-level solutions aimed at making frontier technologies work for the benefit of the world's poorest and most marginalised men and women.

Pathways Commissioners:

- Melinda Gates – Co-chair of the Bill & Melinda Gates Foundation
- Sri Mulyani Indrawati – Minister of Finance in Indonesia
- Strive Masiyiwa – Founder and Executive Chairman of Econet Group
- Professor Stefan Dercon – Professor of Economic Policy at the Blavatnik School of Government and the Economics Department, and a Fellow of Jesus College. Director of the Centre for the Study of African Economies
- Professor Benno Ndulu – former Governor of the Central Bank of Tanzania
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EXECUTIVE SUMMARY

Today the world is witnessing the rise of many new frontier technologies. Some of these innovations, such as advancements in robotics and machine learning, are affecting production processes of goods and services. Others, such as improved communications through virtual reality and the internet of things, affect not only the wider systems of production but also how goods, services, and ideas are exchanged.

The current global debate on technology and inclusive growth is narrowly focused on 'job destruction' from accelerating automation, suggesting that up to 47%[1] of all jobs in OECD (the Organisation for Economic Co-operation and Development) countries and two-thirds of all jobs in developing countries[2] are already at risk. **The first key finding of this report is that such numbers are deeply misleading and have created policy paralysis.** Most are based on technically flawed methodologies, but more fundamentally, these forecasts typically ignore the upsides of technological progress in creating new economic opportunities for workers, firms and consumers alike.[3] Fear is a poor guide for policy. Instead of scaremongering, this report identifies the opportunities and carefully articulates the challenges. It argues that national policymakers, business, and citizens in developing countries, as well as the international community, can and should act to grab opportunities for growth and better jobs and livelihoods, and to minimise disruption.

Instead of adding to the noise with further estimates, the first half of this report combines economic analysis with historical and contemporary evidence to analyse how innovation affects prospects for inclusive growth. **We show that technological progress reduces one or more of three cost drivers, generating growth by allowing economies to create more value from the available resources.** Emerging technologies are further reducing these types of costs across sectors, driving productivity, boosting efficiency, breeding further innovation, and, ultimately, accelerating economic growth. The 18th century spinning jenny reduced the cost of production, by making it possible for one worker to weave as much cloth as eight workers did prior to its invention.[4] This drove the first Industrial Revolution, and started a wave of automation that continues today with robotics, machine learning and 3D printing. Standardised shipping containers and better phones and fax machines reduced the cost of exchanging goods, services and information, underpinning the Asian growth miracles; data and digital communication technologies and platforms bring further efficiencies to exchanges of goods, services and information.[5] Mobile phones now allow two-thirds of the world's population to communicate verbally at the touch of a button,[6] drastically reducing the cost of networking; new communication technologies create further proximity, meaning ideas and knowledge can go global instantly and at close to zero cost.

Fundamentals such as stability, infrastructure, rule of law, education and economic policies will always matter in determining whether innovation is profitable. These go a long way toward understanding ***why* certain countries benefit from new technologies more (and more quickly) than others: the local economic and social ecosystem matters.** Understanding why England managed to take advantage of new technologies in the Industrial Revolution, and why Tanzania could not replicate the economic vitality Vietnam has known over the last 30 years, remains relevant today.[7] This also tells us, just as in history, that there will not be many shortcuts or easy 'leapfrogs'. Nevertheless, given the nature and speed of technological change, there is real opportunity: countries that may have lost out in the past can prepare themselves to take advantage this time around.

The impact of new technologies on economies or jobs cannot be understood by just looking at, say, the labour savings of a new robot. **How technological change and growth in particular sectors 'works through' the sector and the economy are essential for an understanding of the impact of technological change, especially on jobs and living standards.**[8] The agricultural revolution, as part of the Industrial Revolution, brought considerable labour savings, just as the green revolution's mechanisation did in Asia. While agricultural jobs were no doubt disrupted, and some were lost, how this technological change impacted on the *overall* economy in jobs, livelihoods and purchasing power is key. There are echoes today. Whether it is ATMs in the US or textile cutters in Tanzania, evidence shows that overall growth emerged in jobs within firms and sectors.[9] The manufacturing boom in Asia, no doubt a key driver of growth was, in fact, overshadowed in its impact on employment by simultaneous but larger growth in jobs in the services sector, as evidence in this report from Vietnam, Indonesia and Bangladesh shows. Discussions today would do well to focus more on how to foster better linkages between sectors benefiting from productivity growth and the rest of the economy.

Historical experience also shows that, **while technological innovation does not typically 'destroy jobs' in aggregate, it certainly does disrupt jobs and lives.** During the Industrial Revolution, working-class labourers experienced a decline in living standards for the first 60 years of this period, while the income of the top 5% more than doubled.[10] During the Asian boom, job opportunities emerged in urban areas, driving large-scale migration; in many countries as well as globally, this period of shifting global value chains (GVCs) also led to concerns about exclusion and inequality.[11] If change is poorly managed, socially and politically, now, just as in history, disruption will feed resistance to change, and the result is likely to be missed opportunities for inclusive growth.

Much like their predecessors, current crops of technological innovation are rapidly creating new and often unforeseen economic opportunities and disruptions. The pace, direction and magnitude of these changes are hard to predict. Outcomes will depend on local conditions and actions. The second half of this report offers a set of five possible pathways for inclusive growth in a digital age. We do not provide a manual for policymakers; rather, we offer a vision for what is attainable in different contexts, and then develop a set

of priorities which business, civil society, national governments, and international partners will jointly and urgently need to address.

The five possible pathways for prosperity being unlocked right now by technological innovations are:

1. **Raising value from agriculture –** Advancements in data analytics, biotechnology and communications will drive growth by improving yields on the farm, and by enabling more efficient services and logistics. Agriculture will likely be a key pillar of any inclusive development strategy for some time, as most tasks are not easily automated, meaning both continued demand for low-skilled workers and improved terms of trade for farmers as costs, and so prices in other (more easily automated) parts of the economy, fall more quickly.
2. **New GVCs in manufacturing –** Robotics will spread, but it will take time as non-factory floor costs of labour will remain lower in developing countries.[12] But there is much more: frontier communication technologies will drastically reduce the cost of information exchange and networking, making it possible to perform more complex, higher-skilled manufacturing tasks remotely, including from developing countries, where wage cost advantages across the skill distribution are still present. This next generation of manufacturing growth seems likely to remain inclusive, as the lowest-skilled jobs (such as cleaning and catering) within manufacturing firms, but also those in complementary services (such as sales and customer care), seem relatively resilient to automation.
3. **Creating new global trade in services –** Advances in artificial intelligence may disrupt outsourcing of easily codified business processes (such as simple call centres offering basic customer support), seemingly affecting jobs. However, fast-improving communication technologies, including advances in virtual reality, will unlock international trade in complex and integrated services that used to require more face-to-face contact. The result is new opportunities in integrated business services, management advisory services, and even remote healthcare support and other services requiring empathy and judgment, which bots are not going to easily supply at levels required. Relatively low wage costs mean developing countries stand ideally placed to begin exporting these relatively labour-intensive services, which already employ a disproportionate number of women.
4. **Linking the informal sector to the formal economy –** Digital platforms (such as those for mobile money and taxi-hailing) will reduce the cost of exchange within the informal economy, boosting its productivity. The informal sector comprises many rural workers, smallholder farmers, casual labourers and petty enterprises – that is, those groups already facing the most social and economic disadvantage. In some regions, this accounts for over 80% of employment. Linking informal workers to potential markets and the formal economy will likely be highly inclusive, but these links will also provide a route for progression into more formal parts of the economy for previously excluded workers and entrepreneurs, better connecting

them to the potential opportunities of not just the formal economy but also the opportunities that stem from better social protection and social benefits.

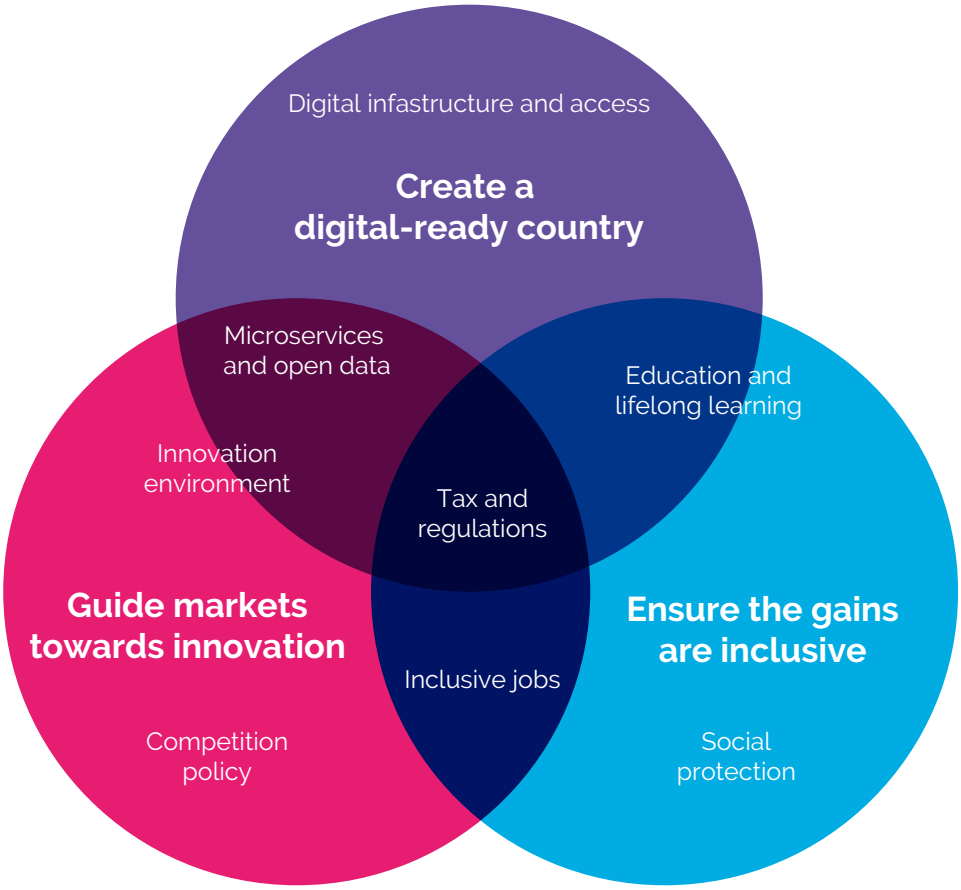
5. **Diverse, connected domestic economies –** Digital platforms and advances in logistics and supply-chain data management will drive growth by reducing the cost of moving information and goods around an economy. Furthermore, better communication technologies and the internet are reducing the cost of networking, bringing new ideas into a developing economy, often at zero marginal cost, opening the scope for making developing economies themselves increasingly innovative. This pathway reduces the need for a country to enter into GVCs by approximating some of the benefits of export-orientation: new technologies can foster competition, complex (domestic) value chain integration, and even learning and knowledge transfer to catch up to the global frontier of production capability.

But, none of these positive growth and inclusion impacts are inevitable. Policymakers, business leaders and citizens have real agency, but also real responsibility and accountability. To capitalise now on the potential of the pathways set out here (and others), and to avoid economic, social and political dislocation, policymakers and businesses need to create the right environment for these pathways to emerge. This means action now to:

- **Create a digital-ready country**, by investing in hard connectivity infrastructure, 'soft' infrastructure such as digital identification and standards for interoperability, redoubling efforts on education, and expanding new digital capabilities (including both technical skills and basic digital literacy).
- **Guide markets towards innovation,** through broad support for entrepreneurs willing to take risks on new products and business models, better access to existing and new financial services needed to take innovations to scale, and carefully calibrated regulatory and tax regimes that balance the needs of society without dampening innovation or competition.
- **Maximise inclusiveness,** by ensuring a level playing field in digital readiness, accelerating transitions for workers in disrupted markets, providing innovative social protection, and above all ensuring that growth creates broad-based prosperity in the first place.

Responding positively and swiftly to technological change requires, first vision, purpose and strategy. Clearly new technologies will create winners and losers; as will government policies and private sector business decisions. Some of these policy priorities are in tension with each other: pro-competitive regulation can stifle (some) investments; public education will be funded by taxes, partly raised from creative entrepreneurs. The solution, we think, is to escape policy paralysis by co-designing a national strategy for inclusive growth through concerted and broad-based dialogue between government, the private sector and civil society. This dialogue should provide a voice for young people, the 'digital natives', allowing them to express their aspirations and to contribute their unique perspective and skills as the first generation born in the digital age.

FIGURE 1. **Policy priorities for inclusive growth**



Delivering such a national strategy and capitalising on technological progress are not just questions of domestic policy; achieving these aims will also require international co-operation. Most of the pathways and policies depend in part on international frameworks: the rules that govern intellectual property, cross-border taxation, trade, and competition. In these areas, international co-ordination will be the only way to fully grasp the opportunities from technological advances. Some countries also suffer from basic resource constraints that prevent investment and implementation. Where developing countries have a clear and feasible strategy to navigate technological disruption, donor agencies should look for opportunities to provide support, including through financial assistance. The time is ripe for concerted international co-operation.

National policymakers, businesses and citizens in developing countries have real agency over how technological progress will impact on their economies and their societies. They must act, domestically and internationally, to chart a course for inclusive growth in a digital age.

Girls in Udaipur, Rajasthan, India stand outside their classroom in front of a world map. Photograph: Ishan Tankha, Pathways for Prosperity Commission, 2018

CHAPTER 1
Introduction

Radical technological changes are fundamentally altering the way people live, communicate, produce, work and trade. Some changes, such as advances in information and communications technology (ICT), biotechnology, and energy production and storage are rightly celebrated for bringing down costs and improving the quality of food, health, education, and the production of goods and services. However, other aspects of technological change, such as the rapid march of robotic automation and the rise of artificial intelligence, drive fears and anxieties about their potential impact on the future of jobs. According to some predictions, technological advancements in developing countries will erode wages and displace workers on a large scale; meanwhile, in developing countries, urgently needed jobs in manufacturing may never materialise. As a result, there is a growing concern that these changes may thwart the aspiration of the United Nation's 2030 Agenda to eliminate poverty.

This, the first report of the Pathways for Prosperity Commission on Technology and Inclusive Development, focuses exclusively on understanding the impact of technology on inclusive growth in developing countries. Its aim is to turn the potential risks of technological disruption into opportunities for inclusive economic development. 'Inclusive growth' is specifically growth that creates better jobs and livelihoods, especially for those living in poverty.[13] This report seeks to provide greater understanding about the potential ramifications of the profound technological changes on the horizon; and practical, evidence-based guidance to developing countries as they seek both to harness technology's potential for development and poverty reduction, and to mitigate potential negative effects.

It is important to recognise that earlier technological breakthroughs have yet to reach many developing countries. Previous rounds of technological change bypassed large parts of the developing world, particularly sub-Saharan Africa. Despite the global availability of new technology, a myriad of factors – including weak institutions, energy poverty, and poor infrastructure – mean that least-developed countries lag more than ever in their intensity of technology use,[14] with major sectors such as agriculture or informal work still using old techniques. In this sense, least-developed countries are not just facing one technological revolution: they still have the challenge of absorbing previous revolutions as well. Creating the conditions to harness new and not-so-new technologies to drive productivity and inclusive growth is imperative to address poverty projections, and to absorb large numbers of people entering the workforce in impoverished conditions.

Current changes are taking place at a time when there is a much better understanding of what states can do, and what capacity is required.
The information age is unlike the Industrial Revolution, during which there was very little understanding of how the state could avoid or limit disruption. This report argues that a national strategy co-designed between government, business and civil society is a first step (see Chapter 7). A widespread perception, underpinned by persuasive evidence, is that previous waves of growth driven by technological change and globalisation have delivered substantial inequality, or, in any case, left many behind. This view contributes to ongoing unease and fear about what the next wave of technological change may mean.[15] If managed properly and with foresight, this change can fuel growth, reduce inequities, and help lift millions out of poverty. If managed poorly, or unmanaged, technological change could further widen the gulf between the haves and have-nots.

Against this backdrop, analysis presented in this report leads to three conclusions:

1. **The current conversation – full of attention-grabbing predictions of jobs losses – is misleading and poorly framed, particularly for developing countries.** This report provides a framework for understanding how emerging technologies can affect prospects for inclusive growth and poverty reduction (see Chapter 2). It demonstrates that, contrary to some of the more alarmist commentary, historical and contemporary evidence shows that economy-wide effects need to be fully assessed, and that the impact of new technologies may well be positive over time as they have been historically (see Chapters 3 and 4). Nevertheless, the analysis also shows that local readiness for innovation matters, as do linkages between new technologies and the rest of the economy. Even if aggregate effects are positive, change will disrupt individual lives and livelihoods. *Inclusive* progress is not inevitable.
2. **Currently emerging technologies will open up a series of new possible pathways for developing countries to create prosperity that can be inclusive.** This report discusses how cost reductions in production, exchange, and networking can extend and expand established pathways, while also providing the foundations for entirely new routes out of poverty (see Chapter 5). In particular, the report argues that, while enhanced manufacturing can still provide a source of growth and jobs, new technologies can reinvent agriculture, open new service exports and create more effective domestic growth engines to drive broad-based development.
3. **National policymakers have real agency over how technological progress will impact on their economies and societies. They must proactively chart a course for inclusive growth in a digital age.** Although the speed, scope and scale of technological change are uncertain, the returns from preparation are high, not just in handling the disruption but also in creating the underlying conditions for inclusive growth. This report addresses the policy priorities for action to pursue these pathways and to make them inclusive (see Chapter 6). Investment in infrastructure, basic education and digital capabilities is vital. Policymakers should also facilitate rather than stifle innovation. They should invest in careful regulation, partnerships and policies, and they should prioritise actions to foster inclusion.

12-year-old Basanti uses an online education tool, Udaipur, Rajasthan, India. Photograph: Ishan Tankha, Pathways for Prosperity Commission 2018

CHAPTER 2
The new wave of emerging technologies

Today the world is witnessing the rise of many new frontier technologies. Some are truly new, others have been in development for decades, and some are old tools finding new applications. Some of these new technologies – such as robotics, artificial intelligence, breakthroughs in biotechnology, and new sources of energy – are affecting the production processes of goods and services. Other technologies such as virtual reality and new communication technologies, improvements in data processing, the internet of things and other forms of digital connectivity affect not only the wider systems of production but also how goods, services, and ideas are exchanged. The illustration below offers an overview of these technologies.

The current wave of technological change is unique in the breadth of its scope, affecting all parts of the economy. Many of today's technological advances are reinforcing each other. Better manufacturing techniques means one can build better sensors, which in turn can increase the precision of manufacturing robots. Machine-learning techniques make customer service more efficient, and also gather data to inform production choices. High-speed internet communication means an engineer in one part of the world can send a complex computer design file to be instantly produced by a 3D printer elsewhere.

The pace of change is also unique, with fast-declining costs of using many new technologies. Moore's Law (predicting the doubling of computer processing power every 18 months) is often cited as an example of exponentially rapid change. Going from the first transistor to the smartphone in half a century is another (see Box 1 for more). But, not only is this pure technological development happening at a rapid pace, it is *maturing* and *spreading* at unprecedented speed. The piston steam engine took a century to reach wide adoption.[16] Nowadays, some new technologies reach global scale in only a small number of years. For example, since the release of the first mass-produced mobile phones in 1997, mobile phone penetration has risen to encompass more than two-thirds of the global population in 2017;[17] real-time computer vision was an abstract academic field ten years ago, but by 2018 Amazon had commoditised facial recognition services. Research shows that the adoption lag between developed and developing countries is closing: new technologies can go global immediately.[18] The economic impact of these changes is on prices: the cost of using technologies is rapidly becoming cheaper (see Figure 2) making it more affordable to deploy them in a range of new applications.

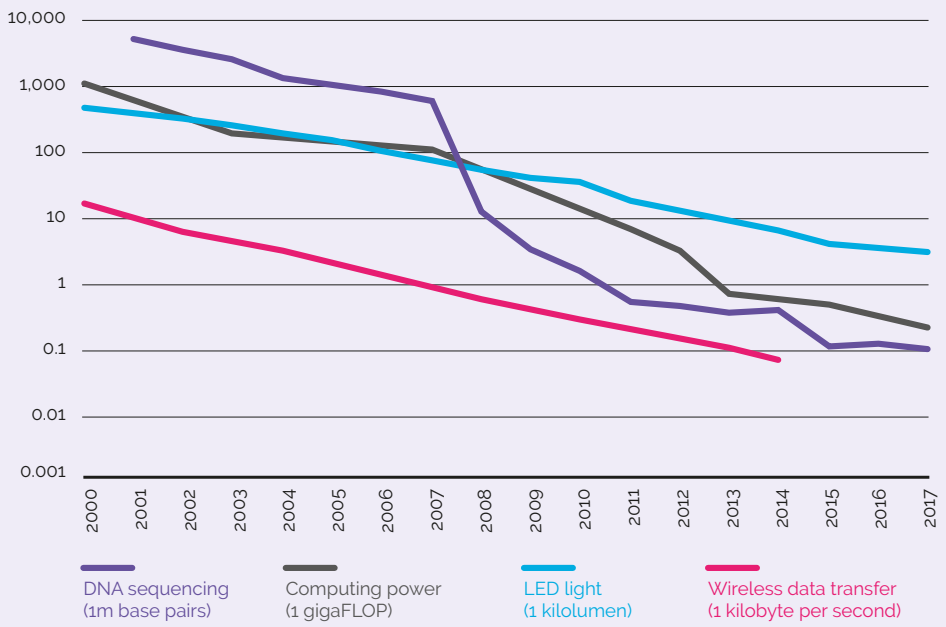

THERE'S A NEW WAVE OF
EMERGING TECHNOLOGIES
Automation & Production
Robotics
Additive manufacturing
Drones
Materials science
Artificial Intelligence
Machine learning
Big data analysis
Personalised services
Data Management
Cloud computing
Distributed ledgers
APIs and digital integration
Energy
Renewable energy
Energy storage
Biofuels
Smart grids
Biotechnology
Synthetic biology
Fortified agriculture
Diagnostics
Drug design
Gene therapy
Communications
Internet of things
Virtual reality
Satellites and fibre-optics
Quantum computing

Box 1. **Technological change and prices**

Exponentially falling costs of using technologies are not isolated to computing power. Similar trends can be seen in the cost of DNA genome sequencing,[19] wireless data transfer, and LED lighting.[20] Technologies that used to cost hundreds or thousands of dollars just two decades ago now cost mere cents. These exponentially falling prices mean that technologies that were previously a luxury can now be commonplace. However, some analysts believe that such exponential growth cannot continue indefinitely, and that growth will instead end in around 20 years. This is because scientists think that we are rapidly approaching the physical limitation of technological improvements in silicon transistors, due, for instance, to thermodynamic effects[21] or physical limits on how small a transistor can be.[22]

Figure 2. The costs of using many technologies are dropping rapidly

Cost per unit (2013 USD, logarithmic scale)



Sources: AI Impacts (2017), Wetterstrand (2018), Tucker (2010b), Nielsen (2018), Zissis and Bertoldi (2014).

A simple framework to assess the impact of new technologies on the economy and people usefully starts from identifying cost reductions from technology. The major areas of technological change identified in Figure 2 are leading to three key sources of cost reductions. Each of these three sources of cost reductions has precedents in history too, as examined in Table 1. First, many technologies bring down the cost of *producing* goods or services. This is the classic way in which technological change is often understood: fewer inputs are needed to produce the same good, or a better good can be produced with the same effort. Second, technologies can also bring down the cost of *exchanging* goods, services, information, labour or capital; often technology makes these transactions more efficient as well.[23] An obvious example is transport cost

savings, which can be made even more efficient through new digital technologies that help with finding or exchanging information, tracking goods, or matching firms to capital, workers or consumers. Third, technologies can bring down the costs of *networking and organisation*, in the sense that technology can make it easier to have face-to-face interactions. This is the equivalent of a key form of the classic 'agglomeration effects' – the benefits in terms of ideas or knowledge transfer and innovation that stem from having close interactions. Agglomeration effects are often seen as a key source of growth.[24] Communication technologies change the consequences of not being able to have face-to-face interaction; some technologies increasingly offer closer substitutes to being co-located. These technologies make more complex organisation and interaction possible.

Table 1. **Direct impact of new technologies on the economy**

Cost reduction	Primary new technology involved	Impact	Examples from present (and history)
Reduction in cost of *producing* goods or services	Biotechnology, energy, automation and production technology, artificial intelligence, data management, communications	Makes the cost of *producing* a unit of a good or service lower	Robots, ICT, new high-yielding seeds, energy mini-grids, energy storage, 3D printers, internet of things (spinning jenny, steam engine, production lines)
Reduction in cost of *exchanging* goods, services, information, labour and capital	Communications, data management, artificial intelligence, energy	Makes the costs of *delivering* a unit and of matching a buyer and seller lower	Internet, smartphone, sensors, matching algorithms in labour or credit market, energy storage, telepresence, virtual reality (canals, railways, shipping containers and container cranes, telephones, call centres)
Reduction in cost of *networking* and *organisation*	Communications	Makes human interaction easier, leading to easier spread of knowledge, ideas and more innovation	Virtual reality, internet, telerobotics (City, telegram, fax, camera)

The discussion here uses this simple framework to explore both the role of technology in historical development pathways (during the Industrial Revolution and during the current Asian boom), and the ways in which emerging technologies may impact on pathways for prosperity in developing countries in the future. Here, despite our broad view of technology in the rest of this report, we focus on automation technology and digital technology (communications, data management, and artificial intelligence), as these are making the current period rather different, affecting all three dimensions of cost reductions. These cost reductions in production or exchange are likely to benefit consumers, including those living in poverty, because they will bring downward pressure on prices of affected goods and services. More contentious is the impact on jobs, livelihoods and societal inequalities in developing countries. The report comments on the current debate on this subject, using our framework as an analytical tool, and underscoring that such assessments need to consider technologies' overall impact on economies (see Chapter 3).

The overall impact of new technologies will be determined by how they are adopted, the extent to which they are adopted *profitably*, and how *indirect* impacts filter through the rest of the economy. In the end, our aim is to assess technologies' overall impact on economies and societies, with a particular focus on jobs and livelihoods for people living in poverty. For the purposes of our analysis, two issues are key. First, firms' decisions to invest in locations using new technologies will depend on whether the local conditions and ecosystem are ripe for such investment. Historically, this was crucial. Bundles of technologies ended up being adopted in particular locations, and not elsewhere, and for good reasons. For example, energy breakthroughs in the form of the steam engine made technologies such as the spinning jenny (a key advance of the Industrial Revolution) far more profitable, but they were used first in England, and it took time for them to spread (see Chapter 4 for further detail). Clearly local conditions, and a familiar list of relevant factors, matter. That is still the case today, as underscored by this report's discussion of possible future pathways (see Chapter 5). Second, the overall impact on jobs, inclusion and inequality will depend on how growth from new technologies work through the economy. This was crucial in examples we examine from the Industrial Revolution in the 18th and 19th centuries; it was also key during the recent period of Asian boom. It is here that business models and government action will matter (see Chapter 6 for further detail). If this period is handled well, then it may bring growth; create new jobs, livelihoods and opportunities; and limit inequality. If not, some may benefit, but poverty and inequality may become further entrenched.

Automated car production, Jensen. Photograph: Shutterstock

CHAPTER 3
The current debate is misleading

The current global debate on technology and inclusive growth is narrowly focused on 'job destruction' through automation technologies. Examples here are sensors, robotics, artificial intelligence, and 3D printing. Virtually all commentators appear to start from a statistic claiming to express the percentage of existing jobs that will be lost, based on some variation of a method first used by economists Carl Benedikt Frey and Michael Osbornein, in a 2013 working paper (published in a journal in 2017).[25] Variations on this methodology have produced widely differing forecasts of job losses ranging from 9%[26] to 47%[27] in OECD countries and estimates that up to two-thirds of jobs in developing countries[28] are at high risk of displacement due to technology over the next decade or two (this aggregate estimate includes numbers as high as 80% for Ethiopia and Nepal). McKinsey & Company,[29] the African Development Bank[30] and others have contributed to these discussions too. All these contributors nuance their commentary in published reports. Nevertheless, in public debate, only the headline numbers stick.[31]

The conversation should not be framed around these numbers, which are deeply misleading because they only count one side of the ledger. The methodology underlying all these forecasts has been questioned by many. To begin with, it looks at the tasks and occupations that *could technically be automated* and ignores whether they would realistically be automated. In the words of the original designers of the methodology *'the actual extent and pace of computerisation will depend on several additional factors which were left unaccounted for'*.[32] The methodology does not include any consideration of the *commercial viability* of adopting new technologies, or any of the supporting complementary investments, such as new infrastructure or skills that may be needed to take advantage of these technologies. Instead, many of the papers present technology as an inevitable destructive force that will hit countries, removing their agency in the face of technological change. Second, this type of analysis equates the technology with labour saving of producing a given quantity (one form of saving costs in production), without acknowledging that lower costs and prices may expand demand and therefore production, as more consumers (including many poorer ones) may be able to purchase more of these goods and services, with resulting impacts on overall employment in a given firm or sector. Third, these numbers do not account for the fact that, even if jobs are made redundant, other jobs will be created: how change works through the entire economy matters.[33] Box 2 illustrates this using evidence from the US and other OECD countries. It is difficult to find examples of technology in recent history that caused job losses but did not also spur other forms of job creation. The personal computer may have decimated typewriter manufacturing jobs, but it unleashed

new forms of job creation across a variety of sectors. Of course, this does not mean that the future will mirror the past. But as automation has been a process ongoing for many decades, jumping to the opposite conclusion, based on the current evidence, is not warranted either.

Box 2. **Jobs come and go, work always remains (evidence from the US)**

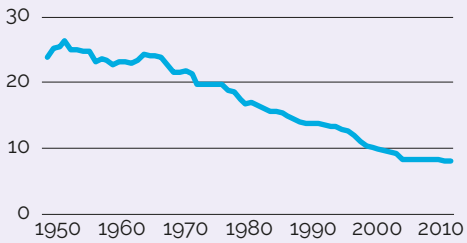
A perennial issue in public discourse about technology is anxiety about redundancy and job losses. To some extent, this is fair. Technology has undoubtedly transformed individual sectors. But, while automation replaces some labour in a given task, price reductions tend to increase demand for these goods, raising output in a way that often increases employment in other parts of the economy.[34] Introducing spreadsheet software in the US, for example, cost 400,000 jobs for bookkeepers and accounting clerks but created 600,000 jobs for other kinds of accountants more focused on customer service.[35]

In the last decade, US job growth has generally outperformed expectations while gross domestic product (GDP) growth has fallen below expectations.[36] This is precisely the opposite of what would be expected if automation were replacing significant amounts of labour *in aggregate.* While automation may replace labour in the sector or task directly affected, it indirectly creates jobs in other activities.[37]

The past may not always be a guide for the future, but it is instructive to see that successive transformational waves of automation have had zero effects on employment (or possibly a *positive* effect). Over the last 70 years, workers in US manufacturing have become eight times more productive, in large part due to a long trend of automation. This has been accompanied by a steady decline in employment in the manufacturing sector (Figure 3), but without negative impact on employment levels across the whole population (Figure 4).

Figure 3. **Manufacturing employment has been in decline…**

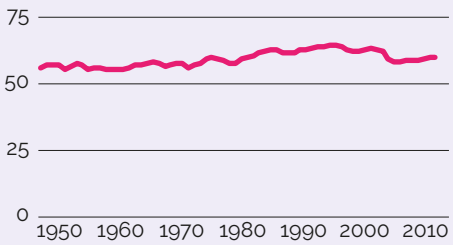
Per cent of US workforce in manufacturing



Sources: US Census Bureau, US Bureau of Labor Statistics, Pathways Commission analysis.

Figure 4. **…But total employment has actually increased modestly**

Per cent of US population (aged 16+) in any employment

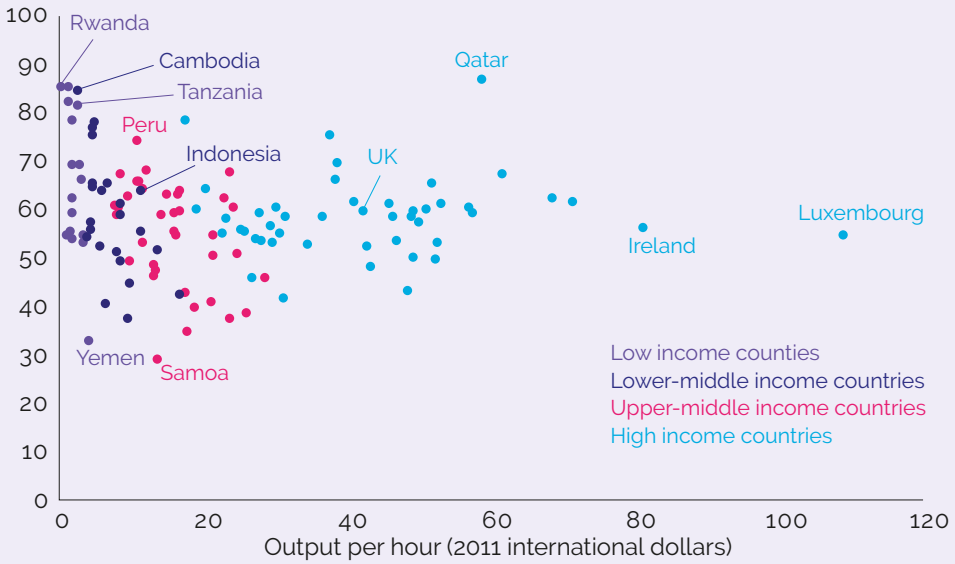


Sources: US Bureau of Labor Statistics, Pathways Commission analysis.

Looking around the world at the present, Figure 5 shows that there is no relationship between the level of productivity (here measured as output in a given time unit) and the rate of employment: countries with more productive technologies do not employ fewer people; they just produce more output.[38]

Figure 5. **Productivity varies greatly around the world; employment less so**

Employment to population ratio (per cent of 15+ year olds in work)

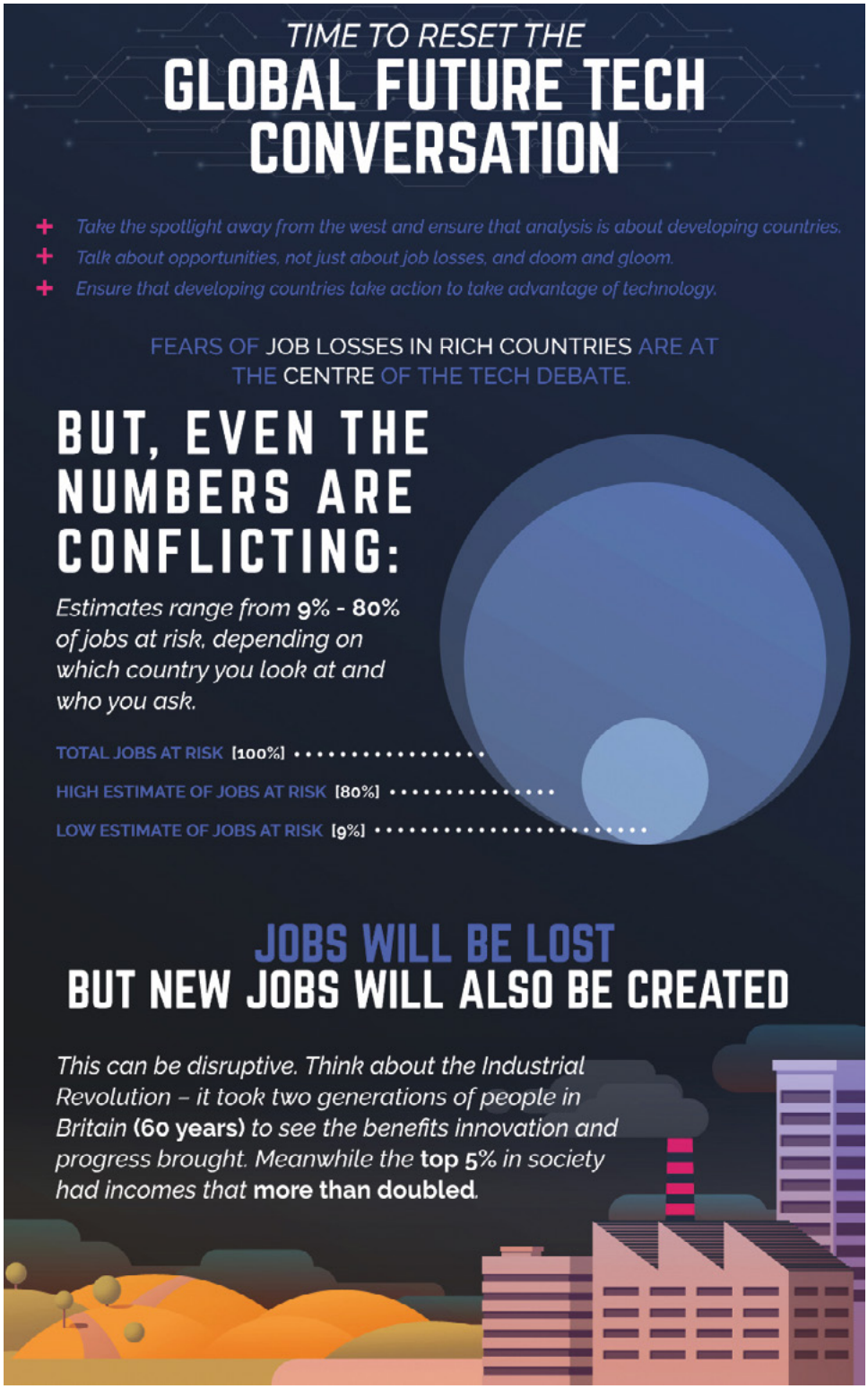


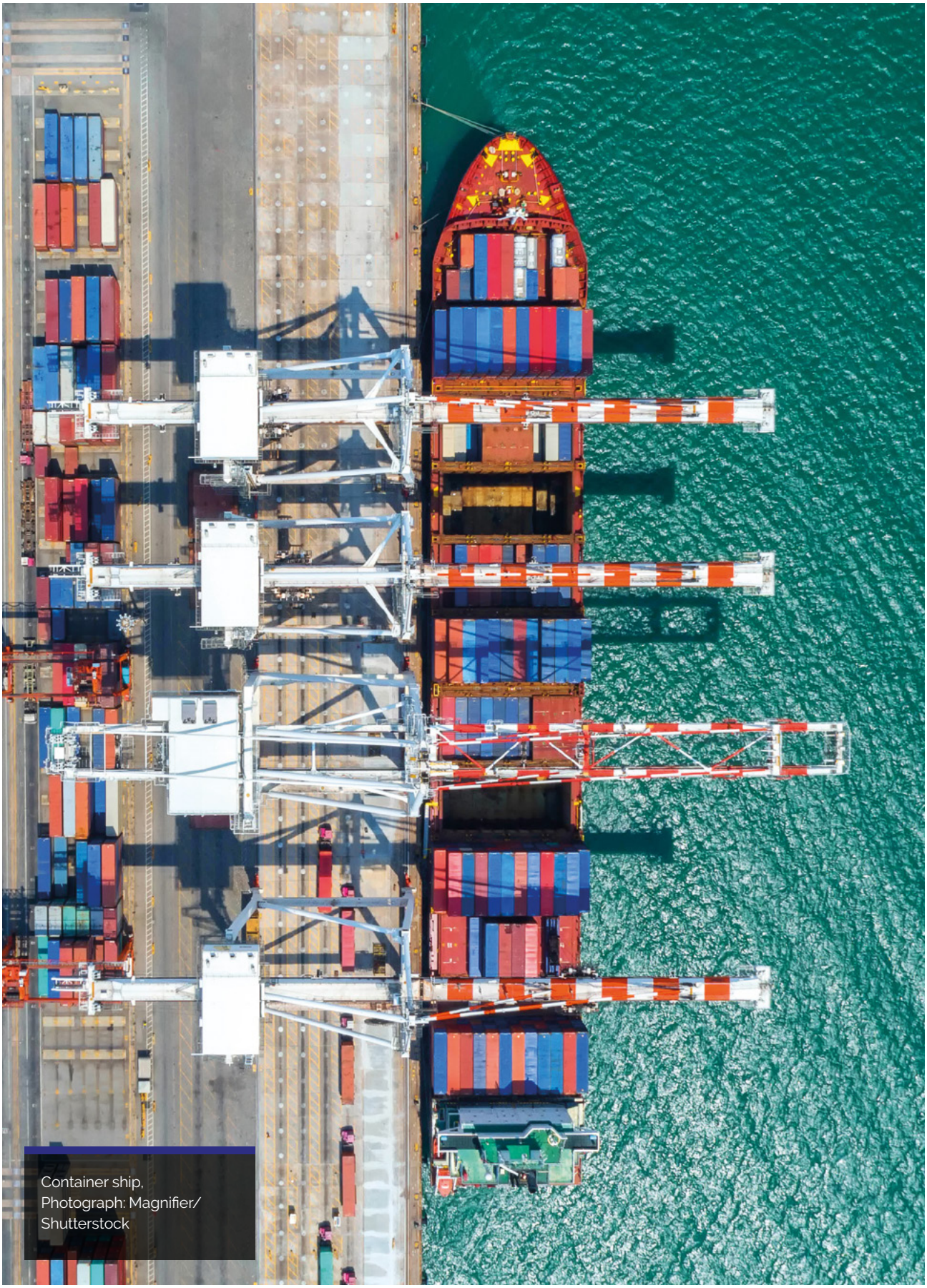
Sources: International Labour Organization (ILO), Pathways Commission analysis, extending analysis in Furman and Seamans (2018).

Notes: the employment-to-population ratio is based on ILO modelled estimates for 2017 for 123 countries; output is calculated from ILO models of worker productivity and from surveys (up to a decade old) of work hours.

Focusing the conversation on misleading calculations of expected job losses only contributes to a state of paralysis. Such a focus removes agency from societies without offering any tools to help understand or respond to these dynamics. It is imperative to reframe the conversation to empower policymakers, other stakeholders and societies so they can shape the outcomes of the new technological revolution on growth, jobs and inclusivity through better policy choices.

The first steps are to discuss what one can learn from earlier disruptions, and to assess what is different this time around. We approach the issue by shifting from a narrow focus on jobs lost to exploring how recent and historical periods of technological change have affected growth and its inclusiveness, and the lessons for developing countries. The report focuses on the Industrial Revolution, the growth boom in an increasingly large number of Asian economies, and on what we already know of the impact of more recent technological change, mainly in the OECD economies. These periods featured disrupted employment patterns as well as long-term poverty reduction, either slowly (in the case of the Industrial Revolution) or quickly (in the case of the Asian boom).


TIME TO RESET THE
GLOBAL FUTURE TECH CONVERSATION
+ Take the spotlight away from the west and ensure that analysis is about developing countries.
+ Talk about opportunities, not just about job losses, and doom and gloom.
+ Ensure that developing countries take action to take advantage of technology.
FEARS OF JOB LOSSES IN RICH COUNTRIES ARE AT THE CENTRE OF THE TECH DEBATE.
BUT, EVEN THE NUMBERS ARE CONFLICTING:
Estimates range from 9% - 80% of jobs at risk, depending on which country you look at and who you ask.
TOTAL JOBS AT RISK [100%]
HIGH ESTIMATE OF JOBS AT RISK [80%]
LOW ESTIMATE OF JOBS AT RISK [9%]
JOBS WILL BE LOST
BUT NEW JOBS WILL ALSO BE CREATED
This can be disruptive. Think about the Industrial Revolution – it took two generations of people in Britain (60 years) to see the benefits innovation and progress brought. Meanwhile the top 5% in society had incomes that more than doubled.



Container ship,
Photograph: Magnifier/
Shutterstock

CHAPTER 4
Insights from past experiences

Technological change was a hallmark of both the Industrial Revolution during the 18th and 19th centuries, and the recent growth success stories in Asia that spread and accelerated in the 1990s. In line with our framework in Table 1, the Industrial Revolution was a period of changing *production technologies* boosting productivity, first in agriculture, but then subsequently and intensively, in manufacturing. It brought down the *cost of production* dramatically, but this effect was also reinforced by the lowering of *trade costs* (through canals and railways). The Asian growth boom was powered by many factors, not least of which was a range of new technologies. The introduction of production technologies that were familiar in more developed economies was important, but the other essential factors were the change in costs of exchange due to *trade and communication technologies*. For example, the garments sector has been playing a key role in manufacturing in countries such as Vietnam or Bangladesh. Technologically, this was possible, first, due to the adoption of production lines of sewing machines, which were widely used decades earlier in Europe and the US. A second factor was the vast cost reduction in shipping, partly due to the use of standardised containers. A third stemmed from improved communication technologies (better telephones, fax, and then the internet), as well as increased access to computing power, which allowed much easier co-ordination between different production units and suppliers. By 1990, trade and communication costs had plummeted to only 5% or less of what they had been just after the Second World War. This enabled increasingly complex production in East and Southeast Asia as part of GVCs for the manufacture of products such as apparel, car parts, electronics and more.[39]

Three insights from the Industrial Revolution and the Asian growth boom are worth discussing to inform our analysis of what may happen next with technological change. First, the broader environment matters. Second, manufacturing's main benefit was as a growth engine, not an employer. Third, technology does not necessarily 'destroy jobs' in aggregate but it does certainly disrupt job markets and, if not managed, technology could lead to increased social pressures or exclusion. Throughout this section, the discussion highlights what these historical insights may mean for present-day experiences.

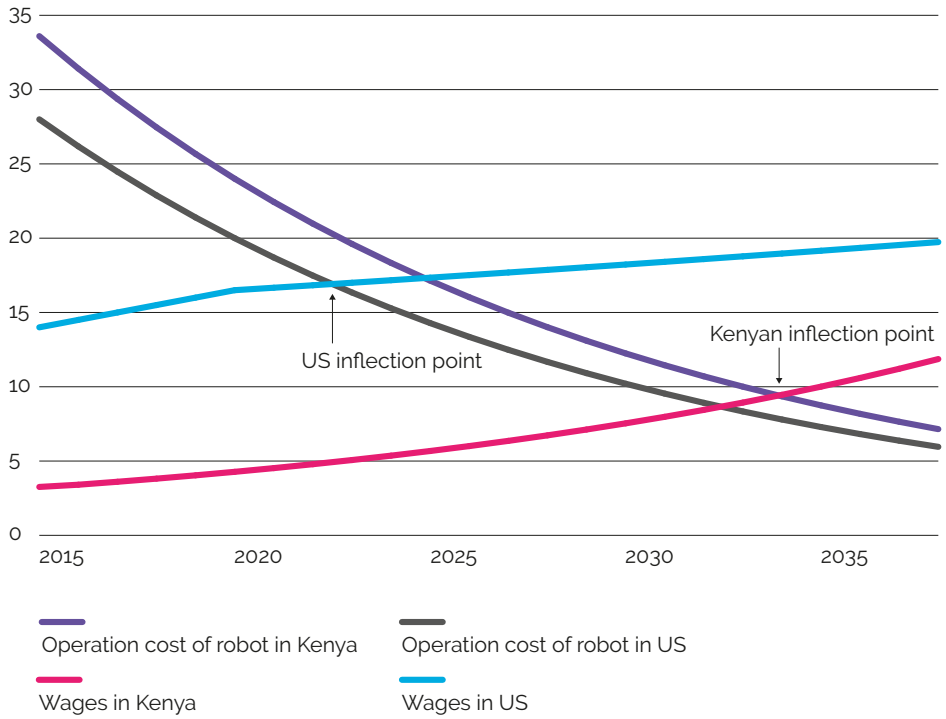
First: technological capacity alone never guaranteed success. Technology had to be bundled with enabling policy and locally profitable business models in a mutually reinforcing manner, as was the case during the Industrial Revolution and the recent Asian boom. Countries, and even cities, varied in their willingness or ability to take advantage of new technologies, depending in part on the local economic and institutional structures, even in

countries where state capacity and political will were similar. For example, the late 18th century spinning jenny allowed one worker to weave as much cloth as eight workers used to. Although both the UK and France had access to this technology, adoption of the technology differed significantly between the two countries: by 1790 there were 900 spinning jennies in France, compared to 20,000 in England.[40] Simply put, higher wage costs and lower capital costs meant that the technology was far more profitable in England than in France; England also moved early in building canals and railways.[41] Similarly while all developing countries, with their lower wage costs, represented potential locations for light manufacturing in the 1970s, only a few of these countries were successful in entering GVCs.[42] These were the countries that: offered peace and stability, built extensive infrastructure that supported logistics, provided sufficient state capability and political will to ensure success of these private investments, introduced sensible health and education policies, and boosted agricultural productivity with green revolution technologies and reforms. In short, the Asian 'miracle' has remained confined to a particular group of countries and regions. Subsequently, new entrants had to climb a steep cliff: early entry was rewarded through further 'agglomeration effects', the network effects from having various industries close to each other, leading to the spread of knowledge and ideas, and contributing to self-perpetuating growth.

Currently, pockets of production around the world are being revolutionised by new technology – but certainly not overnight. In late 2018, Chinese garment manufacturer Tianyuan Garments Company will open its newest factory in the US, not in Asia. This factory will use sewing robots made by SoftWear Automation, reducing the need for workers by 50–70% and producing t-shirts in the US at comparable cost to Bangladesh. And in the UK, 75% of local manufacturers feel they can re-shore their production line in the UK because industrial tech is competitive with foreign labour.[43] But even if we are approaching a new frontier of what 'could technically be automated', the evidence suggests that the latest emerging technologies will take some time to spread. In private interviews, a large Indian holding company with broad interests (across manufacturing, digital services, and more) said it would probably take at least three to seven years before artificial intelligence finds even minor applications in its business. Even Adidas' widely publicised and fully automated Speed Factories in Germany and the US will only supply 0.25% of Adidas' yearly shoe production by 2020 – and only at a high price point.

Figure 6. **Robots will take some time to be competitive in Africa: the case of furniture production in Kenya versus the US**

Cost per hour in USD of labour (for humans) and operation (for robots, including fixed costs)

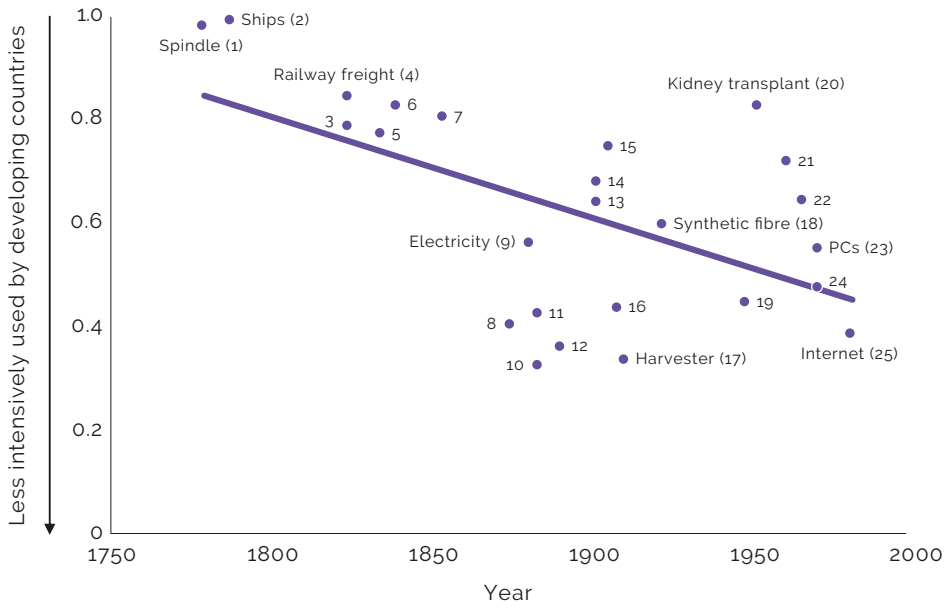


Source: Banga and te Velde (2018a).[44]

The spread of automation and other technologies depends on profitable business models. Labour costs and other locational factors are a big part of this. The Textile Institute recently released a detailed study saying there was limited scope for automation in garment manufacturing.[45] Partly because of technical limitations, but also because low labour costs remain attractive, even when some parts of production are automated. On a pure labour cost basis, recent analysis suggests it may take a decade or two before robots become cost competitive on the African continent, given labour costs. Figure 6 illustrates this for furniture production in Kenya.[46] But aside from cost, other locational aspects still matter; caution is needed before reaching conclusions. Even though recent advances in many technologies (such as ICT and medicine) are immediately available globally, they still are not used nearly as intensively or productively in developing countries (see Figure 7 below).[47] This trend should be expected to continue with the current wave of emerging technologies, which do not 'just work' in the same way that any person could use a threshing machine. Newer technology must be combined with the right mix of human capital and policy ecosystems to create comparative advantage. This will be addressed further in Chapter 6.

Figure 7. **Old technologies were productive everywhere; new technologies are not used intensively outside of developed countries**[48]

Intensity of usage in developing countries relative to intensity in developed countries



Source: Comin and Mastieri (2018); Pathways Commission analysis inspired by a figure in Comin (2014).

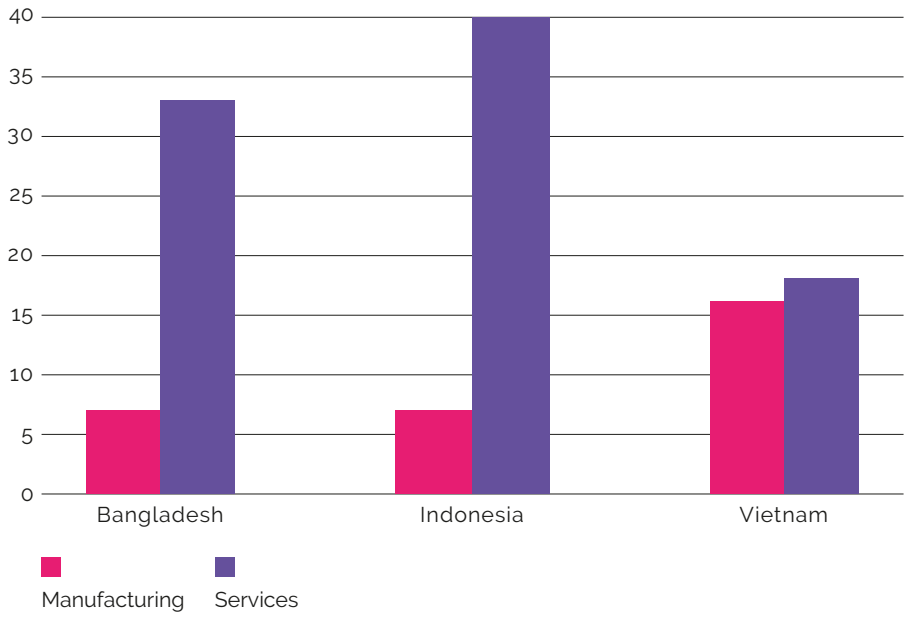
Note: (1) spindles; (2) ships; (3) railway passengers; (4) railway freight; (5) telegraph; (6) mail; (7) steel; (8) telephone; (9) electricity; (10) cars; (11) trucks; (12) tractor; (13) aviation passengers; (14) aviation freight; (15) electric furnace; (16) fertiliser; (17) harvester; (18) synthetic fibre; (19) oxygen furnace; (20) kidney transplant; (21) liver transplant; (22) heart surgery; (23) PCs; (24) cell phones; (25) internet.

Second: analyses of earlier technological change show that, to understand the employment and inclusion impacts, one should look at the underlying growth engine and how it works through the economy as a whole. For example, the manufacturing sector was the growth *engine* during the Industrial Revolution and the Asian growth boom: it fuelled further *productivity* gains in the agricultural sector as well as fast *employment* growth in the services sector. The full development value of the manufacturing sector did not come from manufacturing itself, but rather from the knock-on effects on consumers and on producers in other sectors of the economy. Figure 8 shows this in Bangladesh, Indonesia and Vietnam. During their period of fast manufacturing growth in 1991 to 2017, employment in services outpaced employment in manufacturing, suggesting that manufacturing growth was an engine that drove development across the economy. Manufacturing growth in this period also perpetuated and extended agricultural revolutions during the Industrial Revolution and the period of Asian growth acceleration, making further investment in new technologies in agriculture profitable.[49] Coupled with growing opportunities in urban areas, this also allowed workers to leave agriculture, tightening rural labour markets and increasing livelihoods

for those who remained.[50] In Bangladesh, for example, rural wages almost completely converged with urban wages from 2001 to 2011, despite the fact that rural wages started at a level less than two-thirds of the urban level.[51] This resulted in dramatic impacts on overall poverty, which is usually highest in the rural sector. Poverty rates in Bangladesh (measured as the proportion of people living on less than $1.90 per day) fell from 44.2% of the population in 1991 to 14.8% in 2016, with also huge improvement in health and education, particularly for girls and women.[52]

Figure 8. **Growth in services is often much larger than growth in manufacturing, even during periods of manufacturing boom**

Growth in employment share, 1991–2017 (percentage point change)



Source: World Development Indicators, World Bank.

***A priori,* this transmission dynamic throughout the economy may not be the same during the current wave of technological change.** The current wave combines a broad set of technologies, some labour saving (such as automation in the Industrial Revolution), and others trade boosting (such as communications technologies for the Asian export-led boom).[53] As in both of these previous periods, technologies linked to energy or agriculture are emerging that may bring production costs down even further. This is also a period when manufacturing output is highly dependent upon foreign imports and local services – creating complex interdependencies, many of them positive.[54] Putting this all together, it makes it very difficult to get at impacts on growth and employment across sectors, and reach a firm conclusion about how

these changes will work through the economy. This report offers insights into these issues for particular technologies and opportunities that extend beyond manufacturing (see Chapter 5). Moreover, these issues remain an active field of research on inclusive growth.

Third: looking at the Industrial Revolution and the Asian boom highlights that, while better production technologies introduced significant labour savings, *in aggregate jobs were not destroyed.* There was, however, a 'disruptive' move out of agriculture into both manufacturing and services. During the Industrial Revolution, huge labour savings were made possible in both agriculture and industry. Labour was definitely 'released' from agriculture. This was deeply disruptive, destroying livelihoods for some individuals.[55] During the first 60 years of the Industrial Revolution, real wages were stagnant[56] and many working-class labourers experienced a decline in living standards[57] – a medium-term impact in the arc of economic history, but a lifetime for those involved. Meanwhile the income of the top 5% more than doubled.[58] Still, the period did not result in a permanent loss of jobs in the aggregate. In fact, over the longer term, employment and living standards increased through the growth in opportunities to undertake jobs in manufacturing, as well as through the expansion of the services sector. Booming manufacturing in Asian economies similarly disrupted lives of many people, pulling large numbers into urban centres out of agriculture. However, working through the exact mechanisms is important. The green revolution in Asia, for example, involved clearly labour-saving technologies, such as mechanisation. Contemporary assessments now widely credit the green revolution with creating more employment, boosting real wages, and reducing the cost of living throughout Asia all relatively quickly.[59] Nevertheless, not least in India, early analysis had focused extensively on the loss of employment by landless labourers.[60]

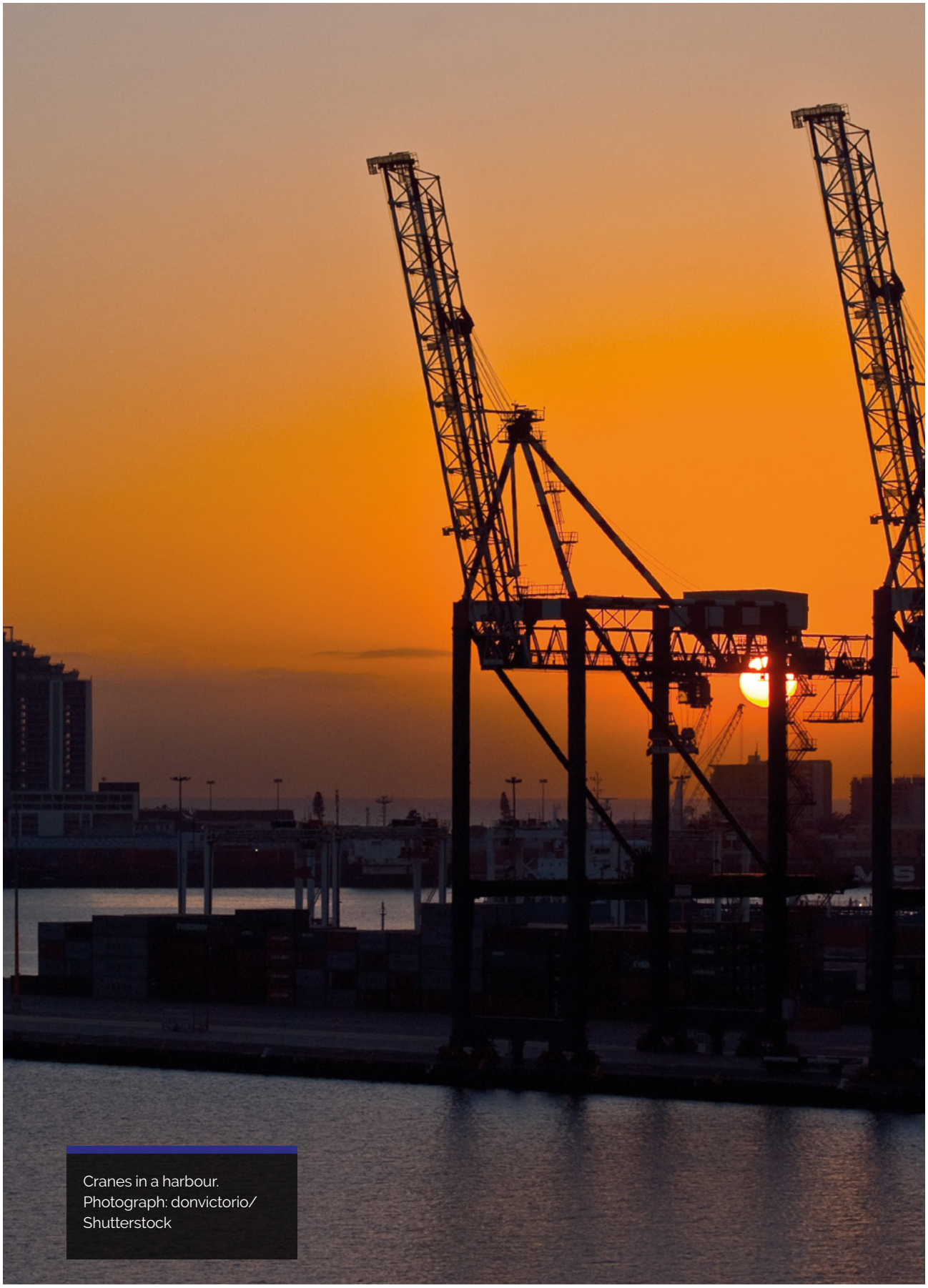
Present-day discussions echo the debates from these periods of profound technological and economic change. More recent cycles of labour-saving technology suggest that automation substituted for human labour in the short term, but led to the creation of complementary jobs in the long term.[61] For example, in the US, despite a four-fold increase in the number of ATMs in the 1990s, the number of bank tellers employed was 10% higher in 2010 than it had been in 1980.[62] Echoes surface in many developing countries' firms today: a Tanzanian knitwear company recently introduced new laser-cutting machine, reducing about 15 jobs in cutting fabric, but also leading to a boost in output that allowed it to create about 300 new jobs in stitching.[63] An *exclusive* focus on the labour-saving nature of technology proved to be misleading for policymakers and the public in previous times. The same is potentially true now.

The new wave of technologies will also have an impact on the inclusiveness of growth through its impact on the demand for skills. Previous waves of technological automation impacted on manual labour-intensive work at the lowest end of the skill distribution. However, artificial intelligence is now automating skill-intensive work as well, substituting cognitive tasks, not just manual tasks, with machines.[64] While it is not clear if these results translate

to developing countries, research in the US shows there has been a hollowing out of middle-skill jobs over recent decades as the labour market polarises towards extreme low-skill and extreme high-skill jobs.[65] If the new jobs created after automation are one of two types – janitors and data scientists, for example – then there may not be intermediate occupations to bridge that gap – affecting the already difficult ladder for mobility for poorer people. Furthermore, the loss of the middle may risk affecting women more than men in developing countries. Factory floor jobs in light manufacturing industries such as textiles, which has so far been a strong route to inclusion for young women, may be at high risk of automation.[66] For example, the Mohammadi Fashion Sweaters plant in Dhaka, Bangladesh, has replaced about 500 workers with industrial robots since 2012.[67] If new industries and jobs are not equally as good at bringing women into the workforce, this could be a backward step for gender equality.

To conclude, labour-saving technologies have been part and parcel of many of the periods of rapid progress; thus, whether and how such technologies will affect inclusive growth trajectories cannot be assessed by focusing solely on job losses. First, technology has always been adopted where the local conditions made it commercially viable for production or trade. Rollout of new technologies is not immediate or guaranteed. Second, the immediate direct effects (such as labour savings) are typically overemphasised,and there will be flow-on effects that may run in the other direction (such as increased total demand creating new jobs). A simple number does not express complex and interrelated effects in a meaningful way. Nonetheless, disruption of people's lives is still real and needs to be considered. Finally, understanding how technology-induced opportunities work through an entire economy, is central to understanding the overall impacts, especially those that affect the poorest in society.

While recognising the scope for disruption is important, it is equally important to map out the opportunities for new pathways presented by new technologies for inclusive growth in developing countries. Disruption as old opportunities disappear will be real, even if new opportunities are created. How policymakers and business handle these disruptions matters. If poorly handled, hardship and inequity may follow, as well as discontent, making appropriate action even harder.[68] Chapter 6 discusses this issue further. However, the focus must extend beyond the potentially negative and disruptive impacts on a certain sector or specific jobs to consider how technologies also make positive, inclusive growth pathways possible. To capture the opportunities presented by new technologies, developing countries have to proactively map new, inclusive growth pathways, and build their policy and business ecosystems.



Cranes in a harbour. Photograph: donvictorio/ Shutterstock

CHAPTER 5
Emerging pathways for inclusive growth

A lot of the discussion around technology starts from an implicit assumption that manufacturing jobs are 'the good jobs', and that manufacturing-led growth is the only possible development pathway; increasingly, both views can be challenged.[69] There is no doubt that growth in export manufacturing, as part of GVCs, was key to poverty reduction in many East and Southeast Asian countries, and more recently in parts of Africa and South Asia. However, it is neither clear that: (i) this particular kind of labour-intensive manufacturing growth miracle will be open for many more new entrants; nor that (ii) there is anything inherently unique about manufacturing as a driver for inclusive growth and poverty reduction.[70] Importantly, other sectors provide good alternatives for transitioning labour out of agriculture and informal economies.[71] And it could well be questioned whether the acclaimed 'learning-by-doing' spill-overs from manufacturing – the knowledge effects on the rest of the economy – are any different from what could be possible from parts of the services or agricultural sectors.[72] The goal should not be to blindly pursue manufacturing, but rather to look for pathways that can drive productivity growth and create widespread economic opportunities at the same time. The situation cries out for a vision that encompasses more than locked-in, narrow sectoral thinking.

New technologies are offering new opportunities for pathways to growth and job creation. As shown in Table 1, these new technologies can be expected to bring down different costs, among them:

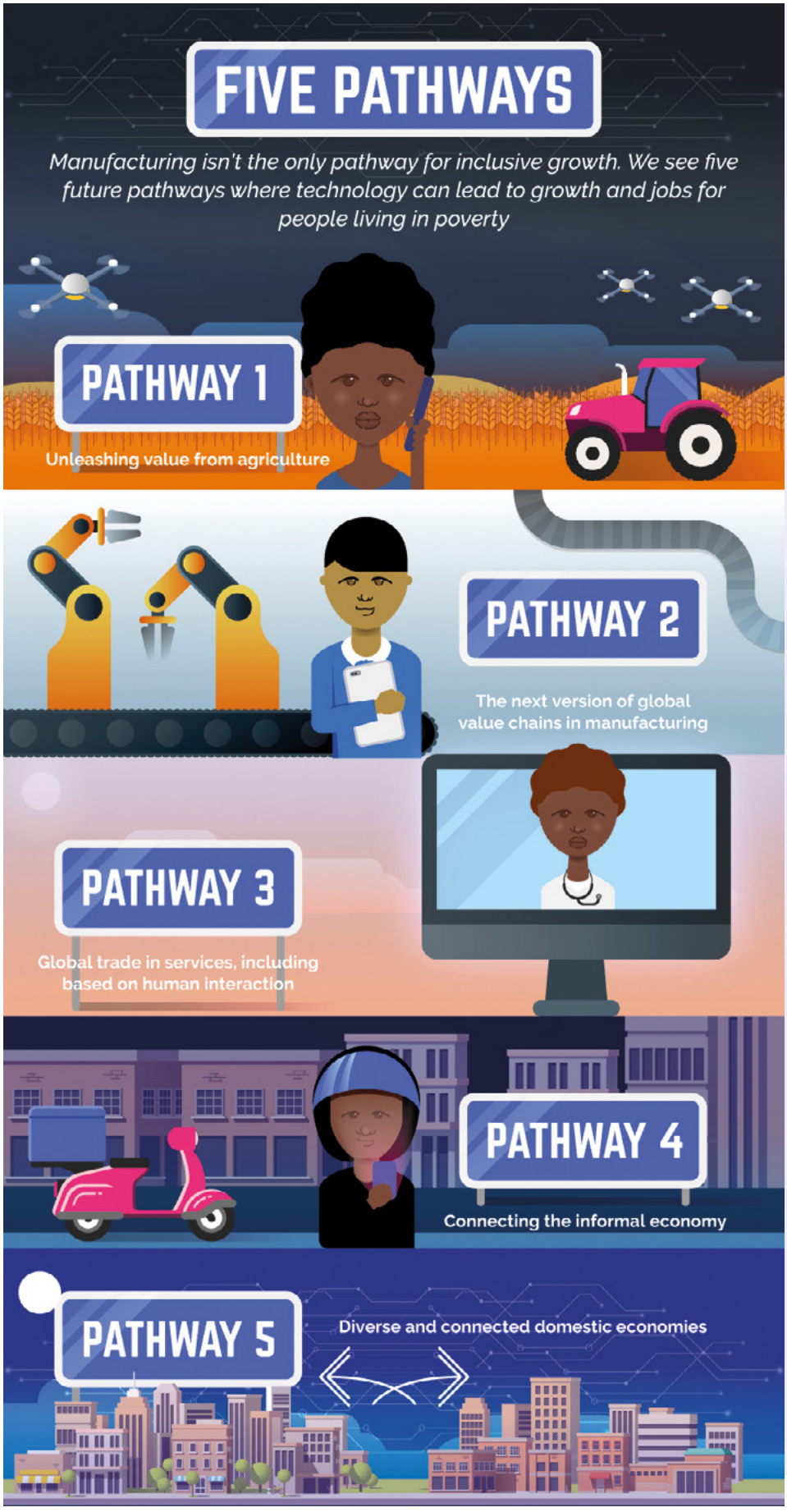
- production costs, for example reducing labour or energy costs
- costs of exchange, such as trading goods, services, or capital, selling labour or obtaining information[73]
- costs of networking and organisation, allowing ideas and knowledge to diffuse, and promoting innovation.[74]

New technologies clearly offer substantial opportunities in this space, with scope for bringing down each of these costs. This report identifies five possible pathways that take advantage of these opportunities from emerging technologies. Table 2 summarises these. This chapter highlights the technologies used and the ways in which they can stimulate investment and growth in these areas. It assesses how inclusive these pathways could be and how to achieve more inclusion. Countries and regions could take advantage of several of these pathways, as is already happening in some cases.

The argument is not that each and every pathway will be required to emulate East Asian success. Rather, these are new pathways that policymakers and leaders in the private sector should seriously consider for their potential to bring opportunities for growth and inclusion in this age of technological change. Chapter 6 discusses how to unlock these pathways.

Table 2. **Summary of emerging pathways**

Pathway	Description	Technology cost reduction		
		production	exchange	networking
Raising value from agriculture	Technology (data analytics, biotechnology, ICTs, etc.) may offer opportunities to improve agriculture yields and the efficiency of agricultural supply chains, with a focus on helping farmers to access markets	x	x	
Extending GVCs to include more complex processes	Frontier communication technologies make it possible to perform complex tasks remotely, removing barriers (such as the need for face-to-face interaction) that limit the abilities to decentralise production	x		x
Creating new global trade in services	Advances in artificial intelligence may disrupt business process outsourcing in codified services, but this may lead to a greater demand for socio-emotional, creativity and design skills which, due to the same technology, can be done remotely	x	x	x
Linking the informal sector to the formal economy	Digital platforms can increase productivity in the informal sector, and can provide a route into the formal economy for many informal workers		x	
Creating diverse and connected domestic economies	Digital technologies and advances in transportation, logistics and supply chain management enhance the connectedness of domestic and regional economies by reducing the cost of trade, providing developing countries with viable alternatives to export-led growth via GVCs		x	x


FIVE PATHWAYS
Manufacturing isn't the only pathway for inclusive growth. We see five future pathways where technology can lead to growth and jobs for people living in poverty
PATHWAY 1
Unleashing value from agriculture
PATHWAY 2
The next version of global value chains in manufacturing
PATHWAY 3
Global trade in services, including based on human interaction
PATHWAY 4
Connecting the informal economy
PATHWAY 5
Diverse and connected domestic economies

5.1 Pathway one: Unleashing value from agriculture

Emerging technologies are boosting the potential of agriculture. Throughout the last few centuries, technological improvements were central to agricultural production, boosting output and bringing down costs of food and other agricultural produce; this will continue to be the case. Further improvements in output are likely through advances in biotechnology. Furthermore, energy costs are one reason why irrigation is not easily spreading in some parts of the world, such as many parts of sub-Saharan Africa. Here, progress in renewable energy, particularly in its storage and distribution, could reduce costs of irrigation in developing countries, contributing to boosting agriculture. In many settings, including sub-Saharan Africa, in particular, yields are still well below the potential that could be obtained using current agro-science knowledge. There are ample opportunities to generate higher-quality information, and to encourage its diffusion. The use of digital technologies is dramatically reducing the cost of generating and exchanging this information. Big data, GPS, drones, and high-speed communication have enabled improved extension services, and they have contributed to optimised irrigation, pesticide and fertiliser use.[75] Communication technologies also hold the promise to connect farmers to markets much more effectively through new models of aggregation, logistics and supply-chain management.[76]

New models of extension and other farm services are beginning to fulfil their potential. Early attempts to use mobile phone technology to direct extension services had limited impacts, but a new generation of services is showing considerable promise. Recent progress allows more precise advice to be passed on to farmers as part of 'precision' agriculture, sometimes with considerable impact.[77] Aerobotics, a South African start-up, has developed a data analytics and machine learning system to process aerial imagery from drones and satellites, providing real-time insights on crop performance, pests, plant health, irrigation levels and more. Applications such as SERO Rice in Vietnam provide a similar function, albeit not as high-tech. Rather than using aerial imagery, SERO Rice uses pictures taken with a user's smartphone, providing a virtual plant doctor with high potential for problem diagnosis. Many other precision agriculture apps – based on delivering tailored knowledge and advice direct to farmers – are being developed in Ghana, Nigeria, Kenya,

India and Southeast Asia.[78] A number of these precision agriculture products are designed to work by simple SMS communication, making them accessible to some of the poorest farmers, not just to smartphone users. The African Soil Information Service is using remote sensing and an open-source approach to soil data. This has brought down the cost of soil mapping by 97% (from $70 to $2 per sample), allowing the service to develop more effective and tailored fertilisation patterns. Digital technologies help to make markets for other inputs more efficient too, making the provision of services to smaller farmers more feasible, and, potentially more profitable than previously would have been the case. For example, Hello Tractor[79] provides a platform for farmers to rent local tractors for a few hours at a time, and FarmDrive[80] in Kenya connects unbanked smallholder farmers to credit.

While boosting yields for farmers will have growth effects, unleashing agriculture's full potential for growth will also require connecting this sector much better to global and national markets. Yield increases obviously improve lives; however, for them to capture fully a route through to prosperity from agricultural activities, farmgate returns must be sufficiently high. Being able to climb up the quality and price ladder for the produce cultivated has always been important.[81] Many factors influence this, including government policies on trade and infrastructure. Limited domestic demand for higher-quality and higher-priced commodities is a constraint, so export of agricultural produce is a sensible route for growth. In a world in which manufacturing goods may become increasingly cheap due to further technological improvement, including through automation, agricultural exports may become a relatively more attractive proposition, offering a further source of diversification for poor economies starved of many viable options.[82] Connecting farmers to markets and improving supply chain management are also critical to reduce post-harvest loss and waste, a problem some have estimated consumes a third or more of the food produced in the developing world.[83] Curbing such post-harvest losses would boost rural incomes, and allow for significantly more efficient water, fertiliser, and energy use.

Emerging technologies could help producers capture higher returns from agriculture. The key here is the ability of new digital technologies to connect much more efficiently the decentralised parts of domestic and international supply chains. There are a number of means by which improved technology can accrue more value to farmers from international and domestic trade. First, while huge cost reductions have occurred in the international transport of produce by air or ship,[84] commensurate improvements have not surfaced in domestic logistics.[85] Poor infrastructure is a factor, as are internal movement-licensing regimes and inefficient logistics monopolies. Digital technologies offer new opportunities. There is scope to learn lessons from GVCs for the domestic part of trading routes, too. Local transport efficiency can be enhanced further through, for example, the use of sensors and databases to monitor produce movements, or the use of the internet of things and big data analytics to optimise logistics routes.[86] AgroSpaces in Cameroon and M-Farm in Kenya are platforms providing pricing data to remove price asymmetry between farmers and buyers,

making it possible for farmers to earn better prices at markets. The next step is to make this communication two-way, in which farmers can signal or transact via such platforms, creating digital markets and also allowing transport of these commodities to be much more efficiently organised. Second, beyond logistics, emerging technologies can also assist in more effective tracing of produce, helping to more easily certify and track quality produce through the chain, and allowing such crops to capture higher prices. For example, the Ethiopian Commodity Exchange can now better differentiate the quality of coffee; its tracing technology even allows a smallholder farmer to directly connect to global buyers.[87] Indeed, there is great demand to be tapped from traceable supply chains: whether people who want to make sure their cotton is organic or their coffee comes from a single origin.

Generating growth in agriculture will continue to play an essential part in an overall inclusive growth strategy. While the vision that agriculture can provide an engine of growth powerful enough to transform economies is unlikely to be valid, the sector's contribution to a developing economy trying to boost its growth is hardly disputed.[88] This is unlikely to change: while low-skilled manufacturing and services may be liable to disruptive automation over time, this is much less likely for agriculture. It also means that, if automation were to take hold in manufacturing due to technological change, manufactured goods would become cheaper, moving terms of trade in favour of agriculture, and, in turn, making agriculture more profitable and attractive.[89] Better functioning agricultural value chains would also make agro-processing more attractive, particularly for those industries using low-value, high-weight agricultural goods, such as paper or leather, that benefit from being located close to production centres.[90]

Major automation may well bypass agriculture, keeping it highly labour-intensive, so that any growth in this sector would remain strongly pro-poor. For example, even in high-wage economies in Europe, vegetable and fruit picking remains highly labour intensive. And, in itself, agriculture is the most labour-intensive sector of most economies in the developing world, even if its scope for absorbing more labour is limited. Thus, agriculture is likely to keep its place in an inclusive growth strategy for poorer countries. This still requires growth and productivity gains in the agricultural sector: the evidence shows that, in countries where there was a sustained increase in the value of agricultural output per worker, it helped to limit the need for rural-urban migration, and provided labour opportunities to rural population.[91]

5.2 Pathway two: The next version of global value chains in manufacturing

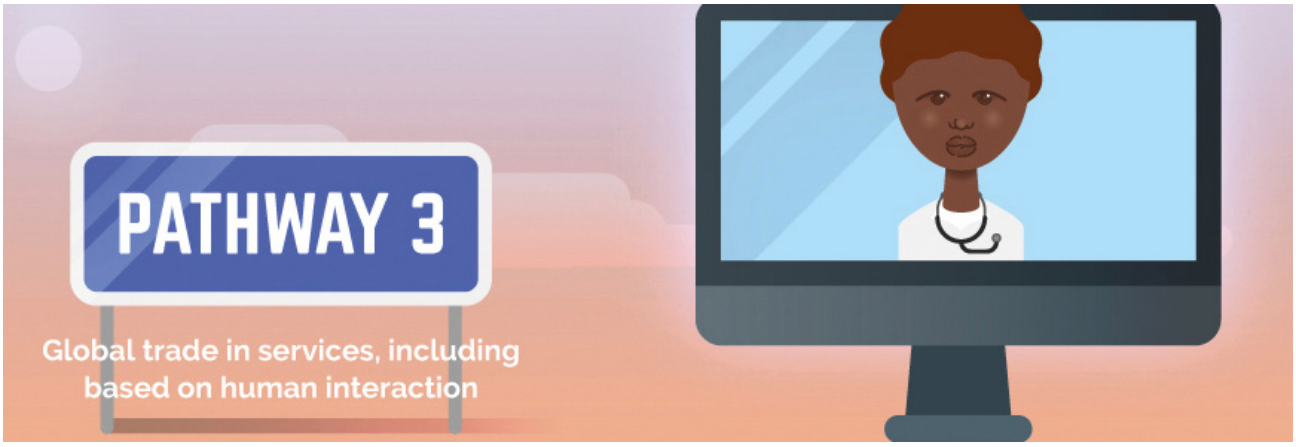
Globalisation, including the inclusion of low-wage economies into global manufacturing chains, has largely been about trade in 'codifiable' product lines. Until now, most manufacturing GVCs involved relatively simple industrial processes, with specifications sent overseas and the manufactured products returned. This restriction to simple goods is due to continuing costs of 'distance', which are more significant for more complex goods and processes. Despite improved ICT, face-to-face costs remain a significant component of running costs, even for businesses in GVCs.[92] This means that, for managing complex business operations or generating new ideas – which both often require face-to-face interaction – communication costs may still be a barrier to moving production into GVCs.

New technologies are helping to overcome the need for real-life, face-to-face contact, thereby allowing more complex manufacturing operations to be managed remotely. New technologies – among them, remote diagnostics, 3D printing, tele-maintenance and virtual reality techniques such as telerobotics, teleoperation and telepresence-enabled human interaction – could allow for far more complex activities to be undertaken at a distance. For example, these technologies could make possible remote management, decision making, design changes, and maintenance of plants.[93] As the cost of virtual 'face-to-face' communication continues to fall and quality continues to increase, more decentralisation should be possible, allowing more countries and firms to enter GVCs, and to take part in global markets. Firms can continue to spread value chains as long as the benefits of fragmentation (eg cheaper labour) exceed the costs (poor and expensive communication). With communication costs falling fast in these countries, this extension of GVCs into more complex processes becomes a real opportunity for new entrants. Furthermore, this is likely to be self-reinforcing: increasingly complex collaboration will lead to knowledge spill-overs, reducing the comparative benefits of agglomeration (the 'innovation effect' of co-locating several parts of production), and further increasing the scope of globalisation of more complex value chains.[94] In short, new communication technologies can bring down the cost of the exchange of

information within a business and across value chains, and also can allow for more complicated interactions, including innovation and the generation of new ideas.

The research shows that human manufacturing roles will not disappear; manufacturing technologies may even offer new opportunities for inclusive growth in developing countries, by providing jobs for relatively lower-skilled people. Despite the threat that the manufacturing sector may become a low-employment enterprise, the next version of globalisation could still be beneficial for least-developed countries with a comparative advantage in labour costs. Automation may mean that having low labour costs ceases to be important on the factory floor, but many secondary services (from robot technician to product designer; cleaner to caterer) are harder to automate. The provision of these services still factors into a firm's costs, now accounting for around a third of the value of manufactured exports.[95] Indeed, even if a polarisation takes place in labour needs (more people at both extremes of the skill distribution, with little demand in the middle[96]), these technologies could specifically favour developing countries. Jobs that require very specific, high-level skills could be done from abroad using new communication technologies, while some of the 'services' within these firms which require relatively low-skilled labour, and other services needed to take products to the market, could provide entry level jobs. This could make developing countries attractive, particularly given global demographic trends. Moreover, the advantages many developing countries have in renewable energy generation – such as abundant sunlight and the flexibility that comes with being less committed to traditional energy sources – could create a comparative advantage in cheap energy, further making these countries attractive sites for the next wave of GVCs.

5.3. Pathway three: Global trade in services, including those based on human interaction



Trade in services constitutes a fast-growing share of global trade, with developing countries catching up. Digital technologies are central to this growth, which offers huge potential for employment of women in developing countries. Currently, global trade in services accounts for about a fifth of global

trade, but this is growing.[97] While the share of developing countries in global services trade is still well below that of goods, they are catching up rapidly.[98] Growth is especially high in particular areas, such as exports in IT or in IT-enabled services (ITeS), often also called business process outsourcing (BPO). For example, in India, total services exports exceed goods exports. India has now become the second largest exporter of IT services in the world and has captured more than 30% of the global ITeS (BPO) sector.[99] This sector's growth was only possible thanks to digital technologies, including data management and communication technologies, bringing down the costs of exchanging information and interacting remotely. The BPO sector has also been a positive driver of inclusion and female empowerment in countries such as India and the Philippines.[100] For example, in rural India, these opportunities for women resulted in higher labour market participation, a higher age of marriage, better education outcomes and greater reproductive choice.[101]

ITeS (BPO) services are growing. BPO services typically constituted standard codifiable work, such as back-office support with data entry, orders, contracts, insurance claims processing, basic accountancy services, and consumer-related care such as IT help, telemarketing or claims support via call centres. In the Philippines, exports from IT-BPO services have grown threefold in the last ten years, and have now captured 10–15% of the global BPO market; these services generate one-third of total export earnings, and employ 1.3 million people.[102] India now contributes about a third to the global market in BPO, having doubled its value added in the last ten years. BPO now contributes about 10% to total export earnings in India.[103]

New technologies are likely to spur the next phase of globalisation: the export of a broader range of services, with huge potential for poor countries. Person-to-person communication may seem like a relatively trivial technology – something the basic mobile phone can achieve – but it is far from trivial. High-bandwidth internet, telepresence, and future virtual reality and telerobotics will allow for high levels of dispersed collaboration and service provision. Internationally traded services can then expand. Initially these services are more likely to create new opportunities at the high-value end, more likely in the realm of professional services than housekeeping services. This is already happening. Interviews with a major Indian holding company suggested that the most recent BPO growth has been possible as more integrated products and services – such as engineering design or integrated accountancy services – are increasingly being delivered remotely.[104] India's success in IT services was only possible through ever higher bandwidth internet. New technologies will allow this growth to accelerate and to broaden the services provided.

However, artificial intelligence is likely to automate some of the routine tasks that were previously done by people, affecting the first stage of BPO; growth will still offer employment opportunities across a wide distribution of skills resilient to automation. This may lead to a second phase of BPO, with increasing demand for services that require socio-emotional skills or creativity. The opportunity is great in areas in which human interaction is valued: jobs that

place a premium on traits such as empathy, encouragement, support, patience, understanding, and judgment, both scientific and moral (as is often the case in medical issues). While computers can increasingly take on technical tasks, human attributes will come at a premium, leading to the broadening of the BPO sector to include tasks such as graphic design, writing, and analysis – a trend that is already emerging with online freelancing services such as Upwork or Fiverr.[105] Firms engaging in these more complex services will still need a variety of workers to support them across the skill distribution. Staff with more basic skills may be less in the frontline compared to earlier BPO models (such as call centres), but low-skill workers will still be needed in firms that provide integrated services. An interview with a leading outsourcing company in India suggested likely continuing employment growth for women and men with a diverse set of skills.

Just as manufacturing exports drove some of the most impressive inclusive growth episodes of the 20th century, new technology-enabled service exports have the potential to transform economies in the 21st century. Despite the prominence of manufacturing in development policy, neither current economic theory nor empirical evidence suggests that manufacturing is inherently more likely to drive sustained growth and job creation than other sectors.[106] Employment in urban services has been expanding rapidly, and productivity in services has begun to expand, sometimes rapidly.[107] Twentieth-century manufacturing may have had *characteristics* that drove learning, product sophistication and productivity growth. Twenty-first-century services exhibit many such characteristics (including increasing technology and knowledge spill-overs, greater urban production, and growing formalisation and organisation).[108]

Technology could transform services that previously demanded face-to-face interaction into traded 'virtual' services; this could become a new and significant pathway that contributes to growth in developing countries. Faced with an ageing population in OECD countries, restrictive migration tendencies, and increased returns to human interaction, businesses in richer settings may prefer to invest in affordable remote workers (facilitated through improved technology), rather than more expensive local labour. Hence, broad economic opportunities become possible for developing countries in fields such as engineering, healthcare, or management advisory. Affordable labour in developing countries could provide 'virtual' tradeable services to consumers abroad. An example of this occurred in 2017 when virtual reality technology (Microsoft Hololens) connected three surgeons in London and Mumbai for an operation in London, each 'seeing' the others in a virtual space to discuss the patient's tumour, and offer judgments on treatments. The healthcare system seems likely to offer developing countries greater potential to serve as a destination for outsourcing tasks, including monitoring of and providing social interaction for outpatients and older people.

5.4 Pathway four: Connecting the informal economy

In developing countries, the largest share of the population, including the poorest and most disadvantaged people in society, is engaged in the informal sector. The informal economy comprises a broad set of activities that are largely untaxed, unregulated and unprotected, and the sector is characterised by limited standardisation and a lack of fixed hours. The informal economy comprises many rural workers, smallholder farmers, casual wage labourers, and small-time petty business and workshops. That is, the sector is composed of those groups most often facing economic and social disadvantage. Not counting agriculture (which has particularly high rates of informalisation), the informal economy accounts for more than half of those who work, and its employment share appears to have increased in the last decade across all developing regions except transition economies. Indeed, in Eastern, Central and Western Africa, informal employment accounts for 77, 79 and 87% of non-agriculture employment.[109] Most poor families engage in a multitude of informal activities. In this way, the lives of the poor often take place in an 'invisible' economy of intermittent informal work, with time allocation studies finding periods of intense activity as well as much underemployment.[110] Moreover, people in the informal sector tend to be excluded – physically and functionally – from the opportunities, markets, and products enjoyed by people in the formal sector.

Improved digital technologies are connecting segmented (and often excluded) parts of economies at extremely low costs. Digital platforms provide a low-cost and scalable opportunity to connect people, allowing transactions to take place that otherwise would not be economically viable due to market frictions and segmentation. They are bringing down costs of exchange and matching buyers and sellers – for money, labour, goods and services. Money transfer and digital payment systems such as M-Pesa offer a prime example of what is possible. M-Pesa created a low-cost method of storing and transferring value over the mobile phone network in Kenya, and in the process, lifted 2% of the Kenyan population out of poverty, and allowed 185,000 women to shift their predominant labour force engagement from agriculture to business.[111] While this largely connected the informal sector to itself, such systems have provided the basis for other products, such as loans by TALA or M-Shwari, to be delivered to those in the informal sector. Moreover, evidence suggests that these systems offer resilience to shocks, and help with large household expenditures

such as those for education.[112] Transport platforms such as Rapido in India and GO-JEK in Indonesia provide platforms for connecting often highly segmented low-end taxi hailing services using motorcycles, offering efficiency gains for riders and consumers. GO-JEK has grown to link more than a million riders, and has expanded to include food delivery, courier services, and cashless payments using its e-money service, GO-PAY. These benefits also surface in our analysis of Uber drivers in Mexico, where we find that the platform – while not perfect – almost universally provides a step up for drivers. Not only do they generally earn more, but they are also safer and typically enjoy better conditions than they would working as taxi drivers.[113] In another field of work – online freelancing – Malaysia has embraced this model of connecting poor and informal workers to broader markets with its eRezeki initiative, specifically designed to help poorer people do relatively simple online work.[114]

These technologies perform a potentially valuable role in terms of stimulating growth and inclusion. By offering workers new employment opportunities that extend to previously disconnected households, and by connecting low-productivity segments of the economy to firms with higher efficiency, these platforms provide a means of moving people up the productivity ladder and, thus, to higher incomes. Connecting people to growing formal parts of the economy – across geography and across sectors – may be a highly inclusive way for poorer people to benefit from economic growth. Indeed, while the common objection to 'gig' platforms is that people lose the protection of a formal job, in developing countries these platforms actually lead to greater formalisation: making it easier and cheaper to link workers to social and other protections. Over time this will also broaden a country's tax base, creating potential for greater redistribution and investment for those who remain disconnected. When people and firms join platforms, it also offers a more effective means of formalising the economy through people's own volition, based on the increased benefits workers and firms derive, rather than on commonly used, more coercive methods such as licensing, registration or rules.[115] Of course, formalisation in itself is only as good as the opportunities, government services, and the demand people are connected to. It is important to consider how those newly formalised workers may benefit from social policies, and how they might be taxed as well, to assess the overall costs and benefits for inclusion (Chapter 6).

Discussions about inclusive growth must include consideration of young people. This report describes potential *future pathways* for development, but it is the 'digital natives' themselves – those born in the midst of current technological change – who will walk these pathways. And yet more than 40% of young people in developing country workforces are unemployed or in poverty, and of those with jobs, 95% are in the informal sector.[116] This is where the long-term inclusive growth challenge is most critical; the opportunity for a demographic dividend could be lost, along with a whole generation of young people. Box 3 offers new findings on these young people, their aspirations, and their views concerning available opportunities. Ensuring that the pathways on offer match these aspirations will remain a challenge.

Box 3. **Including the digital natives**

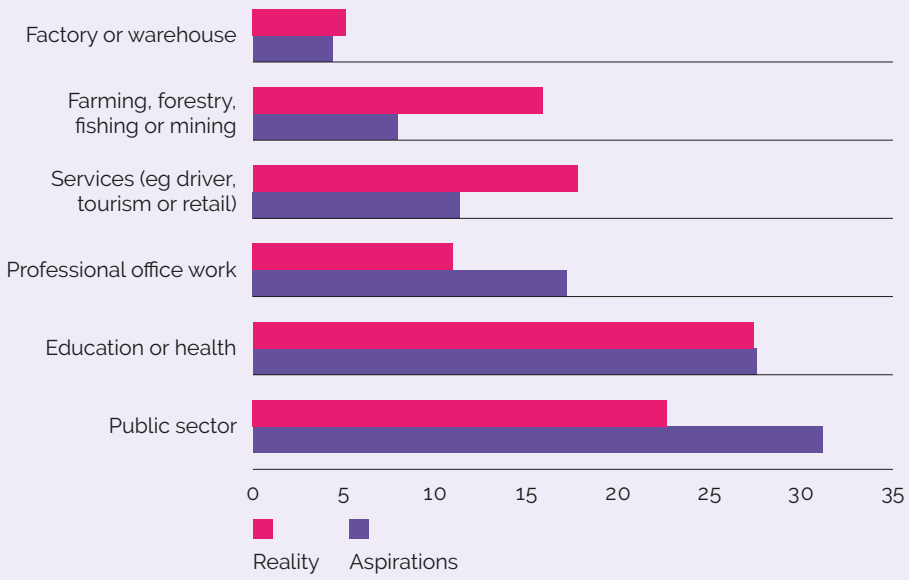
Across the developing world, new generations of people are entering the workforce having never known life without digital technology. To better understand how these 'digital natives' see the issues affecting their economic futures, the Pathways for Prosperity Commission collaborated with U-Report to poll 100,000 young people across the developing world. To gain further insights, the Commission also held face-to-face workshops with young people in Tanzania and Indonesia in July and August 2018.

The results underscore that young people have high ambitions and expectations about their future, but that these goals are not being realised in the workplace. Most young people, around 76%, hope to seek professional work in offices, or careers in education, health, or the public sector (Figure 9). Young people clearly want a pathway to move into more high-skilled sectors such as the public sector and professional services, and out of more traditional sectors.

Nevertheless, a gap exists between expectations and reality. For instance, while 17% hope to have careers doing professional office work, only 11% of young people currently have work in this sector. Most young people remain optimistic: around four out of five expect to achieve their career goal. Of those who think they face barriers, education and lack of informal connections were the biggest reported issues (Figure 10). These findings mirror the priorities highlighted in our youth workshops: participants said that future pathways must be able to solve the mismatch between skills taught in school and those demanded by industry, and to address the unequal distribution of opportunities to young people.

Figure 9. **Young people's jobs do not always match their aspirations**

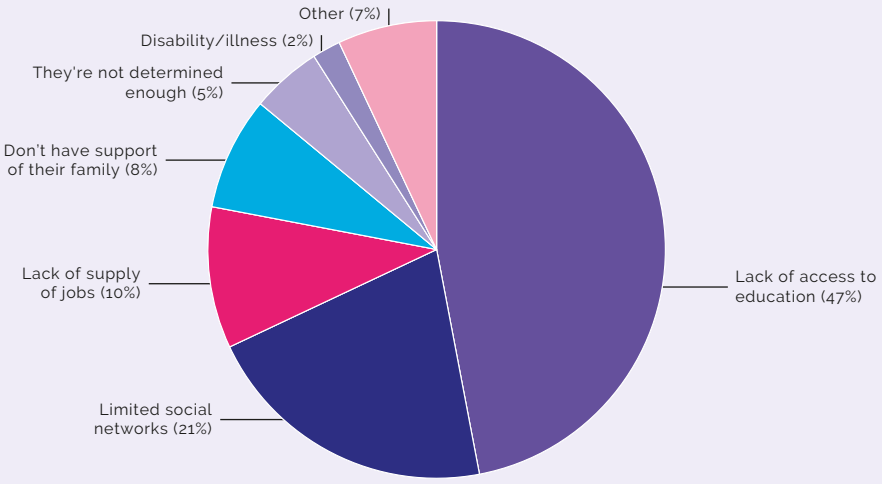
Per cent of respondents who either work in an industry or aspire to work in an industry



Sources: U-Report poll, Pathways Commission analysis.

Figure 10. **Frustrated aspirations are mostly due to lack of education or networks**

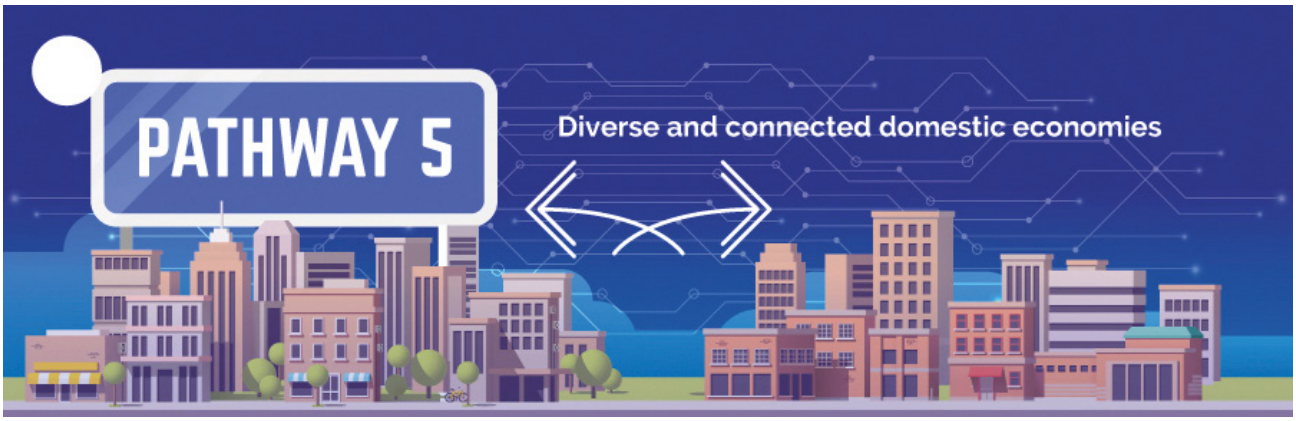
Per cent of respondents stating why they can't get the job of their dreams



Sources: U-Report poll, Pathways Commission analysis.

Note: This data is from a subset of respondents (19% of the total) who said they did not expect to achieve their goals.

5.5 Pathway five: Diverse and connected domestic economies



Perceived wisdom and evidence from recent decades suggest that export-orientation is required to drive growth. There is no doubt that an export-orientated strategy has helped many recent fast growers to move toward the global efficiency frontier, catching up to other countries and driving learning and spill-overs to the rest of the economy. Nonetheless, technology allows for a fundamental re-imagining of opportunities. While countries should embrace export and GVC opportunities where they present themselves, there are also significant opportunities for developing countries to achieve

domestically focused growth, as new technologies offer alternative mechanisms to compensate for some of the advantages from export-orientation. In particular, these technologies offer new ways of increasing the efficiency of allocation within economies, by reducing the costs of exchange and matching, and by offering the chance to learn about global best-practice production without the need to engage in GVCs.

Export-orientation as a growth strategy has long provided one route to closing productivity gaps. While all countries have a mix of highly productive firms and firms that just manage to scrape by, poorer countries tend to have the widest gaps between the best and worst firms.[117] Evidence suggests that these gaps are related to factors such as the vibrancy of entrepreneurship (new entry in markets), competition, and trade and logistics costs.[118] However, even in the poorest countries some firms are as well managed as in the US or other OECD countries. These well-run firms are typically multinationals or exporters. Domestically focused firms have far weaker managerial capability, which is likely to be a source of lower productivity.[119] A further advantage of having an export orientation is the ability to specialise in a product for the global market, particularly when local demand may not sustain such specialisation and associated efficiency. However, many countries have not been able to break through into GVCs of goods and services. Some academics have argued that entry into these chains may become increasingly difficult.[120] They seem to condemn countries to low-growth trajectories based on the domestic economy, as high growth through export-orientation and global economic integration is not possible. While not necessarily subscribing to this view, considering alternatives is possible.

New technology may change the domestic growth opportunities, in ways that can approximate the benefits from export orientation. This pathway does not seek to avoid export orientation by hiding behind tariffs and trade barriers, but rather seeks to take advantage of domestic opportunities. This is relevant for most economies, but especially so for those that may find it hard to break into GVCs. To grow without an export orientation, countries must find other means of creating a vibrant economy of productive, domestically oriented firms. It will have to involve stimulating competition and integration of the domestic economy as a source of growth. Cheaper and higher-quality communications will be able to bring down both the cost of *information exchange in domestic economies*, and the cost of *information access globally* to learn well beyond the country's borders. These lower costs may play a role in removing the 'necessity' of exchanging in global markets to acquire frontier production capabilities,[121] while spurring new local models of innovation.

New technologies can foster competition and overcome some of the inefficiencies of poor infrastructure that make it costly to trade within an economy. Better logistics, communications, and supply-chain management should help overcome basic market failures, connect different and previously unconnected parts of domestic economies, and foster further transmission of efficiency across space and sectors. The advent of mobile phone technologies

has shown what is possible. In Kerala, mobile phones allowed fishermen to determine the most profitable port to sell their fish; by equalising access to information, price variance in the market declined, boats' profits rose by 8%, and consumer prices fell by 4%.[122] In Niger, mobile phones similarly reduced grain price variance for producers and consumers.[123] Digital platforms via the internet moved this to different levels. For example, Trukky is an Indian logistics e-platform aiming to connect independent truckers (of which there are hundreds of thousands) directly to clients, achieving efficiency gains for the truckers and clients, as well as keeping trucking markets competitive. New technologies also offer a route to growth by engendering trust in trade and financial transactions through increasingly secure data management that does not entail costly third-party facilitation.

For smaller economies, this route will still have to involve striving for scale by linking with neighbouring countries, and not hindering trade. While negligible costs of information exchange will allow learning about global production capabilities to become easier without engaging in global markets, for small economies, markets may well be too small to substantially benefit from any reduction in costs of exchange, or to capture spill-overs. Integration with neighbouring economies will play an essential part in creating the incentives that will come from competition in a sizeable market. However, the record of many developing countries is poor in terms of economic integration with neighbouring countries. This is particularly true for those countries that have never managed to break into GVCs. Sub-Saharan Africa, for example, has a history of long delays and costs that hamper cross-border trade, with processing times at borders often many multiples of those in Asian countries involved in GVCs. New technologies, such as e-borders and better logistics management, may help to streamline these costs and delays.[124]

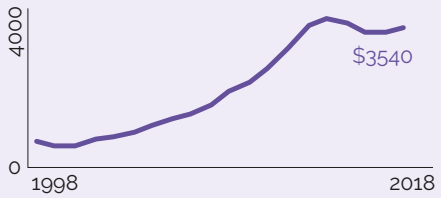
Connecting areas across regions and cities promotes more inclusion as well. A key advantage of this route is that, by focusing on connecting across geographies *within* a country or among neighbouring countries, the local "spill-overs" should be substantial, integrating economies across poorer and richer areas. For example, e-commerce platforms in China such as Tmall.com and JD.com have become available to use even in remote rural villages, and evidence shows that these platforms have led to lower consumer prices and higher wages in these areas.[125] Combining this and other new pathways (such as linking the informal sector into the formal sector, and capturing more value from agriculture), may help to create a more spatially integrated, less segmented and more inclusive economy.

COUNTRY CASE STUDIES: INDONESIA AND TANZANIA[126]

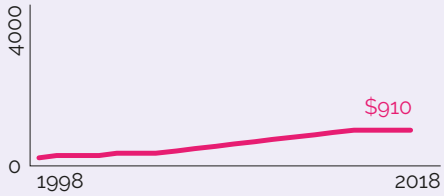
Indonesia has a diverse industrial sector that will face challenges from disruptive technology; at the same time, technology also presents the country with economic opportunities. By comparison, Tanzania has a less diverse economy, and is also less exposed to challenges from automation; but Tanzania needs to act to take full advantage of technology-related opportunities. The Pathways for Prosperity Commission conducted interviews and workshops in each country to understand the ways in which technology is affecting both countries and how this might impact on opportunities for their people.

Indonesia	Tanzania
Characteristics and trajectory	
Indonesia is a lower-middle-income country whose industries consist of a mix of innovative, internationally competitive firms, alongside less innovative, domestic-facing producers that *seem* to be insulated from competition and global chains. With 52% of Indonesians still engaged in agriculture and informal work, the country faces significant challenges in transitioning its workforce into alternative pathways for development beyond manufacturing. Services are growing fast, and opportunities exist for digital co-ordination.	Tanzania is a low-income country whose economy is slowly shifting out of traditional agriculture, but 83% of people still work in the urban informal sector or agriculture. Natural resources and tourism dominate exports. Through new technologies, substantial productivity gains are possible in agriculture and mining. Manufacturing is a small part of the economy, but low labour-cost industries offer growth potential. These particular industries are potentially safe from global automation trends. The informal sector could also benefit from digital co-ordination.

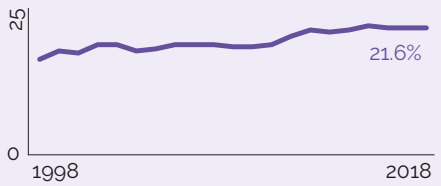
Gross National Income per capita ($US)



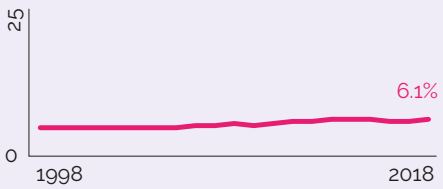
Gross National Income per capita ($US)



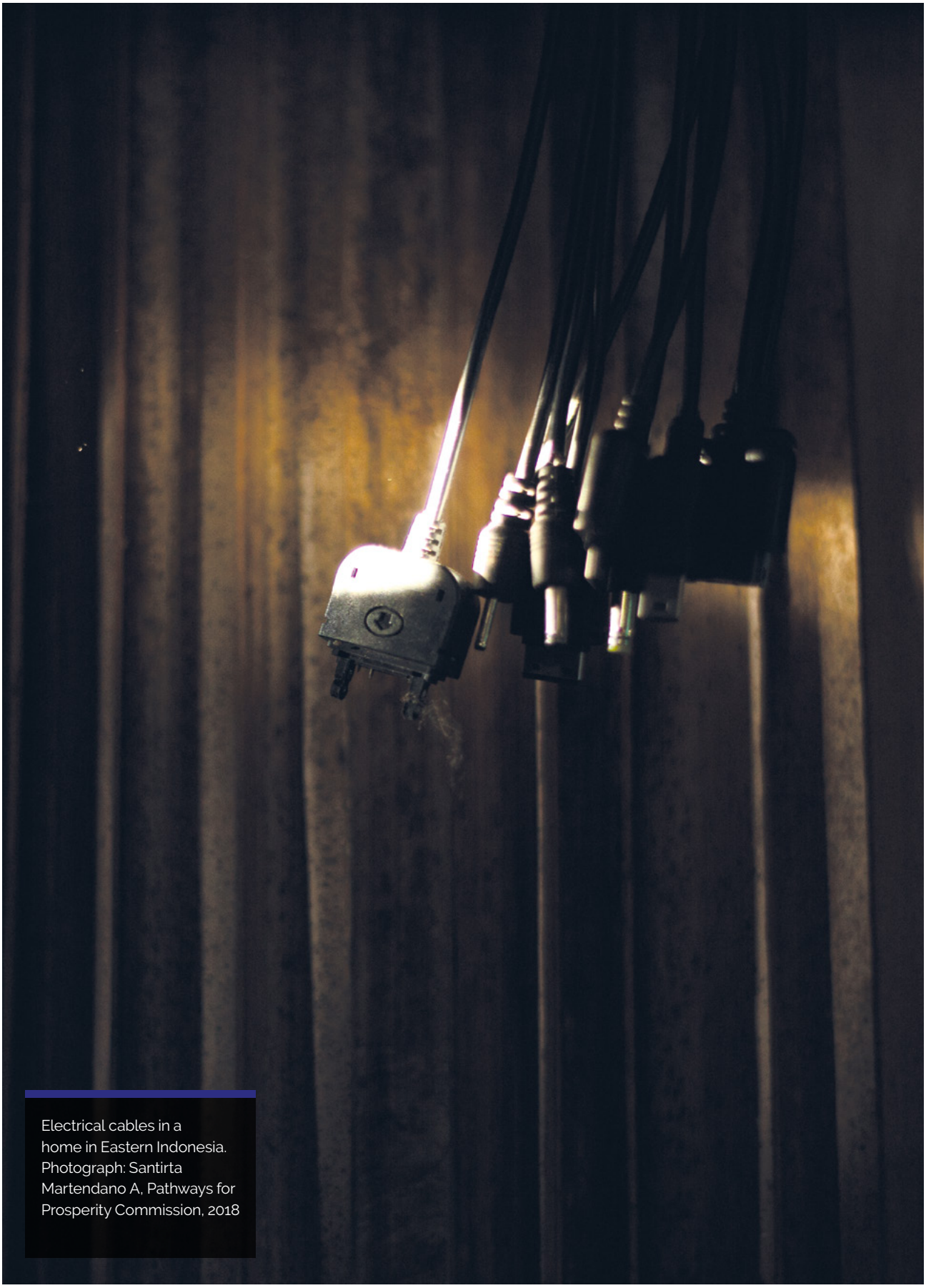
Employment share in industry/manufacturing



Employment share in industry/manufacturing



Indonesia	Tanzania
Challenges to innovation	
• Indonesia should find ways to make setting up a new, innovative business easier • Firms need access to information and advice in order to adapt to changing realities • Digital literacy, infrastructure and human capital are not well distributed across the country	• The bureaucracy required for foreign investment and trade in Tanzania inhibits investment, and hampers the creation of links with GVCs • The education system does not prepare people for work • Establishing a new firm in Tanzania is difficult, as evidenced by the 'missing middle' of mid-sized firms
Indonesia	**Tanzania**
Potential pathways	
• Lay the groundwork to be part of the next-generation GVCs • Integrate domestic and regional economies • Connect the informal and formal economies	• Unleash value from agriculture • Connect the informal and formal economies • Integrate domestic and regional economies
Indonesia	**Tanzania**
Policy and strategy	
Indonesia has a future-looking national industrial policy. The country is willing to use protection, tax, subsidies, state ownership and direct controls to influence the course of industrialisation. Some of these policies create costs and move firms further from being able to adapt to the next GVCs. Other policies actively promote innovation. More active co-ordination may aid particular industries to upgrade in ways that set the stage for future success.	Tanzania's five-year development plan is a 'vision' document. In most ways, Tanzania is less interventionist than Indonesia. Tanzania's plan focuses on manufacturing, even though this sector is not Tanzania's main employer, exporter or source of growth. Across all sectors, Tanzania faces more opportunities than challenges from disruptive technology. Nevertheless, the country needs to act to create an innovation-friendly environment. Its Commission for Science and Technology, which could prove beneficial in helping Tanzania to seize the opportunities presented by new technologies, is at present under-resourced and unfocused.



Electrical cables in a home in Eastern Indonesia. Photograph: Santirta Martendano A, Pathways for Prosperity Commission, 2018

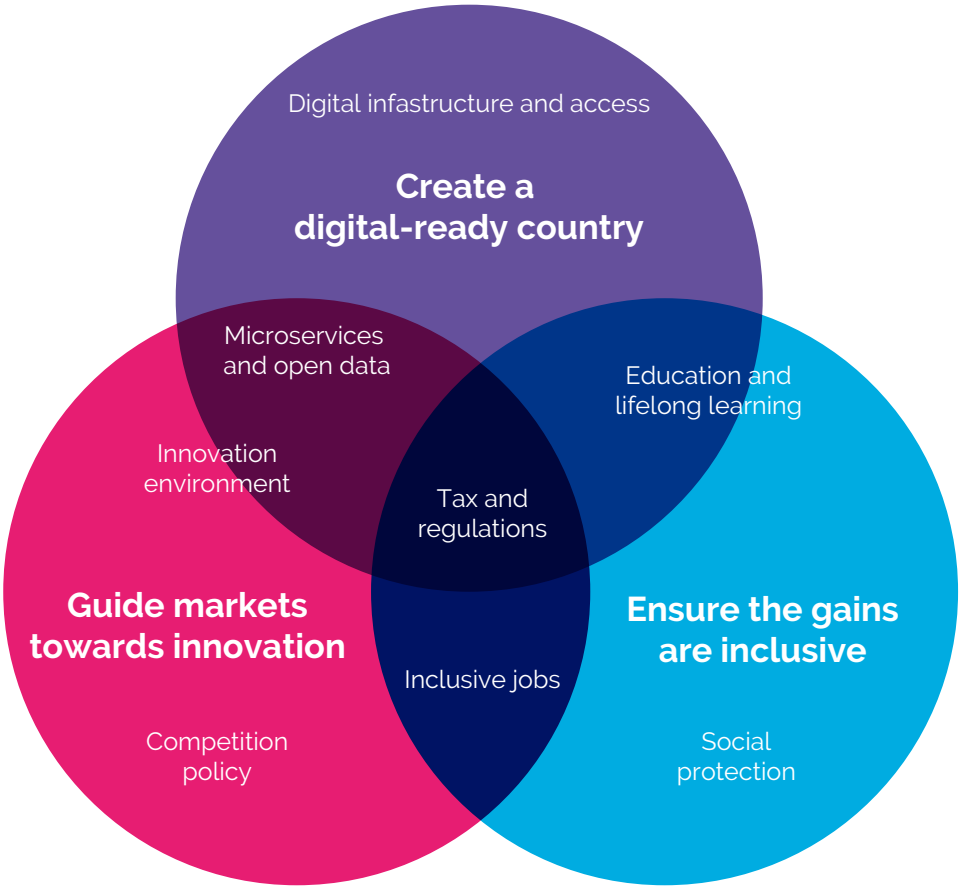
CHAPTER 6
Policies to unlock the pathways

Capturing the opportunities from new technology is possible, but requires appropriate business models and policies. The opportunities described in the previous chapter are real, as well as diverse. There is little reason why all developing countries should not be able to capture at least some of these opportunities. Whether this actually happens depends a great deal on local conditions, as we have seen in our analysis of previous experiences of technological change. Technology alone, no matter how innovative, does not guarantee success. Countries need the right social, political and economic ecosystem for technology to bring jobs and inclusive growth. In the end, the investment choices of businesses, large and small, will determine whether these pathways are realised. However, policymakers, nationally and internationally, have a key role to play to create the conditions that make these investments attractive, productive and conducive to inclusive growth.

Successfully pursuing a technology-enabled pathway to inclusive growth requires the private sector, government, and broader society to work together to design a national ecosystem that: (1) creates a digital-ready country; (2) guides markets towards innovative pathways; and (3) maximises the inclusiveness of new growth models. Here we discuss each of these three areas. National policymakers have considerable agency in this process. Achieving the key elements that underpin a technology-enabled development pathway will require intensive dialogue among business leaders, technologists, politicians and citizens' interests leading to a 'national pact' based on a cross-stakeholder agreement and commitment for action. It will involve choices that will impact on the future structure of the economy, the nature of the jobs created, and the distribution of workers' incomes.

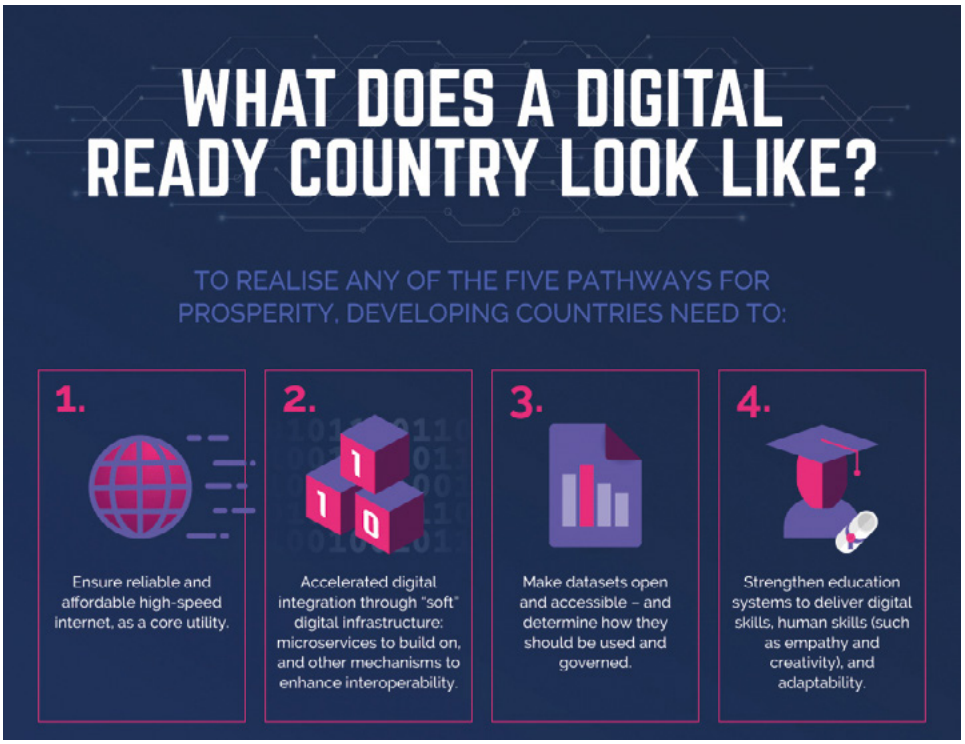
Some of the conditions for this ecosystem are familiar; they are similar to what is required for an investment climate that stimulates growth and job creation more broadly. There is no simple route to prosperity that avoids building the core institutional foundations for inclusive growth: peace and stability, sensible macroeconomic policies, an investment climate that supports private-sector development, and a government and political culture that act in the interest of growth and inclusion, but also do not take on more than they can effectively manage. Many of these basic elements are lacking in some of the countries that are most in need of pathways for prosperity. Let us be clear: there is no substitute for some of the essential ingredients for success. This report takes the importance of these essential elements as a given.

Figure 11. **Policy priorities for inclusive growth**



The *specific* requirements for an ecosystem to support new pathways are not generic. Nor are they simple to achieve. Trade-offs are inevitable as policymakers balance various and sometimes competing interests. There is no obvious blueprint for policymakers to follow that will guarantee success. Change will disrupt incumbent interests, and may have impacts across the income distribution. Digital infrastructure may take resources away from other infrastructure. Tax advantages for innovation in some sectors will affect relative incentives across sectors, and also affect government revenue available for targeting inclusion or education. In the sections that follow we explore the diagnostic and policy tools that could contribute to building a conducive ecosystem. We sketch out the issues and trade-offs that countries must begin to consider as they shape their strategy. Of course, not every policy issue is equally important for every pathway. A country that wants to establish a services export sector must invest heavily in the depth of digital capability; they might focus on industrial parks or specific locations with promising infrastructure arrangements. By contrast, countries that want to unlock the informal sector, connect farmers to value chains, or integrate wider geographies digitally, must focus on access to a breadth of digital capabilities and the entrepreneurship environment.

6.1 Create a digital-ready country



Investing in digital capability – underpinned by both technological and human capacity – offers the most robust strategy for the future. Most, if not all of the growth pathways listed above, depend on using digital technologies to connect people and businesses. For instance, using internet of things technology to remotely manage complex logistical supply chains will require substantial digital investment, which will also facilitate trade in services. The development of tools for precision agriculture, and platform apps for helping informal workers enter into the formal sector, also both rely on digital capabilities. Fostering connected, integrated domestic economies will require building digital capability across the board. In this section we discuss the need for physical digital infrastructure, soft digital infrastructure (basic digital building blocks that can be used in health, e-commerce, mapping, or other digital services), and digitally relevant human capital.

To realise any of the five new pathways for prosperity, countries will have to ensure reliable and affordable high-speed internet as a core utility. Developing countries need to ensure that there is investment in adequate digital infrastructure in order to fully harness digital technologies for social good and economic growth. Almost all pathways assume the ability to move, compute and process information at large scales, whether to optimise supply chains, connect informal workers to buyers, or beam services abroad. Connectivity, both globally and within countries, depends on new infrastructure to ensure high-speed internet as a fundamental enabler. Currently many developing countries lack this basic infrastructure. Just 12% of people in the lowest-income countries recorded having used the internet in 2016, compared to 82% in high-income countries.[127] However, 84% of the global population had some form of 3G coverage, suggesting that the problem is not

purely about infrastructure but also about the business models that sell access.[128] (This issue is discussed in more detail in the Pathways for Prosperity Commission's report *Digital Lives: Meaningful Connections for the Next 3 Billion People*.) Many developing countries are recognising the importance of digital connectivity, and some are financing mega projects to provide nationwide internet coverage. Indonesia is investing in a 13,000 kilometre, Rp 14 trillion (US $950 million) fibre-optic network that will span the central, western, and eastern islands of the country. This 'Palapa Ring Project', which aims to bring broadband to the most remote parts of the country, is funded through a collaboration between the state and private investors. The Brazilian government has launched a 'broadband-for-all' initiative (*'banda larga para todos'*), which includes an R $3 billion (US $720 million) state-owned satellite and a partnership with private firm Viasat, which will build the required infrastructure on the ground to work with the satellite. Tanzania has invested in 10,000 kilometres of fibre-optic cable to create a backbone network connecting all regions and districts within its vast (963,000 square kilometre) geographic reach. Furthermore, this network links to the undersea cable global communication network; and by further linking with the fibre-optic cable networks in other landlocked countries of Uganda, Rwanda, Zambia and Malawi, this investment has helped to bring the whole region into the high-speed and low-cost global communication system.

The new technologies that underpin all five of these pathways require electricity to operate; thus, stable and accessible energy generation will be critical to any pathway. Making full use of the opportunities afforded by new GVCs and by the global trade in services, in particular, will require that countries have robust sources of energy to power energy-intensive activities such as robotic manufacturing, high-speed internet, internet of things monitoring and virtual reality technology. However, whereas energy is a basic constraint on production everywhere, in some areas, it is *the* binding constraint. As a result, these countries need to devote resources and attention towards grid-level energy generation and storage technologies.[129]

Digital innovation can be accelerated through encouraging 'soft' digital infrastructure: microservices which can be built upon and other mechanisms to enhance interoperability. Digital services can be costly and difficult to create. This is part of the reason behind the relative lack of start-ups and new digital products coming out of Africa. Despite year-on-year growth, African enterprises receive a fraction of a per cent of global start-up funding.[130] But the costs of creating a digital service can be reduced and simplified through the use of Application Programming Interfaces (APIs) and 'microservices', which are digital services distilled to their simplest possible parts, and then packaged in a way that other developers can use in their applications. Examples of microservices are identity authentication, route planning, payment processing, and cloud computing and analysis. Each of these components would be prohibitively costly for a small start-up to build itself, so the availability of such microservices can speed up innovation and bring down costs.

How these microservices are being provided matters – and various models can be considered. Private business has conducted much of the innovation in microservices, with businesses selling such services individually. For example, Nigerian start-up Flutterwave enables African developers to embed payment processing into their digital products. Customers of Amazon's Rekognition can use cloud-based machine learning to power object recognition in their own app. WhereIsMyTransport provides data on South African public transport routes, which developers can integrate into other products. Indeed, encouraging firms to compartmentalise each aspect of their product fosters innovation by giving entrepreneurs and developers access to a suite of digital building blocks to plug into new applications.

Where these microservices constitute a critical input (such as map navigation) or the provider has a dominant market position (such as credit reporting in some countries), governments may consider regulating price or service levels. Just as governments might impose regulation for dominant market power in traditional sectors, regulation might be needed regarding new technology sectors. The aim should be to ensure that new technology-oriented microservices are accessible for further use, innovation, and integration within a broader ecosystem of digital services. In the financial services sector, third-party developers and aggregators have played a critical role – in some cases with encouragement from regulators – by linking financial service providers, payment platforms and service providers such as utilities and government services (for example, in East Africa).[131] Some have focused on democratising this interoperability through creating open-source software – as in the case of payments platform mojaloop.io. Such open-source software represents an often-understated component of the digital services ecosystem; many critical digital services depend on open-source foundations.[132] Probably the most ambitious form of government engaging in providing microservices is in India. Building on the AAdhaar biometric identification system, the Indian government allows businesses to connect directly to its Aadhaar database to verify user identity; at present more than 1.2 billion people out of India's 1.3 billion citizens are connected, offering scope for more people than ever to participate formally in the economic (as well as political) life of the country. This has now been extended to a suite of microservices in the form of the IndiaStack collection of six civil APIs (see Box 4).

Box 4. **IndiaStack**

In 2015, India created a policy on open Application Programming Interfaces (APIs). Subsequently, in partnership with the non-profit think tank iSPIRT, the government developed IndiaStack, a repository of open APIs that organisations and individuals can use to build or improve their applications by accessing data and infrastructure owned by government institutions and others. Using these APIs, developers can incorporate functions such as digital user authentication, digital signatures and payments processing into their applications.

Many of these services are based on biometric and identity data collected under the direction of the Unique Identification Authority of India (UIDAI), a special-purpose government institution. However, the Stack also links together features which extend beyond this identity data. Through the National Payments Corporation of India, it also includes the financial data and infrastructure of members of the country's largest retail banks. While the data and functions of each API in the Stack are owned by a separate organisation, iSPIRT facilitated bringing them all onto a single platform with resources for developers. iSPIRIT also manages the project's website, IndiaStack.org, and oversees communication with the developer community that engages with the Stack.

Using this infrastructure, businesses and digital service providers can build completely new products. For example, now that the majority of their customers' identity and demographic information is stored by the government, the payments service PayTM has begun using the Stack to conduct all identity and address verification.[133] EasyGov uses the Stack to assist more than 10,000 Indians to search and apply for social welfare services.[134] Users can choose to use their identification (Aadhaar) numbers to sign up to the service.[135] Users are required to enter a one-time PIN for authentication. As more than 1.2 billion of India's total 1.3 billion population has now been registered for Aadhaar, the system offers a foundation for an inclusive digital infrastructure, reducing the risks excluding traditionally marginalised groups (although its rapid and mandatory rollout has not been without critics).[136]

Countries need to consider how to use, govern and protect the data that pump through these digital pipes. Data is highly versatile and can create significant value, so this is about making sure that it is put to good use in a way that still respects people's privacy. Efforts to make government data more openly accessible (such as the Open Data Institute) are relatively young: nine out of ten government datasets are not open.[137] Extending efforts to open government data represents a fundamental step to foster innovation. But, private data becomes a different game entirely. Often, they are closely guarded by firms with good economic reason: data has become a key input in the business models of many digital companies. These data provide the fuel for the algorithms that drive returns, whether from efficient goods delivery, matching drivers, or targeting advertising. The creation of markets and systems for data use would boost innovation beyond the boundaries of a single firm (just as Uber sells access to its traffic data).[138] The person with an innovative idea for a product may not be the same person who has access to the data to make the product a reality.

At the same time, the matter of who owns the data is a hotly debated. Do the datasets belong to the individuals who are the sources of the data, or the businesses that collect these data? Or by contrast are these data a public good? Radically varying proposals are emerging for new data market principles.[139] In India, some developers interviewed are producing protocols to make data a saleable commodity. But there are many reasons that a well-functioning data market may not emerge: two such issues are the gains that come from monopoly ownership over a sizeable dataset (many algorithms become more valuable the more data are used) and the 'non-rival' nature of data (once used, it can be used again freely, making it difficult to set a price). Some have also floated the idea that governments could mandate firms above a certain size to make data available to independent public-interest researchers via a secure interface to allow the data to be mined for public benefit.[140] For developing countries, the evolution of data governance in richer economies has implications that will need to be addressed, as shown by the EU's Global Data Protection Regulation (GDPR) which has created a de facto global standard in some instances. There are no easy answers as to what is right or best, but no country can afford to ignore data governance issues.

Countries should focus on the supreme currency in the digital age: people and their skills. This report argues that a narrow focus on the labour-saving aspect from emerging technologies is misleading, and that new pathways with new sources of job creation are possible in this age of technological change. Nevertheless, emerging labour-saving technology will encroach further into routine tasks across the skills distribution, so a digital economy will need different skills. Economies will need people with skills that *complement* these technologies to allow new pathways to emerge. Two types of skills are necessary for the digital age: digital skills and digital-complementary skills that will offer further returns.

1. **People will require digital skills. Each society will need to have a sufficiently large group with advanced digital knowledge and engineering skills.** Indeed, some pathways will require more emphasis on these technical skills. For example, the next version of GVCs in manufacturing will require technical workers trained to operate complex computer-aided manufacturing tools. Governments supporting the emergence of a digital economy will also need far more skills, to take decisions and actions that allow economies to take advantage of the new opportunities. India, which has been leading in taking advantage of digital opportunities (including in global services exports, as well as initiatives on digital microservices such as IndiaStack), has about 1.5 million engineering graduates per year. This means that every eight years, the number of engineers added is the equivalent of 1% of the total population. The software industry recruits about 300,000 of these engineers annually.[141] For the broader workforce, digital literacy will be required. Growing access to the internet no doubt makes a fast difference in basic digital skills. But, in many developing countries, such as Zimbabwe and Sudan, less than 5% of the adult population can perform basic or medium-level digital tasks such as copying and pasting files.[142]

2. **The automation of many routine tasks will increase the returns to *other complementary human skills*.** For example, industries will require more workers with soft skills, such as empathy or clear communication, for a pathway that seeks to exploit global trade in services, such as personal counselling or business consulting. In fact, in any sector, those skills that cannot easily be automated or codified will increasingly be in demand. Our analysis suggests that certain mainstay skills will offer critical advantages in the future. These include digital literacy, socio-emotional interpersonal skills, and 'hard' cognitive skills that are difficult to computerise, such as language comprehension rather than mathematical calculation.[143] This is a challenge not to be underestimated, at a time when current education systems in many developing countries are struggling to provide even the most basic skills,[144] let alone to provide the skills for the future. At the same time, educational systems have hardly changed since the dawn of the Industrial Revolution in the 18th century. They will need to adjust. The fast pace of technological change also offers new opportunities for education systems in need of transformation. In its next phase of work, the Pathways for Prosperity Commission will further explore this key issue.

6.2 Guide markets towards innovation

To foster these different new pathways for prosperity, an innovation ecosystem will need to emerge. Delivering the potential of these pathways for inclusive growth will require business and government to do things differently. Policy paralysis will at best slow progress, and at worst lead to greater social and economic exclusion of already marginalised groups. To capitalise on these new pathways, incumbent and new investors will also need to change business models, and embrace new technological opportunities. Expanding value chains in agriculture will require logistics models that will disrupt existing transport or aggregation models; the resulting overhaul of transportation, or the entry of new players have the potential to make existing firms obsolete. Efficiently connecting informal sector labour to opportunities will require entrepreneurs who can turn local knowledge into profitable businesses. In short, whether involving existing firms, large or small, or new entrepreneurs, all this will require investments: fostering entrepreneurial talent, new skills and capabilities; establishing new funding sources for research and development and scaling; creating an attractive investment climate; and having appropriate regulation.[145] The experiences of others can offer lessons, but simply emulating success is difficult. These are highly demanding tasks for all those involved, and especially for government, which will need to be a key actor.

It is important to encourage and support businesses and entrepreneurs to be innovators. Ultimately, for many of the pathways to succeed, developing countries need firms and individuals willing to take risks on new technologies. There is no substitute for private sector firms acting as agents of change, stimulating economies and societies with the introduction of new ideas

in the market.[146] Stand-alone, siloed policies around job creation are unlikely to be enough to guarantee innovation. Instead, governments can seek to foster a broader enabling environment through a combination of integrated programmes, changing social attitudes, effective universities (including research and development), peer support networks, and finance and investment providers, all working together to create conditions essential to innovation-led economic growth.[147] Such efforts by policymakers to address these issues include Singapore's SME21 initiative. At the turn of the millennium, Singapore's government introduced the SME21 programme, aimed at stimulating local business efforts via policies focused on strengthening innovation institutions through financing growth, facilitating market access, accelerating e-commerce, and strengthening local talent with grants and innovation programmes. Singapore's total entrepreneurial activity ranking, as measured by the Global Entrepreneurship monitor, rose from 17th to 8th in the five-year period after the programme's implementation.[148]

Innovators need access to a full life cycle of funding – from seed funding, to early stage venture capital, to public offering – that is also innovative in its approach. Governments can help to encourage this. This is definitely one of the lessons from Israel's success as a 'start-up nation'.[149] Ranked consistently as one of the top ten most innovative countries in the world, Israel owes much of its success to policies such as 'Yozma'. Implemented in 1993, the government-backed 'matching' initiative offered to double any international investment made in the country's domestic private-sector firms. As a result, it kept 'sector-neutrality' in terms of which initiatives to pick – avoiding the strategy of trying to 'pick winners', a classic potential source of failure of industrial policy. The matching programme kick-started international investment in the region, in spite of the significant investment risks faced by global funders. Today, research and development centres are widespread across the country. Israel offers a successful example of the service export pathway put forward in this report; it now has a combination of multinational technology companies such as IBM, Facebook and Google, as well as thousands of domestic firms that service global technology markets.[150] Elsewhere, demand-side-led innovation also offers success stories. For example, Brazil's national agricultural research institution EMBRAPA partnered with agricultural producers to develop processing technology aimed at improving the quality and output of its produce. In the cashew sector, and with funding supporting on-site processing technology development, local farmers were empowered to develop enhanced production technologies. This was successful, enabling the sector to enter global markets with sufficient volume and quality control.[151]

Balancing the regulatory burden on entrepreneurs is crucial to encouraging innovation. At the outset, this does not mean policymakers should always avoid regulating new technologies (or repeal regulations). Indeed, regulation is crucial; but regulating for areas in which change is fast and unpredictable may be stifling. The East African approach to fintech may offer relevant lessons.[152] In Kenya, for example, Safaricom's M-Pesa emerged thanks in part to regulatory provisions that treated the nascent company differently from incumbent

deposit-holding banks. In Tanzania, the private sector and regulators worked together to allow the emergence of a relatively competitive ecosystem with appropriate regulation. Across the region, this willingness to engage in nuance meant that regulators did not simply select the closest existing regulatory package (banking regulation) and apply it to a new and different product (mobile money transfers). More in general, this concept could be extended to other areas by providing start-ups the opportunity to operate under looser regulatory requirements – the minimum viable regulations – until they reach a certain size.[153] Co-operation between the private sector and regulators, acting in the interest of both growth through innovation and consumer protection, also provides a model for use elsewhere.

A dynamic and diversified economy requires an effective competition policy, particularly during times of structural change. Many of the new pathways for inclusive growth require making space for new entrants and allowing productive firms to thrive. Creating economic vitality means building in flexibility for needed changes, such as replacing less technologically advanced manufacturers, or allowing new entrants in domestic value chains, for example. During periods of structural change, pressures to protect incumbents may be particularly problematic. Dialogue with the private sector may be particularly difficult here, too; firms that have yet to be created (or are in a very nascent stage) cannot participate in such discussions.

The standard competition policy toolkit is strained by the nature of emerging technology firms.[154] Appropriate competition policy has become even harder to create with the emergence of digital services firms with zero marginal costs of expansion, leading to economies of scale and the scope for concentration of power and monopoly rents. Furthermore, the common business model of multi-sided markets (such as for social media platforms or for search engines, where revenue comes from advertisers and services are free for consumers) may be open to predatory and, therefore, uncompetitive behaviour as part of a quest for market power.[155] Such behaviour would constrain entry, and then incumbent power would impact on innovation and the future growth potential of economies. Still, blanket approaches using the standard competition indicators such as market share may mislead here given the nature of digital services. Better approaches to competition policy are based on the principles of promoting pro-inclusion, pro-consumer innovation; such approaches focus more on whether entry into markets is possible, and less on market shares. In any case, given the role and nature of digital services in future potential pathways, countries will not be able to go *without* competition policy in this space. Building capacity in terms of understanding digital services markets will be an important part of the process. Box 5 offers ideas for competition policy for the digital economy.

Box 5. **Ideas for better competition policy**

Some commentators suggest that policies should move away from a framework based on prices and consumer choice, and towards a framework that defines anti-competitive behaviour as that which stifles innovation and prevents the emergence of a superior product.[156]

This shift would disallow 'predatory innovation', such as anti-fragmentation innovations introduced by Google that reduced interoperability by imposing restrictions on Android device manufacturers and mobile network operators.[157] Using a new definition of anti-competitiveness, authorities might assess acquisitions based not on a price effect, but rather on whether acquisitions are designed to create synergies or eliminate rivals.

Other commentators suggest that the currently dominant model of competition assessment (based on analysing outcomes on price and consumer choice) is outdated, and that we need to move to proactive norms and standards that active promote pro-competitive behaviour.[158] Perhaps the best example of this idea is the principle of mandated interoperability, which has long been common in telecommunications markets. A more recent example is the EU's recently-legislated Payment Services Directive 2 (PSD2, which came into force in January 2018), requiring open and interoperable banking standards which force banks to create microservice APIs for third-party fintech apps (eg payment processing, account balance checking).[159] This requirement effectively breaks the banks' monopoly on financial customer services. Kenya has taken a similar move recently, forcing interoperability on mobile money providers.[160] Regardless of the eventual approach they take, countries must soon engage with their business communities to develop effective competition law that is rooted in economic reality and capable of keeping pace with technological developments.

Digital services and other emerging technologies should not simply be exempt from taxation – this might boost some innovation but would be counterproductive. Taxation should instead balance fairness, efficiency and incentives for innovation. Governments require taxation, not least to manage the downsides of disruption. Growth from innovative pathways, just as all economic growth sources, should also be taxed. At the same time, taxation should be fair, and should consider the potential dampening impacts on innovation and market growth. A tax on services is unlikely to be efficient if it is introduced because it seems relatively easy to assess and collect. Examples include transactions taxes on social media, and taxes on informal motorbike taxi-drivers registering on new sharing platforms. There are also well-known challenges related to taxing digital services in particular, given the mobility of intellectual capital, intangible assets and data. Profit-based taxes may be harder to levy at levels commensurate to activity in such circumstances (as firms may 'book' their profit in any number of different jurisdictions), and transactions taxes (such as value-added taxes or other indirect taxation) may end up being preferred. As Box 6 shows, many developing countries are trying to bring taxation of digital services into the picture in various ways. In any case, the issue of taxation of digital and other innovative services requires careful analysis to achieve the aims of imposing

reasonable taxation that neither stifles the early profitability of innovative activities, nor negatively affects inclusion.

Box 6. **Designing taxes for new technology**

Most developing countries are keen to find new ways of increasing revenues in general. Raising taxes from the digital activities is no exception. It is also very tempting: by their digital nature, transactions could, in principle, be quite easily monitored and recorded, so a tax could be cheaply and easily collected. Some fear that taxes such as a transactions tax on social media (as was begun recently in Uganda, for example) may be pursued simply because it seems easy to levy – not always the best guide to tax design. Nevertheless, there is a legitimate case to think about taxing digital services, provided that such taxes do not bias incentives against innovation, inclusion and expansion. The mobility of intellectual capital, and the intangible assets and data that are characteristics of digital services add further complexity in raising taxes from profits in specific localities: firms might often store their data and register their intellectual property in another jurisdiction. Government revenues may be challenged, including by companies locating even more of these assets in low- or zero-tax jurisdictions, thus allowing for base erosion through transfer prices.[161]

Many countries around the world have already begun to reform their digital services tax policies in ways that acknowledge these problems. For example, Colombia,[162] Bangladesh,[163] Tanzania,[164] and South Africa[165] are among the many countries that are considering or have already begun putting a value-added tax on cross-border digital services such as the provision of music and film content, web-hosting and internet-based auction services provided by foreign entities. In 2016, the Indian national government introduced an 'equalisation levy' of 6% on payments for online advertising services to foreign companies that do not have a physical presence in India.[166] The tax is estimated to have generated between Rs 560 crore (US $78 million) and Rs 590 crore (US $82 million) in the 2017–18 fiscal year.[167] Given the increasing importance and value of data, countries may also consider implementing a tax on the value of data collected from their citizens. 'Data tax' advocates, such as Facebook co-founder Chris Hughes[168] and University of Oxford professor Viktor Mayer-Schönberger,[169] argue that, because the data that some companies use are a collectively generated resource, the benefits from its use should go to everyone rather than to a handful of companies making enormous profits. They suggest a moderate tax of 1% to 5% on the revenues of companies using 'meaningful amounts of information and data about people to build their businesses'.[170]

6.3 Maximise the inclusiveness of new pathways

All of the new pathways for prosperity identified in Chapter 5 hold potential for inclusive growth, but new large-scale job creation for the poor cannot simply be taken for granted. Change will almost certainly still be disruptive. Laying the foundations for a successful digital economy, and securing the investment and innovation needed to turn the opportunities into actual pathways is hard enough; yet, even accomplishing these key tasks does not guarantee that any subsequent growth will spur the large-scale inclusive job creation needed in so many settings quickly. For example, widespread job creation driven by further growth in manufacturing is likely to depend on the extent to which linkages to the service sector and other parts of the economy can be fostered (as manufacturing itself may become less labour-intensive). New global services value chains may offer huge opportunities, but their impact on jobs and inclusion will depend on the type of investment developing countries can attract, and the types of jobs they create (is there only work for high-skill professional services, or for all people?).

Making growth inclusive through jobs is not a simple task; nonetheless effort can and should be directed into tackling some of the usual challenges. Some of the common factors for making growth inclusive also apply to the challenges posed by technological change. For example, inclusive growth will benefit from quality infrastructure investment that connects poorer geographies, and from capitalising on the job-creating potential of foreign direct investment by making deliberate efforts to foster linkages to the domestic economy. The most 'pro-poor' of the pathways are likely to be those that focus on boosting agricultural value chains or connecting the informal sector with formal job opportunities. These pathways offer the most opportunities for the vast majority of the poor population who depend on agriculture or informal sector work in developing countries. As the experience with earlier waves of industrialisation (eg garments) or export of services (eg BPO) illustrate, business models matter crucially for whether these jobs will be empowering for women, or will be closed off, with further consequences for inclusion.

Inclusion must encompass more than just getting people into jobs; it also requires giving people access to better public services and support to make sure they can take advantage of opportunities from emerging pathways. Ensuring that growing numbers of people in poverty enjoy basic health and education remains a key route to ensure that poorer people benefit from growth. Providing these basic social services – many of which are being made cheaper and more accessible with new technologies – will do more than simply spread the gains. These services also ensure that people in poverty are in a better position to join the workforce, benefit from emerging opportunities, and contribute to their economies and societies. None of this is new, but it also cannot be ignored either by government or business leaders concerned with stimulating pathways for prosperity in their nations. Policy decisions as well as business models will shape whether any emerging growth will be inclusive and offer new jobs and livelihoods.

Education was raised previously as a requirement to create a digital-ready country; it is also important to focus on resilient and transferable skills – not just in order to capture the benefits of the digital age, but also in order to ensure that citizens can cope with disruption. A period of rapid technological change needs a workforce that has the skills to handle and adjust to disruption. None of us can predict with accuracy which pathways would open or close for particular countries. Thus, effective workforce preparation requires giving people skills that are resilient to change. The prospect of disruptive change may well reduce the value of narrow vocational training, which focuses on the gaps of today and prepares a person for a specific long-term path. Instead, adaptive skills required for lifelong learning will be at a premium, both to take advantage of change, and to be resilient to it. This distinction – between narrowly focused training and change-oriented education – may well be a key determinant in the success or failure of efforts to make future pathways for prosperity inclusive. It will be in the interest of both business and policymakers to lay the foundation of a successful workforce of the future.

Social protection will play an important role both in supporting those affected by disruption and in contributing to the inclusiveness of growth. Given the large levels of self-employment in developing countries and the disruption on the horizon, the principle of emphasising the protection of the individual, rather than the job itself, is of growing significance. This worker-oriented concept underpins the increasing use of targeted cash transfer programmes in many developing countries. The growth in the popularity of such programmes reflects their high rates of return, and the reduced implementation costs made possible by digital technologies. Moreover, by assisting those experiencing disruption, governments can cushion the social shocks of technological change, building political support for growth-enhancing technologies, and raising the likelihood that the change from a new growth pathway will be accepted.

Debate should continue over how to best design, fund and target these transfer programmes. Funding proposals include specific robot taxes, taxes on the productivity *advantage* that new technologies have over workers, and general profit taxation that treats robot-related profits like profits from other capital. Each has different measurement problems, different risks of avoidance, and different incentive effects on innovation. The matter of how to designate who receives such transfers is also for debate. Transfers could be means-tested or simply universal, as the widely discussed Universal Basic Income.[171] Targeted transfers ought to be most affordable for governments. However, during periods of high disruption, targeting may exclude many vulnerable people, not captured by the rules. Although it may be more costly, Universal Basic Income runs no risks of exclusion.[172] As with most other policy areas, countries will need to find a solution that best fits their specific needs, is affordable and has most political and social support. Nevertheless, a well-functioning social protection system will be required to provide the conditions for innovation, and to avoid potential political backlash when firms try to adopt growth-enhancing new technologies that disrupt labour markets.

Ultimately, the inclusiveness of new pathways will depend on how policymakers, businesses and communities respond to disruption and to new opportunities. All pathways presented in Chapter 5 will create opportunities through a disruptive shift in labour demand. All pathways will inevitably leave some people behind. Some pathways are more capital-intensive; others are more labour-intensive. Thus, each presents a different balance of opportunities for financiers and labourers. No pathway will achieve its potential to reduce poverty without concerted effort to maximise the inclusiveness of a more productive economy. Indeed, this remains our strongest message on inclusion: *do not view technology as a jobs killer; instead focus on smooth, fast transitions to new and better-quality jobs and livelihoods that can emerge from new pathways.*

Children walk along a pathway to school, Udaipur, Rajasthan, India. Photograph: Ishan Tankha, Pathways for Prosperity Commission, 2018

CHAPTER 7
Towards national and international action

Responding positively to technological change requires first vision, purpose and strategy. Once these are achieved, a mix of all the more granular investments and policies set out in this report is needed. This report does not provide a single blueprint or the perfect policy mix; every country is different, and every country will need a different, tailored approach. However, though countries' situations are different, one theme emerges as a constant: new technologies will create winners and losers. The same is true of government policies and private-sector business decisions. Unless all parts of a country work together to balance these trade-offs, charting a course towards shared prosperity will be incredibly difficult. Chapter 5 provides potential pathways for economic development that, in our estimation, offer good prospects for inclusive and shared growth. Chapter 6 offers a brief analysis of the policy settings and levers that are most in need of adjustment and tuning in order to pursue one of these pathways. Indeed, some of these policy priorities are in tension with each other: pro-competitive regulation can stifle (some) investments; public education will be funded by taxes, but they partly need to be raised from business. The solution, we argue, is to co-design a 'national pact' or joint strategy between government, the private sector, and civil society.

The topics outlined in this report can help developing countries unlock new growth pathways; nevertheless, developing countries should not face this challenge alone. The international community can, and should, contribute in concrete ways:

1. First, many of the pathways rely on a deepening of globalisation to a greater or lesser extent, and in different ways. Allowing trade and investment flows is a fundamental prerequisite for development; whether it is exporting services online or letting international firms bring investments in new technology. The international community should continue to stand for a rule-based international trading system, maintaining the openness, predictability, and order required for developing countries to take advantage of new pathways.

2. Developing countries that have a clear and feasible national strategy to navigate technological upheaval should be a priority for international support. Developing countries may have a clear plan designed between industry and government. They may also have the institutions required to execute it. At the same time, they may suffer from basic resource constraints that prevent

investment and implementation. Donor agencies should look for opportunities to support countries embarking on these growth pathways.

3. Many decisions made by the international community will clearly affect how countries are able to pursue these growth pathways; some issues can only be resolved at international levels. Most of the pathways and policies depend on frameworks around intellectual property, cross-border taxation and accounting, regional trade, and competition. The digital information age and the technological advancements in transportation and logistics reduce the importance of geography, and lead to more and more interactions across borders. At the same time, we are seeing the rise of global mega-corporations with clout to rival nation states. In some areas, international co-ordination offers the only way to fully grasp the opportunities from technological advances, and to avoid a 'race to the bottom'. Developing countries will require a keen understanding of what they need from international frameworks to support their domestic policy efforts. The time is ripe for concerted international co-operation.

National policymakers, businesses and citizens in developing countries have real agency over how technological progress will impact on their economies and their societies. They must act now, domestically and internationally, to chart a course for inclusive growth in a digital age.

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Endnotes

1 Frey and Osborne (2017).

2 World Bank (2016), International Labour Organization (2017),

3 For an in-depth discussion of the methodology and its flaws, see Lippolis (2018).

4 Aspin and Chapman (1964). The spinning jenny is a machine for spinning with more than one spindle at a time, patented by James Hargreaves in 1770, and was one of the key developments in the industrialisation of weaving during the early Industrial Revolution.

5 By 1990 trade and communication costs had fallen to 5% or less of their post-Second World War levels (Baldwin, 2016).

6 GSMA Intelligence (2017).

7 Allen (2009)., Baldwin (2016) and Pathways Analysis discussed in Chapter 4.

8 For an exploration of these linkages in the US, see Autor, D. and Salomons, A. (2018).

9 Bessen (2015), Banga and te Velde (2018a).

10 See Allen (2017, 2009), Voth (2003), and Feinstein (1998) for declining conditions and Lindert (2000) for the incomes of the top 5%.

11 For discussion, see for example, Rodrik (2018a), Stiglitz (2018) or Milanovic (2016).

12 See for example, Nayak and Padhye (2017). Banga and te Velde (2018a) suggest similarly that robots will not be competitive in Africa for some decades.

13 Inclusion is not just about getting people into jobs. Although job creation must be a key focus, inclusive growth also requires directly supporting people to make sure they can take advantage of employment opportunities. For example, ensuring that growing numbers of people in poverty enjoy basic health and education remains a key route to ensure poorer people benefit from growth. Technology can play an important role in service delivery, too, but this is not the focus of this report.

14 Comin and Mestieri (2018).

15 For discussion on the debates on the effects of globalisation see Rodrik (2018a) or Stiglitz (2018). On the rise of inequality see Picketty (2014), Bourguignon (2016) or Milanovic (2016). For a critique see Ravallion (2018).

16 Allen (2004).

17 GSMA Intelligence (2018).

18 Comin and Mestieri (2018).

19 Wetterstrand (2018).

20 Haitz and Tsao (2011).

21 Kish (2002).

22 Lundstrom (2003).

23 See Rodrik (2018b), Malherbe (2018) and Gollin (2018). The importance of trade costs has recently been highlighted again in research by Donaldson (2018), Donaldson and Hornbeck (2016), and Atkin and Donaldson (2015).

24 Glaeser (2010) and Krugman (2009). See also Baldwin (2016) and Malherbe (2018).

25 Frey and Osborne (2017).

26 OECD (2018a).

27 Frey and Osborne (2017).

28 World Bank (2016) and International Labour Organization (2017a).

29 McKinsey Global Institute (2017).

30 African Development Bank (2017).

31 For an in-depth discussion of the methodology and its flaws, see Lippolis (2018).

32 Frey and Osborne (2017:268).

33 Autor and Salomons (2018) and Autor (2015).

34 Autor (2015).

35 Harford (2018).

36 Furman and Seamans (2018).

37 Autor and Salomons (2018).

38 This extends analysis by Furman and Seamans (2018).

39 Baldwin (2016).

40 Aspin and Chapman (1964).

41 Allen (2009).

42 Baldwin (2016).

43 The Manufacturer (2018).

44 This analysis which, at best, offers suggestive findings that illustrate likely trends uses the following assumptions and data: data for US furniture wages and operations costs of robots come from Sirkin et al (2015). Kenyan wages are hourly US$ calculated as total annual compensation per employee in the furniture sector (from the Kenya National Bureau of Statistics (2016)), divided by 2,000 hours; annual nominal wage growth in the furniture sector from 2012 to 2016 was 7.5% per year. Kenyan operating costs of robots were assumed to be 20% higher due to higher capital costs and energy costs. Labour productivity increases in Kenya were estimated to be 1.7% per year.

45 Nayak and Padhye (2017).

46 Banga and te Velde (2018a).

47 Comin and Mestieri (2018).

48 In the data from Comin and Mestieri (2018). They use "Western countries" as their developed-country group, defined as: Austria, Belgium, Denmark, Finland, France, Germany, Italy, the Netherlands, Norway, Sweden, Switzerland, UK, Japan, Australia, New Zealand, Canada, and the US.

49 Allen (2009) and Gollin (2010).

50 Wiggins and Keats (2014).

51 Zhang et al. (2013).

52 It would be wrong to attribute all this success to Bangladesh's entry into garment GVCs, even if this entry no doubt played a crucial role. Complementary factors, such as sound macroeconomic policies, strong political will of leading elites, and a close collaboration in health and other social policies with local NGOs, most notably BRAC, mattered a great deal. For a recent further discussion of other factors in its success, see Hossain (2017).

53 The analysis was largely confined to the domestic impacts of growth engines in fast-growing economies, such as East Asian countries in recent times. However, one can argue that these high growth rates had further positive impacts also on other developing countries. In particular, cheaper and newer consumer and capital goods from this growth boom helped drive improvements in living standards throughout the world; helped reduce the cost of investment in other sectors; and ushered in the commodity boom (beneficial to commodity exporters) that lasted nearly two decades as the demand for commodities as inputs was pulled up by this manufacturing boom (Gollin 2018; Rodrik 2018a).

54 In the last 15 years, the 'foreign' value added (from non-manufacturing economies) as a share of value added of manufacturing exports has increased, due to growing international integration and trade in intermediate goods (Los et al. 2015; Malherbe 2018). So, in the same way that considering economy-wide impacts of technology within countries is important, the indirect effects of GVCs in manufacturing also warrant consideration.

55 Allen (2009).

56 Allen (2017, 2009).

57 Voth (2003), Feinstein (1998).

58 Lindert (2000).

59 Moscona (2018).

60 Wills (1971).

61 Autor (2015).

62 Bessen (2015).

63 Banga and te Velde (2018a).

64 Acemoglu and Restrepo (2018).

65 Autor (2015).

66 Chang and Huynh (2016). See also Nayak and Padhye (2017) for a contrary view.

67 Larson (2018).

68 See also Rodrik (2018a) and Stiglitz (2018).

69 Gollin (2018).

70 Rodrik (2018b).

71 Kaplinsky (2018).

72 Gollin (2018). See also World Bank (2017) in which it is shown how the services content of manufacturing has been increasing over time, making manufacturing and services less distinguishable.

73 These cost reductions in exchanging goods can come from declines in transaction costs (such as moving goods) but also from getting better matches, say in labour markets, and overcoming market failures, such as information asymmetries in various markets, or overcoming counterparty risk (such as not knowing the reliability of a trading partner or creditworthiness of a potential borrower) (Malherbe, 2018).

74 Another way of putting this is that the benefits from agglomeration may decline.

75 Deichmann, et al. (2016).

76 Deichmann, et al. (2016).

77 Cole and Fernando (2016) and Casaburi et al. (2013).

78 Ekekwe (2017) and Chatterjee (2018).

79 Hello Tractor (2017).

80 Ekekwe (2017).

81 Reardon et al. (2003).

82 Gollin (2018).

83 Estimates of postharvest loss vary significantly, but the scale of the problem is undoubtedly important. For a detailed meta-analysis see Affognon et al. (2015).

84 Baldwin (2016).

85 Berg et al. (2017).

86 Dixie and Jayaraman (2011).

87 It is important to note that this does not mean that technology can deliver on these promises without other improvements in the value chain. For example, for detail on the case of the Ethiopian Commodity Exchange and the questions regarding its overall impact on the coffee value chain, see Hernandez et al. (2017).

88 This is the case even if, at times, the potential contribution of agriculture is misunderstood. See Dercon and Gollin (2014).

89 Gollin (2018).

90 Malherbe (2018).

91 Moscona (2018).

92 Baldwin (2016) and Glaeser (2012).

93 Remote diagnostic tools allow for the analysis of machinery performance using data obtained from built-in sensors, and transmitted to a remote global service capability. Tele-maintenance allows for the restoration of a failure of a remote system without the need to physically access the remote system. An example is Siemens' remote service (Rodriguez Sanchez et al., 2011). See also Malherbe (2018).

94 Malherbe (2018) and Baldwin (2016).

95 OECD (2013). See also World Bank (2017a) on the increased role of services in export manufacturing value added.

96 Autor (2015).

97 Loungani et al. (2017). Note that this is likely to be an underestimate, as implied by the discussion on manufacturing GVCs. Services account for at least a third of manufacturing exports, making the overall share of services in global trade substantially higher. Francois et al. (2015) suggest that services may account for up to half of global trade. The discussion in this section is about the direct contribution of services in exports only.

98 World Trade Organization (2017). See also Malherbe (2018).

99 Loungani et al. (2017) and IBEF (2018).

100 Forey (2013).

101 Jensen (2012).

102 World Bank (2018a) and Errighi et al. (2016).

103 IBEF (2018). India also export increasing values of IT services, contributing 30% to total exports.

104 For example, in its accounting offering, the outsourcer HCL includes embedded analytics and compliance services. Tata Consulting Services provides services that help the train system manufacturer Bombardier Transportation manage 300 sites in more than 60 countries. Tata's rival, WNS, offers a 'single global back-office', which provides finance and administration, human resources and procurement services for manufacturing operations based anywhere.

105 Graham and Anwar (2018).

106 Gollin (2018).

107 Ghani and O'Connell (2014).

108 Gollin (2018).

109 International Labour Office (2018). The figures are higher when the informal sector is defined to include agricultural work.

110 Banerjee and Duflo (2007).

111 Suri and Jack (2016).

112 Bharadwaj, Jack and Suri (2018).

113 Eisenmeier (2018).

114 Mahmod et al. (2017).

115 Bruhn and McKenzie (2014).

116 International Labour Organization (2017b).

117 Hsieh and Klenow (2009).

118 Atkin and Donaldson (2015).

119 Bloom and Van Reenen (2007).

120 Rodrik (2018b) suggests that new technologies will not make it easier to focus on export manufacturing for many developing countries: international economic integration may not be a sensible development strategy anymore. He also questions the desirability for new entrants to move into GVCs in current circumstances. He argues that this may well imply that countries should focus more on 'domestic integration', as discussed in this pathway.

121 Note that one route for learning, through foreign direct investment, already allows for learning and other spill-overs without direct participation through global markets.

122 Jensen (2007).

123 Aker (2010).

124 Malherbe (2018). Using data from World Bank's Doing Business indicators, he reports how landlocked African countries spend about double the time processing exports and imports, compared to Asian component-producing countries.

125 Fan et al. (2018).

126 This information is based on two in-depth studies conducted over June to August 2018. The full studies are available at pathwayscommission.bsg.ox.ac.uk

127 International Telecommunications Union (2018).

128 International Telecommunications Union (2018).

129 Innovations in storage technologies such as high-capacity batteries could dramatically change the returns to sustainable energies, too. This is an area in which global research and development would be beneficial.

130 Kazeem (2018) and Rowley (2017).

131 McKay and Pillai (2016).

132 Eghbal (2016).

133 IndiaStack (2018).

134 Mahalakshmi (2018).

135 EasyGov (2018).

136 See Abraham et al (2018) for a review of the Aadhaar system, including a treatment of some of the issues that have surfaced.

137 World Wide Web Foundation (2017).

138 Uber (2015).

139 Posner and Weyl (2018).

140 Verhulst and Young (2018).

141 Queen Elizabeth Prize for Engineering (2015).

142 Banga and te Velde (2018b).

143 Banga and te Velde (2018b).

144 Pritchett (2013).

145 For a review, see World Bank (2018b).

146 Audretsch et al. (2006).

147 Malecki (2018).

148 Chernyshenko et al. (2015).

149 Senor and Singer (2009).

150 Other sector-neutral funding streams in Israel focused on: start-ups and early-stage capital (Tnufa), industry-university co-operation (Magneton), and harnessing the potential from immigrants and the diaspora.

151 Klerkx and Leeuwis (2008).

152 Greenacre (2018).

153 Financial Conduct Authority (2017).

154 Baker, Sallet and Scott Morton (2018).

155 Tirole (2017).

156 Coyle (2018).

157 Schrepel (2017).

158 Khan (2017).

159 Genova (2016).

160 Communications Authority of Kenya (2017).

161 OECD (2015) and Crivelli, de Mooij and Keen (2015).

162 Sledz (2018).

163 Taxamo (2018).

164 Becker (2015).

165 EY (2018).

166 OECD (2018b:142)

167 Chaturvedi (2018).

168 Hughes (2018).

169 Thornhill (2018).

170 Hughes (2018).

171 Devarajan, S. (2017).

172 Ghatak, M. (2017).

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