



When the factory doors close, which windows (of opportunity) remain open?

The impact of automation on manufacturing as a path to development

Background Paper

Adrienne Lees

Adrienne Lees
Overseas Development Institute Fellow,
Ministry of Finance, Uganda

Background Paper 22
January 2019

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. It 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.

This paper is part of a series of background papers on technological change and inclusive development, bringing together evidence, ideas and research to feed into the commission's thinking. The views and positions expressed in this paper are those of the author and do not represent the commission.

Citation:

Lees, A. 2019. *When the factory doors close, which windows (of opportunity) remain open? The impact of automation on manufacturing as a path to development*. Pathways for Prosperity Commission Background Paper Series; no. 22. Oxford. United Kingdom.

www.pathwayscommission.bsg.ox.ac.uk
@P4PCommission
#PathwaysCommission

Cover image © Adrienne Lees



Table of Contents

Introduction	2
The risk of reshoring	3
Current trends	5
Automation, economic development and inequality	7
Window of opportunity?	8
i. Manufacturing	8
ii. Globalisation of services	9
iii. Platform economics	11
iv. Bolstering domestic trade	11
Policy implications	13
i. Get the basics right	13
ii. Lower technology costs	13
iii. The importance of education	14
iv. Preparing for the digital economy	14
Conclusion	16
References	17

Introduction

Technological change and automation are set to fundamentally change the nature of production in developing countries. Headlines such as 'Automation could destroy millions of jobs' (*The Guardian*, 2018) and 'Cheap automation raises risk of "premature deindustrialisation"' (*Financial Times*, 2015) give the impression of a bleak future for manufacturing in developing countries. However, the current debate focuses too heavily on whether jobs can technically be automated, and the implications that this has for reshoring,¹ without adequate consideration for the economic, political, and social factors that affect production. Examining the risk of reshoring more holistically and considering the dearth of international evidence for a distinct reshoring trend, it seems unlikely that automation will dramatically change global value chains (GVCs) in the short term. Thus, developing countries may still have a window of opportunity to pursue manufacturing-led growth, capitalising on industries where the adoption of technology has been slow, as well as growing domestic and regional demand for consumer goods.

This paper reviews and critiques the argument that large-scale reshoring is likely to limit the ability for low-income countries to achieve growth through export-oriented manufacturing. While the immediate risk of reshoring resulting in premature deindustrialisation may be low, it will become increasingly important to consider other paths to development. This paper argues that export-oriented services, platform economies and bolstering domestic trade all present new opportunities.

¹ Ellram (2013) defined 'reshoring' as "moving manufacturing back to the country of its parent company". Others have used the term more loosely to mean a change in location with respect to the previous offshore country. This paper uses 'reshoring' broadly to encompass the reversing of a previous decision to offshore certain manufacturing processes. This can refer to the complete repatriation of manufacturing processes, or a portion of the production process.

The risk of reshoring

The offshoring of jobs and activities to less-developed countries has long been a part of the discourse on manufacturing. In recent years, the idea of reshoring has gained attention across the media and academia, and in policy debates. The location of manufacturing activities depends on several factors, including labour costs, proximity to market, and availability of resources (De Backer et al., 2016). Another factor is the accelerated adoption of automation, driven by technological advances that increase the scope and usability of robots delivering better quality and more consistent results. This is largely driven by a decrease in hardware and software prices, which has made investment in robots more attractive. Increased adoption of labour-saving technology is expected to allow for lower-cost and higher-quality production in developed countries, while simultaneously reducing the importance of labour costs in production decisions. Combined with increasing wage costs in low-income countries, this discourages further offshoring to these countries, and favours reshoring (Hallward-Driemeier and Nayyar, 2017).

Beyond technological advances, reshoring considerations have been influenced by changes in shipping costs. With limited shipping capacity and rising oil prices, companies are faced with rapidly rising transport costs, reducing the cost savings of offshoring, and increasing the importance of proximity to final consumers (UNCTAD, 2017). In addition, given that offshoring typically entails long and complex GVCs, a significant amount of working capital is held up in stocks and inventories, and surplus inventory is routinely sold at a discount. Proximity to market improves flexibility, reduces lead times and allows for more production to be done 'just in time'. Finally, growing populism and the related rejection of globalisation in high-income countries has increased the political prioritisation of relocating manufacturing and 'bringing jobs home'.

There are several arguments against reshoring manufacturing processes. First, offshoring has led to the creation of industrial clusters with strong ties and a dependence on local supply networks to complement assembly (UNCTAD, 2017). Combined with a potential scarcity of skilled operatives in high-income countries, as those skills have increasingly been developed at the site of production, this makes reshoring difficult. Second, on the demand side, the size and growth of markets in developing countries, as well as the expansion of regional trade, creates opportunities to produce lower-quality and lower-priced goods destined for local markets (UNCTAD, 2017). Thus, reshoring the manufacture of products destined for the local market is unlikely to be economical, despite the potential for automation. Indeed, technological advancements might strengthen GVCs by allowing headquarters to manage increasingly complex functions, track and monitor components throughout the supply chain, and use big data to optimise distribution and logistics. This reduces the costs of international coordination, improving the ability to offshore.

Considering these ambiguous benefits, the risk of large-scale automation leading to significant reshoring and job losses is perhaps somewhat overblown in public debate. While research into job destruction through automation has produced some alarming results, these remain controversial. Frey et al. (2016) use data from the World Bank and a variation on the methodology in Frey and Osborne (2013) to show that the risk of occupation automation across Africa varies from 65% to 85%, against an OECD average of 57%. The authors also show a correlation between automation risk and

low gross domestic product (GDP) per capita, meaning that low-income countries are relatively more vulnerable to job losses. Similarly, a report from McKinsey (2017) estimates that 'automatable' jobs account for 41% of jobs in South Africa, 52% in Kenya, and 55% in Thailand. However, the methodologies behind these predictions have been criticised. Ahmed and Chen (2017) question the assumption that whole occupations rather than single tasks would be automated. When they broke occupations down into tasks, the threat of automation to employment for low- and middle-income countries was found to be between 2% and 8%. The high variation in forecasted job losses indicates that the debate is far from reaching consensus.

Frey and Osborne (2013) examine the proportion of occupations that could *technically* be automated, ignoring factors affecting the commercial viability of this automation. Industries such as the manufacture of vehicles, electronics and machinery are posited as highly susceptible to automation. This is because jobs in these industries are characterised as non-creative, routine, and without the need for emotional intelligence. However, it may not yet be economically feasible to deploy robots in certain labour-intensive manufacturing processes. For instance, the textile industry has seen a low deployment of robots, despite the tasks being technically automatable. Manufacturing sub-sectors are not uniform in the extent to which technological investment or reshoring is appealing. In the near future at least, the manufacture of certain products will remain potential entry points for developing countries (such as labour-intensive tradable products and food processing).

Current trends

International evidence suggests that reshoring and the accompanying changes to GVCs are somewhat exaggerated, and offshoring remains the dominant trend. Despite technological advances, labour cost differentials are still a major factor in a firm's decision on where to locate production. Also, demand factors are growing in importance, particularly as demand for manufactured products in developing countries rises with incomes.

Alarmism in the media over reshoring seems to have been driven by several high-profile examples. In 2017, Adidas began producing trainers at 'speed factories' in Ansbach, Germany and Atlanta, US. The main motivation behind establishing these highly automated factories, complete with computerised knitting, robotic cutting and 3D printing, was to shorten the supply chain, reducing time to market from as long as 18 months to less than a week (*The Economist*, 2017).

Production can also be more customised, facilitating bespoke trainers. However, the automated factories will only manufacture an estimated 1 million pairs of shoes each year, at a high price point – a drop in the ocean for a company estimated to sell 360 million pairs annually. In fact, Kasper Rorsted, chief executive at Adidas said that, due to Asia's entrenched supply chains, the prospect of moving large volumes of manufacturing back to Europe is "an illusion", adding that announcing manufacturing bases in the US is largely a political interest (Hancock, 2017).

Another popular example is the reshoring of Philips shavers to the Netherlands, as rising labour costs and high turnover of personnel in China rendered the per-unit labour cost lower in Dutch factories than in offshore plants. Additionally, when the intended market is Europe, locating production in the Netherlands cuts out months of logistical effort and delayed earnings (Noordhuis, 2012). Similarly, Tom Davis Glasses, manufacturer of upmarket eyewear, began moving production back to the UK from China in 2017, with the aim of having 70% of manufacturing in the UK by 2020 (Margolis, 2017). Beyond labour costs and cheaper computerised machinery, Tom Davis anticipated that 'Made in the UK' would be a good selling point.

These anecdotal examples aside, the quantitative evidence suggests that reshoring has fallen short of expectations. Recent data from the German Manufacturing Survey indicates that about 2% of German manufacturing companies engaged in reshoring between 2010 and 2012, while four times as many companies offshored activities in the same period (De Backer et al., 2016). The European Manufacturing Survey (covering firms in Austria, Switzerland, Germany, Denmark, Spain, France, Hungary, Portugal, the Netherlands, Sweden, and Slovenia) gives similar results, with 4% of firms in the sample having reshored some production activities between 2010 and 2012. For every reshoring company, more than three companies offshored production (De Backer et al., 2016).

A further study by the Hackett Group in 2012 used survey data from the global sourcing strategies of large companies. The results indicated that the net manufacturing capacity returning to developed countries barely offsets the amount that continues to be offshored. In fact, the Hackett Group instead predicted that manufacturing capacity would be more likely to be reallocated among emerging economies, while the share of global manufacturing capacity in developed countries

would remain unchanged (De Backer et al., 2016). Finally, using survey data from 74 leading manufacturing companies predominantly from the US, Europe and Japan, Cohen et al. (2016) found some evidence of a global restructuring of supply chains. However, there was no consistent trend of investment in automating production across industries, region, or firm size. Interestingly, the authors also found that the limited amount of manufacturing returning to the US is driven by non-American firms, inconsistent with the reshoring hypothesis (Cohen et al., 2016). Production decisions are decreasingly motivated by cost, as cost advantages have become more temporary with the higher volatility of exchange rates, transportation, labour and energy costs.

Evidence of reshoring based on aggregate trade data backs up these survey results. While data on reshoring is typically not directly captured in official statistics, the extent of reshoring by individual companies can be inferred using the share of domestic demand served by imports – if more production is reshored, domestic production will increasingly satisfy domestic demand. For a selected group of OECD countries, De Backer et al. (2016) found a slowing of imports' share in domestic demand, but limited evidence of a true reversal. In fact, imports from the Asian region still show an upward trend. This might suggest that reshoring has not yet yielded strong aggregate effects for national economies.

While the true extent of reshoring activities and the shortening of GVCs might be limited, it is important to note that, for companies that have reshored, sizeable job losses have been recorded. The Adidas 'speed factories' were estimated to create 160 jobs, but reduced employment in Vietnam by 1,000. Using data from the Reshoring Initiative, Banga and Te Velde (2018) found that, between 2010 and 2016, Asia suffered 138,450 job losses following reshoring activities by 1,112 companies. This translates to around 124 jobs lost per company. Similar patterns were observed in Africa – while only seven companies reshored production, 126 jobs were lost per company. More concerning, however, is the loss of potential jobs. As new technologies are adopted in developed countries, further production may not migrate to developing countries, so fewer jobs are created. While difficult to quantify, a recent survey of Chinese manufacturing firms indicated that 28% identified rising wage costs in China to be the greatest challenge to firm operations, but the preferred response to this was to upgrade technology rather than investing in regions with cheaper labour (Banga and Te Velde, 2018).

Automation, economic development and inequality

Notwithstanding the above discussion, in the long run, the impact of increased digitalisation and reshoring cannot be ignored. These forces may contribute to a decline in the ability of low-income countries to exploit the classic structural transformation route to development where economies move from agricultural to low-end manufacturing, and then to high-productivity manufacturing for export. Without experiencing mass migration to formal, labour-intensive manufacturing, developing countries risk increasingly experiencing "premature deindustrialisation" (Rodrik, 2016). This is particularly concerning for Africa, as its growing cohort of youth entering the labour force may not find the manufacturing jobs that were once available (Norton, 2017). The ability of manufacturing-led development to produce convergence in wealth is thus being questioned. Signs of deindustrialisation at low-income levels are already being seen – urban migrants in Africa are crowding into informal or 'petty' services, while the share of manufacturing in GDP in Latin America, as well as economy-wide productivity, is declining (Rodrik, 2016). Further deindustrialisation, without an alternative model for broad-based, labour-absorbing growth, risks exacerbating global wealth inequalities.

At a country level, if reshoring and job automation become dominant trends, this may give rise to growing inequality and the hollowing out of the labour force. One mechanism likely to drive this distributional impact is that technological upgrading boosts the advantage of capital over labour. This is because the technology is typically owned by the wealthy who almost exclusively accrue benefits (Millington, 2017). Owners of capital might experience greater returns from an automated labour market as there would be zero unscheduled downtime and increased resource efficiency. As increased profitability flows to owners of capital, the share of national income allocated to labour reduces, further polarising incomes and wealth.

Since technology complements high-skilled workers, increasing their productivity, job creation will tend to be concentrated in high-skill activities, with comparatively fewer benefits for low-skilled and medium-skilled workers (Millington, 2017). As middle-skilled, routine jobs are progressively automated, low-skilled workers will face increased competition from the now-redundant middle-skilled, placing additional downward pressure on wages. This further widens income inequality and could create a 'hollowed-out' workforce, where employment opportunities are concentrated in low-skilled, non-automatable jobs, or in high-skilled professions, depending on modern skills. The hypothetical consequences of this are far-reaching. In a digital economy, workers face increased isolation, reducing their ability for effective collective action. Weakened labour institutions and the erosion of the tax base could follow.

The accelerating pace of change, and a lack of evidence for improved human adaption to jarring dislocation, heighten these risks as compared to previous technological advances, such as the industrial revolution in Europe and the US, a transition that occurred over almost a century. The rapid deployment of automation technology could well exceed the pace at which economies will be able to reabsorb displaced workers. Such structural dislocation could result in a long-term rise in unemployment and acts as a brake on growth.

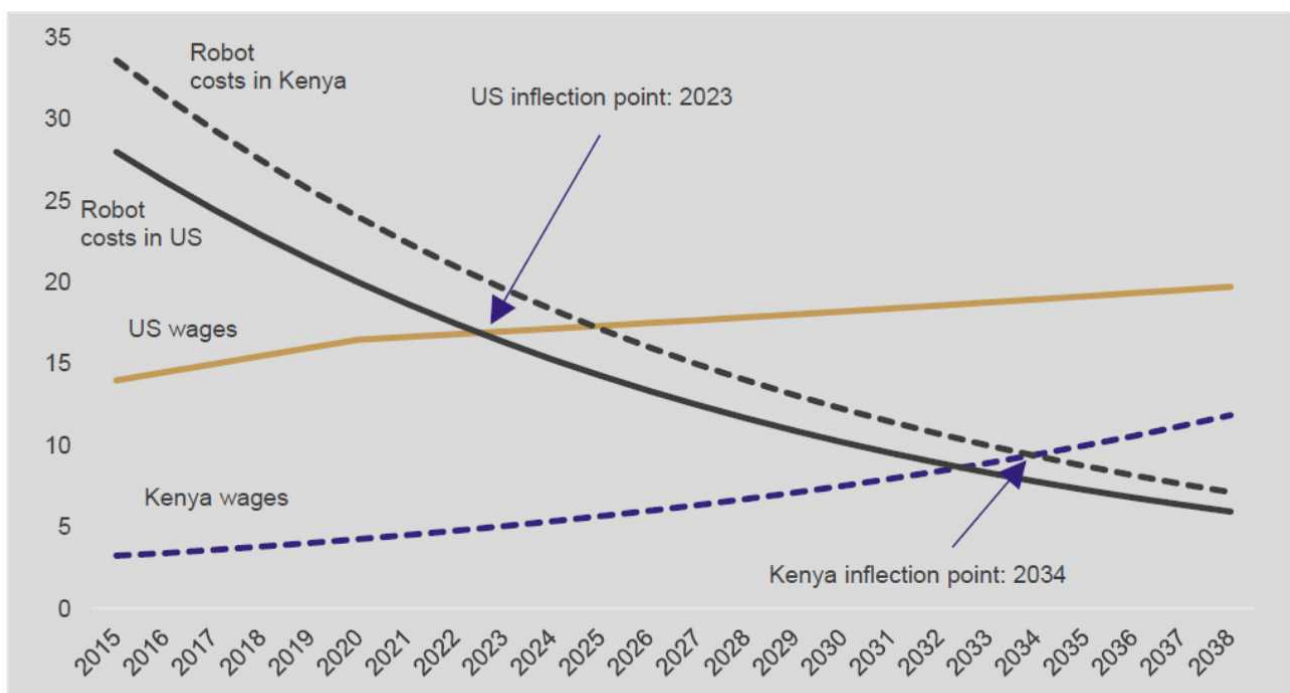
Window of opportunity?

i. Manufacturing

Given the growing fear that robots will replace human labour, should low-income countries continue to pursue manufacturing-led development? The pace of digitalisation is slow in many developing countries and firms are unlikely to invest in automation until the cost of employing labour is significantly higher than the cost of operating robots. While some manufacturing sectors – such as electronics and transport – are experiencing fast automation and the shortening of GVCs, others – such as food, basic metals, wood products and paper – have resisted technological change (Banga and Te Velde, 2018). Countries might be able to use such sectors to develop, especially if catering for local and regional markets. However, this window of opportunity will not stay open indefinitely. Countries should focus on boosting traditional manufacturing now to allow for an easier transition to more complex, digitised manufacturing activities in the near future.

Recent analysis indicates that African countries have a decade or two before robots become cost competitive (Banga and Te Velde, 2018). Figure 1 compares the hourly cost of robotic operation against hourly wages for US and Kenyan furniture manufacture, a sector that has been slow to automate. Labour costs for the US are predicted to overtake the costs of operating robots as early as 2023, whereas the inflection point for Kenya could be as late as 2034. Given the possibility of reshoring furniture manufacture, the cost of US robotics operation could be a better comparator. This narrows the window for Kenyan firms by one to two years.

Figure 1. Furniture manufacturing in the US vs Kenya



Source: Banga and Te Velde, 2018.

It has also been argued that new technologies have the potential to bridge the productivity gap between low-income and more advanced developed countries. The expansion of additive manufacturing, or 3D printing,² can overcome shortages in local skills and supply chains. This might enable firms to replace or fix broken parts with 'printed' supplies, or to prototype new ideas (Murray, 2017).

E-commerce can improve a firm's access to inputs and to consumers, reducing search and transaction costs for smaller firms (Murray, 2017). However, barriers to the success of e-commerce are significant: many firms do not have affordable and reliable internet connections; banking services are unsophisticated; computer literacy remains low; and national postal services tend to be slow, unreliable, and limited in their reach. Yet, the potential of e-commerce to boost domestic and regional trade is recognised and, despite these constraints, e-commerce is growing. Jumia, an online marketplace started in Nigeria in 2012, now boasts more than 5 million customers across 14 African countries. It has raised more than US\$400 million (£314 million) in capital. In the first quarter of 2018, their generated revenue amounted to US\$177 million (£139 million), while analysts estimate that Africa's market for online retailing will reach US\$75 billion (£59 billion) by 2025 (Drechsler and Steger, 2018).

ii. Globalisation of services

While some potential for manufacturing-led development may still exist, it is important for low-income countries to consider other paths to development. One such opportunity could be the increasing globalisation of services markets. Internet-enabled commerce could expand opportunities for exporting services through business process outsourcing (BPO) and freelance activities (Murray, 2017). Currently, almost half of BPO services are in banking and finance – for example, bookkeeping – and a further 20% are in technology and telecommunications, such as web design and call centres (Millington, 2017). However, this is likely to change as technology improves the ability to provide traditionally face-to-face services virtually – for example, medical diagnosis. Such services are less likely to be automated as human traits, including empathy, patience, and encouragement, are highly valued. However, while the internet has connected a larger pool of workers in low-cost markets to clients in more advanced economies, the online job search remains concentrated among the educated youth (Millington, 2017).

The impressive growth of Rwanda's economy in the two decades since civil war gives an example of a services-first transformation. After the genocide, the government invested heavily in infrastructure development and construction, building roads, digging trenches for internet cables, expanding the electrical grid, and improving urban infrastructure. This activity stimulated service inputs, including engineering, architectural, and legal services (Ggombe and Newfarmer, 2017). As the economy

² This refers to the process by which 3D objects are built by adding layer upon layer of material. A product is designed in 3D printing software, which is then fed to a printer that emits a liquid which sets solidly, or a powder that laser fuses.

expanded, so did high value-added services such as telecommunications and finance. Meanwhile, retail trade and informal urban services absorbed many low-skilled workers. Growth in services productivity over the past 20 years has exceeded productivity growth in the rest of the economy – from 1991 to 2013, decompositions of annual productivity growth indicate that services account for over 90% of growth in output (Ggombe and Newfarmer, 2017). In 2013, the Rwandan Government embarked on an ambitious programme to achieve middle-income status, with an emphasis on exports. Service exports have since grown dramatically and tourism now accounts for about 30% of total exports (Ggombe and Newfarmer, 2017).

South Africa has seen similar rapid growth across the services sector, coupled with signs of deindustrialisation – close to two-thirds of GDP and employment is accounted for by the services economy, with almost all post-2000 employment growth attributable to services jobs (Bhorat et al., 2016). When broken down, there is evidence of a slight shift towards high-productivity services such as finance and insurance, some shift to low-productivity retail services, and a significant shift towards government services. While growth in government services is not fiscally sustainable, this reorienting of the economy does have some potential. High-productivity financial and communications services have good growth potential but are skill-intensive and thus constrained by the education system.

To really drive growth, services need to become more export-oriented – tourism and agro-processing show strong potential (Bhorat et al., 2016). For example, tourism can create low-skilled jobs through catering, guiding and hotel staffing, and has the potential to boost input industries, particularly agricultural supplies. Agro-processing and horticulture share many characteristics with labour-intensive manufacturing. The value of the sub-Saharan food and beverages market is expected to increase dramatically due to rising incomes and urbanisation. This suggests that targeted investment in processing, logistics, market infrastructure and retail networks could help to support development in the region (Brookings, 2018).

However, the literature on development has traditionally been critical of the sustainability of services-led growth. Rodrik (2016) warned that the recent service-sector growth in Africa is driven by urban migrants in informal services, without much further scope for expansion. High-productivity tradable services, such as ICT and finance, rely on highly skilled labour and thus are constrained in their ability to absorb vast numbers of low-skilled, unemployed workers. Services growth tends to be geographically concentrated in wealthier, urban regions, with limited trickle-down to spatially dislocated regions (Bhorat et al., 2016). Thus, the services sector has been criticised for generating jobless growth. Nevertheless, recent literature has pointed to a potential change – in South Asia, services have experienced faster employment and wage growth than other sectors, as well as a stronger correlation with poverty reduction than growth in manufacturing (Bhorat et al., 2016). With the number of services produced and traded globally expanding, there are opportunities for developing countries to find alternative specialisations.

iii. Platform economics

Digital platform companies and the flexible work they allow could unlock significant economic benefits, raise labour-force participation and boost productivity. Platforms solve co-ordination and transaction cost problems by improving the ability of two economic agents to create value (Dahlman et al., 2016). A classic example is Uber facilitating a value-creating exchange that matches drivers and passengers. Using platforms, users can find jobs, access information, and advertise to potential customers. Such companies require little start-up capital and customer acquisition costs decline with each additional customer, making the underlying engineering scalable.

One such outfit is Amazon's Mechanical Turk, an online platform matching firms and individuals with freelance remote workers. While it has not seen its network of freelancers expand much beyond the US and India, if Africa can improve broader literacy and fluency in international languages, it may see stronger growth in the sector. This is especially true as Asian wages rise, and existing customers note that African accents tend to be easier to understand (Murray, 2017).

Such companies have been criticised for their relatively poor pay, lack of career prospects and job security, and their inability to provide social security and benefits to workers. However, many workers in developing countries are already engaged in small, task-based jobs on an informal basis. Providing a way to access such jobs safely and efficiently could be a boon to workers, increasing their productivity and providing a steadier stream of income. For example, the SafeBoda app in Uganda acts like Uber for motorcycle taxis. It matches passengers with drivers who have undergone road safety training, follow a strict code of conduct, are Red Cross-certified first responders, and carry high-quality helmets for passengers. Customers can buy SafeBoda credit using mobile money and a fare is automatically deducted, eliminating the need to bargain and carry cash. Drivers have seen 30–40% increases in earnings through the app. Weekly credit payments into their mobile money accounts improve the ability to budget and save (Rosen, 2017).

iv. Bolstering domestic trade

While the literature has typically encouraged an export orientation, the slow growth in global demand following the 2008 financial crisis has increased the support for a more domestic demand-oriented growth model. This will depend on the ability to boost domestic consumer demand, and the creation of a vibrant economy of productive, domestically oriented firms (UNCTAD, 2013). Producing lower-quality, lower-priced goods for the domestic market may give better productivity gains, either through learning by doing (Matsuyama, 2002) or through the adoption of new technologies to satisfy growth in demand (Foellmi and Zweimueller, 2008). The consequent economies of scale allow goods to be produced at lower costs, which benefits the consumers and industries using those goods as inputs. Furthermore, given that domestic firms have better knowledge of local markets and preferences, they may well have an advantage over foreign firms in catering to domestic demand. Capitalising on this knowledge would limit increases in domestic demand being met by imports.

Pursuing such a strategy requires: (i) increasing domestic demand by lifting the incomes of domestic consumers; and (ii) boosting domestic productivity growth, increasing the capacity of domestic production to satisfy rising domestic demand. Achieving the first without the second will lead to an increase in consumption of imports, adding to changes in the trade balance due to slow export growth, and risks causing balance-of-payments problems (UNCTAD, 2013). Consequently, the concurrent expansion of other developing countries becomes important, as this creates a larger and more dynamic market, spurring trade among developing countries (also called South-South trade) and further growth across developing economies. Over the past decade, almost all manufacturing industries in Africa have seen expanding intra-Africa trade, suggesting that this option has significant potential (Brookings, 2018).

In contrast with export-oriented growth that depends on the cost of wages, a domestic trade growth strategy should emphasise the income aspect of wages, as household spending is the biggest driver of domestic demand. Promoting better pay and employment creates income to be spent and an increased demand for goods, which could be produced domestically. (UNCTAD, 2013). One way to boost domestic demand is through increased investment in public employment and infrastructure, as demonstrated by Rwanda. With increased demand, firms are incentivised to upgrade their productive capacities and the associated investment decisions would better correspond to the needs of the domestic market, rather than catering solely for exports.

Policy implications

i. Get the basics right

To avoid being left behind, developing countries should embrace the inevitable digital revolution and bolster their technological readiness. Stemming the risk of reshoring will require enhanced public investment in infrastructure, logistics, and utilities. Adopting new technologies can allow for some 'leapfrogging', for instance, sharp declines in the cost of solar power and the superior irradiation in Africa make bypassing the national grid possible (Murray, 2017). However, the need to overcome the traditional constraints to development cannot be escaped – a consistent power supply, well-maintained roads linking regional hubs, efficient transportation networks, and affordable and reliable telecommunications. Exploiting the window of opportunity in less-automated manufacturing sectors, as well as the expansion of new prospects such as e-commerce, will not be possible until these fundamentals are in place.

ii. Lower technology costs

Reducing the cost of being connected and increasing access to ICT will be critical. High data costs and low levels of smartphone penetration, as well as poor integration of payment and banking systems, leave many citizens locked out of the digital economy. Yet the success of companies like Jumia is indicative of strong latent demand, as e-commerce offers consumers more choice and convenience.

Policymakers should target public-access solutions, such as free or subsidised internet access in public Wi-Fi hotspots. Botswana has embraced such ideas, enacting laws that allow net neutrality, simplifying their licensing regime, and increasing the number of hotspots at hospitals, bus stops, and shopping malls across seven major towns (Banga and Te Velde, 2018). Governments should reduce taxes on ICT services and equipment supplied to more rural areas. They should create incentives for network operators to expand their coverage and encourage greater competition to bring down prices.

If developing regions – and Africa in particular – wish to take advantage of shifting GVCs, they should focus on bringing down trade costs. Non-tariff costs, including customs clearance delays, corruption, and infrastructure deficiencies, severely constrain GVC participation (Brookings, 2018). Furthermore, since services such as finance, telecommunications, and logistics are required to participate in much of modern manufacturing, lowering barriers to foreign investment in services can provide effective support to industrialisation through GVC integration.

iii. The importance of education

Technological readiness will also require future workers to make themselves relatively more 'immune' to automation. One approach is to concentrate on developing skills in science, technology, engineering, and mathematics (STEM subjects), so that people can work with or even develop technology. Another approach is to nurture skills that are least automatable, such as cognitive, non-routine skills which have higher returns (Patrinos, 2016). These include analytical, problem-solving, self-management, communication, and social skills, as well as learning to become more adaptable and embrace lifelong, consistent upskilling. For developing countries, nurturing basic skills will remain an urgent priority – one cannot be at the technological frontier without basic literacy and numeracy.

The internet offers exciting new opportunities for skills development through online education platforms such as edX and Codecademy. Online courses have massive potential to improve the ability of workers in developing countries to gain internationally competitive skills and adjust to a world of lifelong learning (Patrinos, 2016). However, this should not be seen as a substitute for traditional teaching models. African countries have some of the lowest literacy and education levels in the world. While enrolment levels have improved, the quality of education is, on average, extremely poor (Murray, 2017). So, while well-targeted ICT initiatives could bring helpful improvements, it is not a 'silver bullet' to educational achievement. Policymakers should prioritise basic literacy, numeracy, and fluency in a major international language. Successful educational reform will depend on creating a system where: assessment is used to measure progress; schools are empowered through autonomy and resources; accountability to governing boards and parents is improved; and teachers are well trained (Patrinos, 2016).

iv. Preparing for the digital economy

Governments should strive to create a business climate that is amenable to the expansion of the digital economy. Digitalisation will lead to more independent contracting, casual work, and firms without a physical 'footprint'. Due to the virtual nature of transactions, tax loopholes are invariably created. Unlike in traditional businesses, it is difficult to measure where and how much value has been added in the digital economy (OECD, 2014). These problems are amplified by permanent establishment rules based largely on physical presence. Thus, while digital companies operate virtually, their profits are taxed only in the state where they have a physical establishment. Many online workers do not pay tax on their earnings and imposing such taxes could create a barrier to growth of the industry (World Bank, 2015).

The 'gig economy' will require rethinking the provision of social protection, as pensions have traditionally been viewed as the responsibility of employers, while online platforms give workers greater flexibility. In the absence of social security nets, this flexibility and reduced job security could leave many workers disenfranchised. Solutions could include full portability of pensions

across employers and self-employment, expansion of national healthcare schemes, supporting the participation of older workers in the labour force (by removing forced retirement in certain professions, for example), and ensuring that platform companies operate in the formal sector as far as possible.

Promoting the growth of services and "industries without smokestacks" will be critical. Liberalising trade in services, promoting telecommunications competition and removing barriers for the provision of professional services are central to this. Developing countries should promote growth in services exports, such as investing in medical services to appeal to regional patients who cannot afford treatments in the global North. These countries should also improve the marketing of tourist attractions and encourage the construction of accommodation to bring down travel costs for visitors. Resilient services-led growth requires strong human capital. The lack of education remains a pervasive problem in many low-income countries. This reinforces the need to prioritise literacy, ICT competency and fluency in a major international language.

Conclusion

Technological advances, including automation and robotics, are undeniably changing the future of work. In developing countries, the risk of growing inequality and the hollowing out of the labour force is high. However, appropriate policy measures could curb the potential negative impact. To capitalise on tradable services, developing economies need to create the right investment climate by improving traditional and ICT infrastructure ensuring that the regulatory environment complements the digital economy. In the face of automation, skills will increasingly matter, and governments should reform education systems to emphasise STEM subjects and computer literacy. Finally, implementing an effective 'export push' strategy will enhance productivity and growth. Governments should develop trade policies, public investments and institutional changes that aim to increase the share of non-traditional exports in GDP.

References

- Ahmed, S. A., and Chen, P. (2017). Emerging technologies, manufacturing, and development: Some perspectives for looking forward. Washington DC: Unpublished manuscript prepared by the World Bank.
- Banga, K., and Te Velde, D. W. (2018). Digitalisation and the future of manufacturing in Africa. London: Overseas Development Institute.
- Bhorat, H., Steenkamp, F., Rooney, C., Kachingwe, N., and Lees, A. (2016). Understanding and characterizing the services sector in South Africa: An overview. Geneva: UNU-WIDER.
- Brookings. (2018). Foresight Africa: Top Priorities for the Continent in 2018. Washington DC: Africa Growth Initiative, Brookings.
- Cohen, M. et al. (2016). Off-, On- or Reshoring: Benchmarking of Current Manufacturing Location Decisions. Available from: <http://pulsar.wharton.upenn.edu/fd/resources/20160321GSCBSFinalReport.pdf>
- Cooper, Y. (2018). Automation could destroy millions of jobs. We have to act now. The Guardian, 7 August, 2018. Available from: <https://www.theguardian.com/commentisfree/2018/aug/06/automation-destroy-millions-jobs-change>
- Dahlman, C., Mealy, S., and Wermelinger, M. (2016). Harnessing the digital economy for developing countries. Paris: OECD Development Centre.
- De Backer, K., Menon, C., Desnoyers-James, I., and Moussiegt, L. (2016). Reshoring: Myth or Reality? OECD Science, Technology and Industry Policy Papers, 27.
- Drechsler, W., and Steger, J. (2018). Rocket Internet's African e-commerce startup Jumia ready for next stage. Handelsblatt Today, 8 January, 2018. Available from: <https://global.handelsblatt.com/companies/rocket-internets-african-e-commerce-startup-jumia-ready-next-stage-950799>
- Ellram, L. M. (2013). Offshoring, reshoring and the manufacturing location decision. Journal of Supply Chain Management, 49 (2), 3-5.
- Foellmi, R., and Zweimueller, J. (2008). Structural change, Engel's consumption cycles and Kaldor's facts of economic growth. Journal of Monetary Economics , 55 (7), 1317-1328.
- Frey, C. B. (2015). Cheap automation raises risk of 'premature deindustrialisation'. Financial Times, 30 September, 2015. Available from: <https://www.ft.com/content/de07e776-2172-11e5-ab0f-6bb9974f25d0>

- Frey, C. B., and Osborne, M. (2013). The future of employment: How susceptible are jobs to computerisation? Oxford Martin School Working Paper.
- Frey, C. B. et al. (2016). Technology at work v2.0: The future is not what it used to be. London: Citigroup and University of Oxford.
- Ggombe, K., and Newfarmer, R. (2017). Rwanda: From devastation to services-first transformation. Geneva: UNU-WIDER.
- Hallward-Driemeier, M., and Nayyar, G. (2017). Trouble in the making? The future of manufacturing-led development. Washington DC: World Bank.
- Hancock, T. (2017). Adidas boss says large-scale reshoring is "an illusion". Financial Times, 23 April, 2017. Available from: <https://www.ft.com/content/39b353a6-263c-11e7-8691-d5f7e0cd0a16>
- Margolis, J. (2017). Made in England: why some manufacturing is coming home from China. Financial Times, 27 August, 2017. Available from: <https://www.ft.com/content/141418ba-88b1-11e7-afd2-74b8ecd34d3b>
- Matsuyama, K. (2002). The rise of mass consumption societies. Journal of Political Economy, 110 (5), 1035-1070.
- McKinsey Global Institute. (2017). A future that works: automation, employment and productivity. New York: McKinsey.
- Millington, K. A. (2017). How changes in technology and automation will affect the labour market in Africa. London: K4D/DFID.
- Murray, S. (2017). New technologies create opportunities. Geneva: UNU-WIDER.
- Noordhuis, M. (2012). China No Match for Dutch Plants as Philips Shavers Come Home. Bloomberg, 19 January, 2012. Available from: <https://www.bloomberg.com/news/articles/2012-01-19/china-no-match-for-dutch-plants-as-philips-shavers-come-home-1->
- Norton, A. (2017). Automation and inequality: The changing world of work in the global South. London: International Institute for Environment and Development.
- OECD. (2014). Addressing the Tax Challenges of the Digital Economy. Paris: OECD/G20 Base Erosion and Profit Shifting Project, OECD Publishing.
- Patrinos, H. A. (2016). The skills that matter in the race between education and technology. Washington DC: Brookings Institute.
- Rodrik, D. (2016). Premature deindustrialisation. Journal of Economic Growth, 21 (1), 1-33.

Rosen, J. (2017). Uganda's "Uber for Motorcycles" Focuses on Safety. MIT Technology Review, 3 April, 2017. Available from: <https://www.technologyreview.com/s/604013/ugandas-uber-for-motorcycles-focuses-on-safety/>

The Economist. (2017). Adidas's high-tech factory brings production back to Germany. Available from: <https://www.economist.com/business/2017/01/14/adidass-high-tech-factory-brings-production-back-to-germany>

United Nations Conference on Trade and Development (UNCTAD). (2013). Trade and Development Report 2013: Adjusting to the changing dynamics of the world economy. Geneva: UNCTAD.

UNCTAD. (2017). Trade and Development Report 2017: Beyond Austerity - Towards a Global New Deal. Geneva: UNCTAD.

World Bank. (2015). The Global Opportunity in Online Outsourcing. Washington DC: World Bank Group.

World Bank. (2016). World Development Report 2016: Digital Dividends. Washington DC: World Bank.

