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THE IMPACT OF NEW TECHNOLOGIES ON EMPLOYMENT AND THE WORKFORCE

WHAT ARE THE IMPLICATIONS FOR DEVELOPING COUNTRIES, ESPECIALLY IN AFRICA?

Author:

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The mission of the **Atlantic Council's Africa Center** is to promote dynamic geopolitical partnerships with African states and to redirect US and European policy priorities toward strengthening security and bolstering growth and prosperity on the continent.



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Introduction

New technologies, such as automation, artificial intelligence and industrial robots, are often seen as a real danger for existing jobs and also for future job-creation prospects¹. There is a perception that they will make work redundant and lead to massive job destruction. However, others believe that automation, like previous technological waves², will increase the demand for labor in other sectors and create new jobs that did not exist in the past, and therefore lead to higher wages and improvements in the standards of living.

It is important to note that technological advances have historically increased productivity, generated sustained increases in living standards and created more jobs than they have destroyed³. However, this progress has sometimes been accompanied, especially during the transition period, by several disruptions, particularly in the labor market. Indeed, technology has brought about profound structural economic change, creating new jobs and sectors, while destroying and modifying others, with major consequences for certain categories of the population, especially low-skilled workers.

Ongoing technological advances offer new prospects for higher productivity and economic growth. However, they are also accompanied by growing concerns about their future impact on the workforce⁴, especially in the current context of high and rising levels of inequality⁵ and polarization in the labor market.

It should be noted that we have experienced in the past both an increase in incomes and a stable labor share because of other technological changes that have generated new tasks for labor and, thus, offset the job losses induced by automation. The future of work will certainly depend on how artificial intelligence (AI), robots, and automation impact the allocation of tasks to labor and capital. It will also depend on the preparation and measures taken by governments, in particular, for effectively supporting the population during this transition, to ensure that new technologies are inclusive and beneficial to all social categories of society.

1. See for instance, Melanie Arntz et al (2016) for a comparative analysis of the risk of automation for jobs in OECD countries.

2. By 2025, 97 million jobs will emerge and 88 million jobs will be displaced due to automation technologies; World Economic Forum (2020).

3. It should be noted that historically, technology has always ended up creating more jobs than it has destroyed. This is mainly due to the way automation works," explained David Autor (2011). Indeed, automation, by allowing certain tasks to be performed faster and at lower cost, leads to an increase in the demand for human workers to perform other surrounding tasks that have not yet been automated (Autor, 2011).

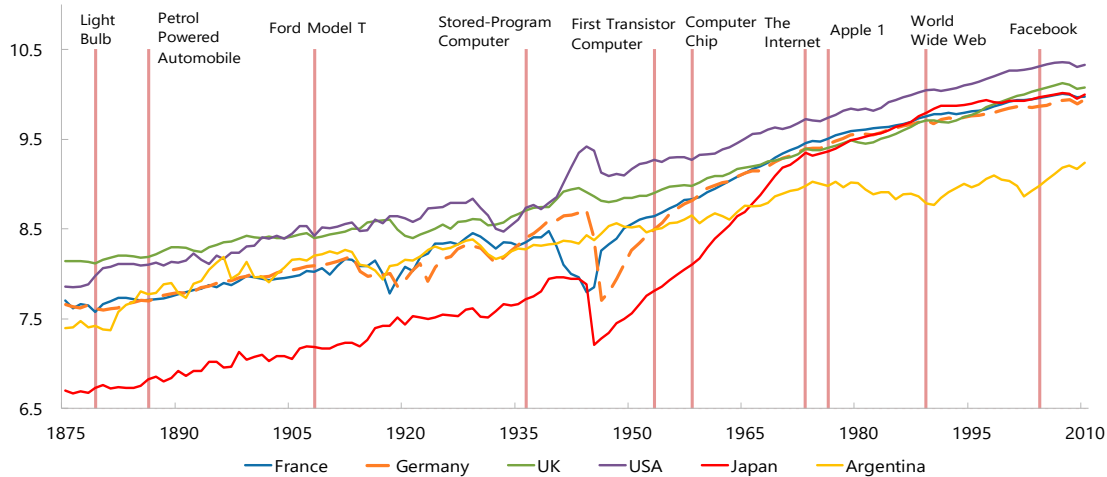
4. It is worth mentioning that concern about the threat that technology poses to future jobs and the workforce is not new. In 1930, John Maynard Keynes predicted a future increase in unemployment due to technological progress. He wrote, "We are being afflicted with a new disease of which some readers may not yet have heard the name, but of which they will hear a great deal in the years to come—namely, technological unemployment. This means unemployment due to our discovery of means of economising the use of labour outrunning the pace at which we can find new uses for labour".

5. What is important to note is that growing inequality, combined with increased anxiety relative to the negative impact that new technologies can have on employment, as well as stagnating wages for low- and medium-skilled workers, are key factors that have contributed to increased social tensions and populism in several countries. We now face a dangerous return of nationalist and protectionist sentiment, which has accelerated in the context of the COVID-19 crisis, particularly in developed countries.

Technology: Engine of Growth

Historically, technology has been the main driver of productivity growth, which in turn has played an important role in increasing economic growth in the long run. A combination of important innovations, including steam power, railways, electricity, and the combustion engine, and improvements to production methods and infrastructure development, increased both total factor productivity and GDP per capita throughout the nineteenth and twentieth⁶ centuries. Technology and Innovation was also associated with a net increase in total employment. Since the beginning of the twenty-first century, information and communication technologies (ICTs) have further boosted productivity, and new technologies including automation, advanced robotics and artificial intelligence offer new opportunities for improving productivity in the future (IMF, 2018).

Figure 1: Technological Innovation Has Underpinned the Rise in Living Standards
(GDP per capita, 1990 Int. GK\$, logarithms)



Source: Maddison Project and IMF Staff Calculations, 2018.

Notes: GK \$ refers to the Geary-Khamis dollar, more commonly known as the international dollar

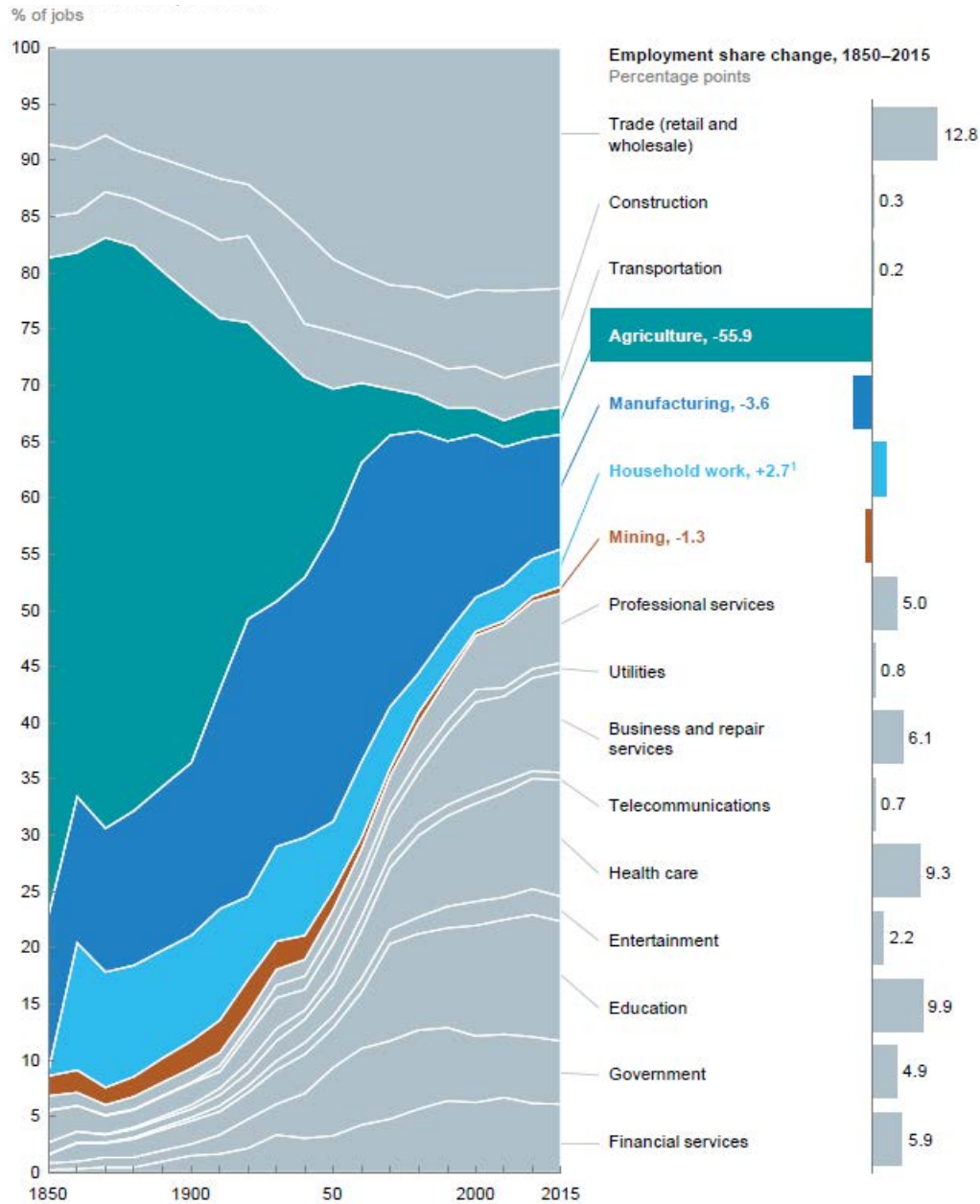
... But a Source of Disruption: Huge Historical Shifts of Workers Across Sectors

While new technologies have played a major role in increasing economic growth and improving living standards, they have historically brought about profound structural economic changes and severe disruptions, especially in the labor market. In the United States, for example, the distribution of employment by sector has changed considerably since 1850, declining from 60% in 1850 to less than 5% in 1970, and

6. It should be noted that proactive policies, particularly in the area of public infrastructure and investment in human capital through more or less equal access to education and progressive taxation, were also key important factors behind economic growth and improvements in advanced countries' living standards in the twentieth century (see Piketty, 2019).

then to nearly 1.3% in 2019. This huge decline in agriculture's share of total employment was mainly due to mechanization and the introduction of new production technologies. It has also been associated with a significant shift of labor from agriculture to other sectors and the emergence of new activities in the manufacturing and the service sector, which did not previously exist (Figure, 2).

Figure 2: Share of Total Employment by Sector in the United States, 1850-2015



¹ Increase from 1850 to 1880 in employment share of household work primarily due to changes in how unpaid labor (slavery) was tracked.

Source: IPUMS USA 2017; US Bureau of Labor Statistics; McKinsey Global Institute analysis.

Other countries, such as China, have recently experienced an even more rapid decline in the share of employment in agriculture. One third of China's labor force left agriculture between 1990 and 2015. It should be emphasized, as Table 1 shows, that all industrial countries have experienced during their development phases more or less the same transitions in the labor market: first, a massive shift of labor from the agriculture sector to the manufacturing sector, and now from the manufacturing sector to the services sector. However, developing countries are still lagging behind in this transition, as the agricultural sector continues to play a very important role, employing for example more than 50% of the total labor force in sub-Saharan Africa.

Table 1: Employment Share by Sector Between 1991-2019

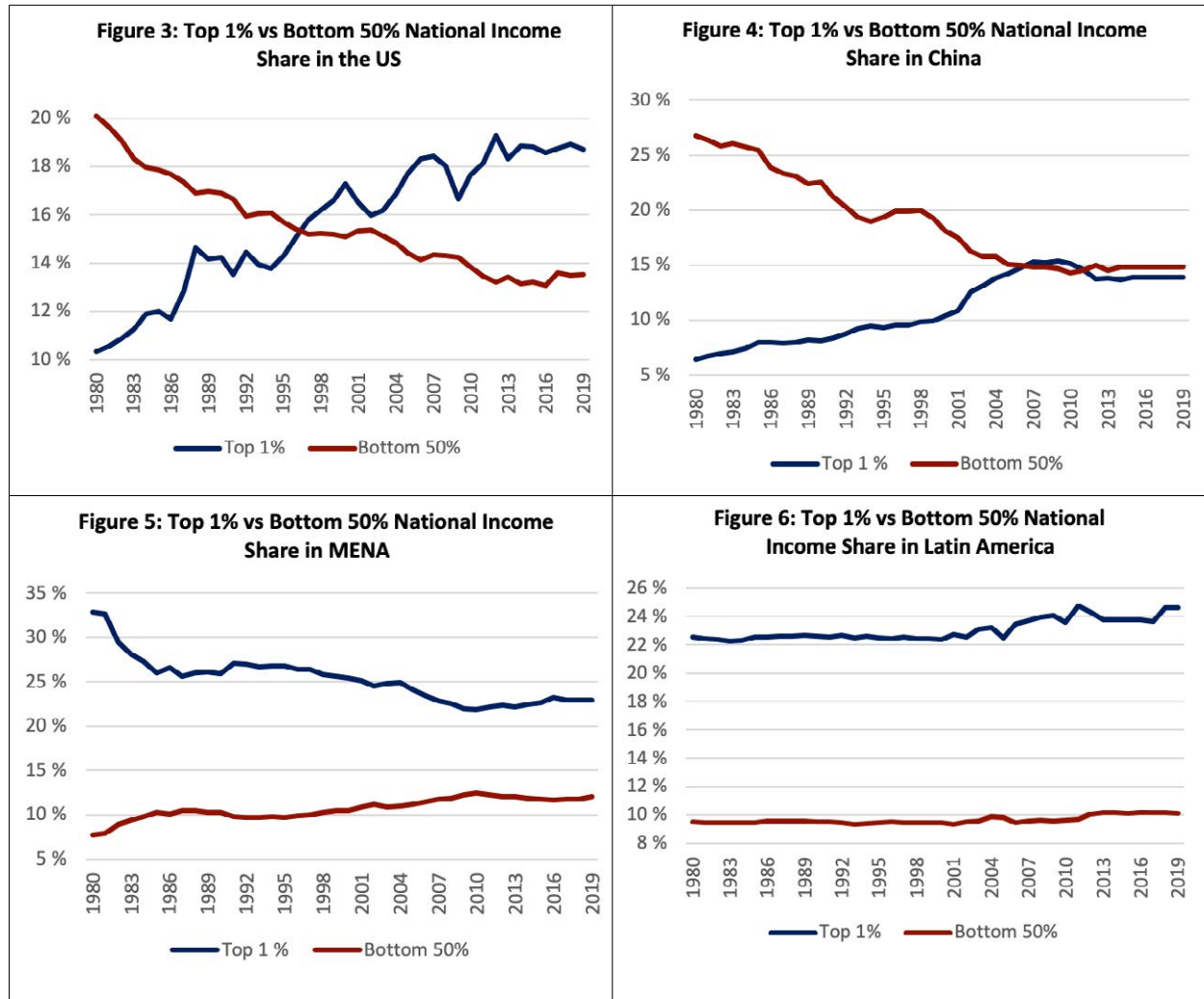
	Employment in agriculture (% of total employment) (modeled ILO estimate)		Employment in industry (% of total employment) (modeled ILO estimate)		Employment in services (% of total employment) (modeled ILO estimate)	
Country	1991	2019	1991	2019	1991	2019
United States	1.9%	1.3%	26.0%	19.8%	72.1%	78.9%
France	5.7%	2.4%	28.4%	20.1%	65.9%	77.5%
Germany	3.5%	1.2%	37.6%	27.0%	58.9%	71.7%
United Kingdom	2.2%	1.0%	30.4%	17.9%	67.5%	81.1%
Japan	6.7%	3.4%	34.6%	24.3%	58.7%	72.3%
China	59.7%	25.4%	21.4%	28.2%	18.9%	46.4%
European Union	10.7%	4.4%	34.2%	24.9%	55.1%	70.7%
High income	7.0%	3.1%	31.2%	22.9%	61.8%	74.1%
Upper middle income	48.4%	21.6%	22.7%	25.8%	28.9%	52.6%
Lower middle income	58.2%	39.5%	15.7%	22.4%	26.1%	38.1%
Low income	69.3%	59.1%	10.0%	10.9%	20.7%	30.0%
Sub-Saharan Africa	62.6%	52.6%	10.9%	11.3%	26.5%	36.0%

Source: WDI, World Bank, 2020.

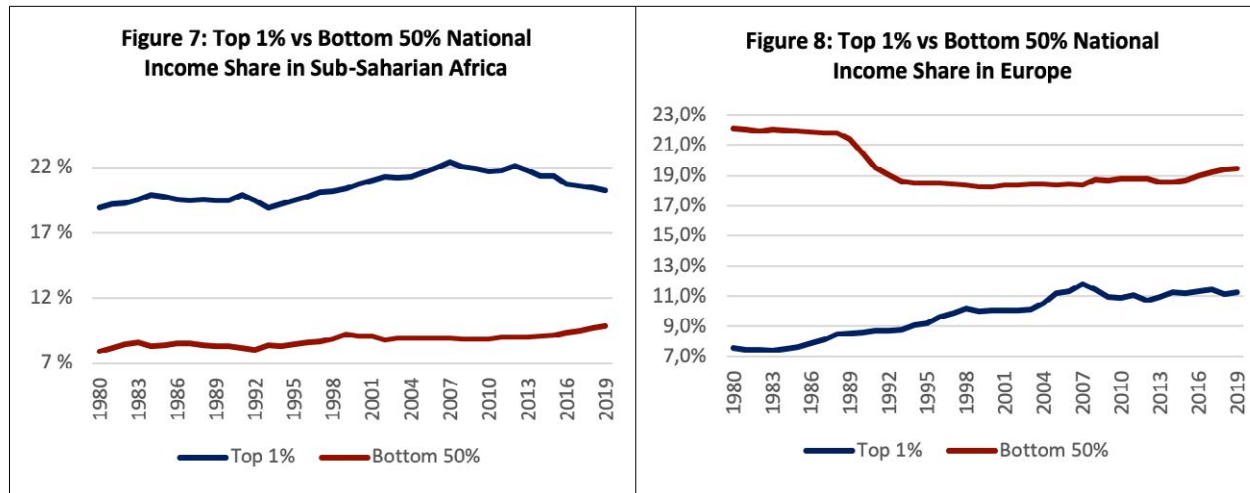
Furthermore, it is important to underline that workers generally have initial training and experiences that are very specific to particular jobs and sectors, and given that the process of skill acquisition can be long and requires large investment, the adjustment period can be difficult and can lead to frictional unemployment, at least in the short run, for some categories of low-skilled workers. In addition, as automation allows to replace easily routines and repetitive tasks, it reduces the demand for these skills and workers, and also leads to lower their wages. Therefore, the adjustment and transition period can also be socially costly.

Growing Inequality

Technological advances have not only disrupted and changed the structure of labor markets. Most worrisome from the economic and political points of view is that they have also contributed in the past three decades to a significant increase in inequality⁷ in developed, emerging and developing countries (Card and Dinardo, 2002). Inequality has increased since 1980 in almost all world regions, but at speeds and rates that vary from one country to another, highlighting the important role of each country's national economic policies in dealing with inequality (Figures 3 to 8).



7. Globalization is also an important factor that contributes to these trend by also placing a premium on skills, even in countries which have an abundance of unskilled labor, and by creating many winner-takes-all opportunities. See <https://www.worldbank.org/en/news/feature/2014/06/23/theorist-eric-maskin-globalization-is-increasing-inequality>. See also, for instance, Era Dabla-Norris et al (2015) and Piketty (2019) for more detail on the causes and consequences of income inequality.

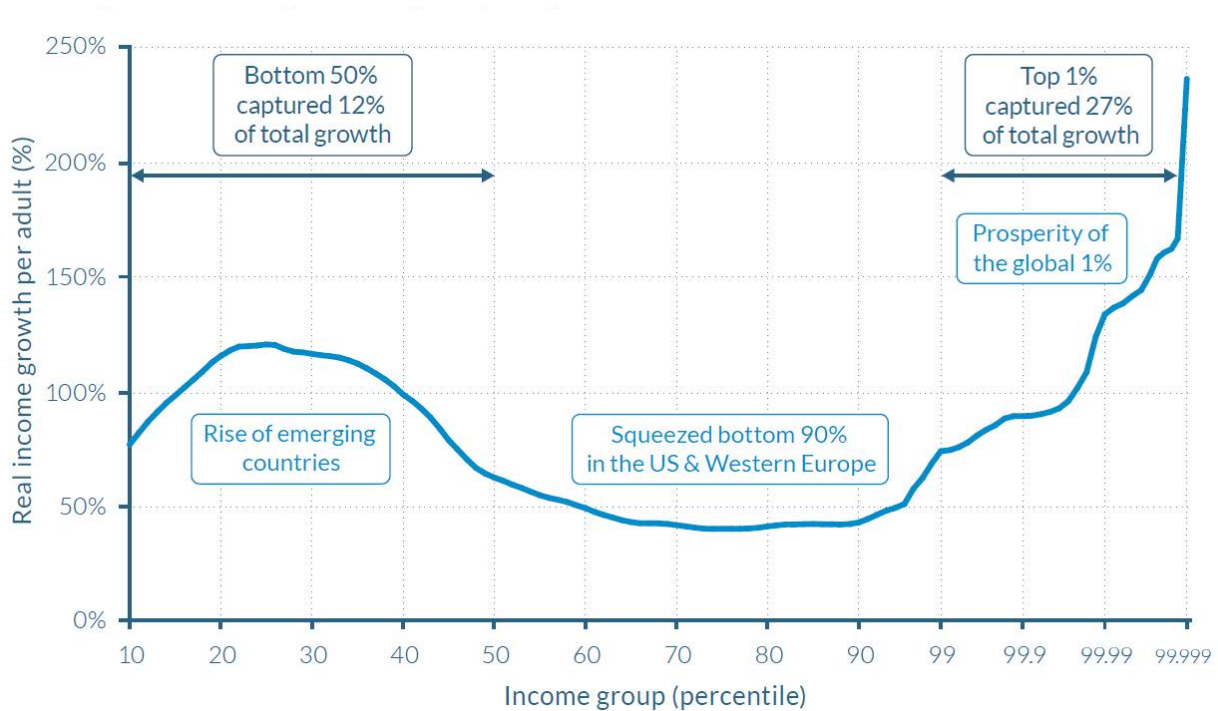


Source: World Inequality Database, 2020.

It should be emphasized that technological progress has been skilled-biased and has disproportionately favored high-skilled workers over low-skilled ones, leading to a polarization of the labor market and income gains at the global level (ILO, 2017).

As shown in Figure 9, which represents the elephant curve of global inequality, the people in the bottom half of the income distribution saw a significant increase in their incomes between 1980 and 2018 (between 60% and 120%), while the people in the top 1% of the income distribution have experienced an even greater increase in their incomes (between 80% and 240%), while people in the middle class have seen stagnation in their incomes. In other words, inequality has decreased between the bottom and middle of the global income distribution, and increased between the middle and the top of the income distribution (Piketty, 2019).

Figure 9: The elephant curve of Global Inequality and Growth, 1980-2016



Source: WID.world (2017). See wir2018.wid.world for more details.

How do Technology and Employment Interact?

The overall impact of technology on employment is both complex and ambiguous. There are forces that are disruptive, that destroy jobs, and others that are self-correcting and increase the demand for labor. It is important to emphasize that the adoption of technologies not only increases the productivity of labor and capital, but also impacts the distribution and the reallocation of tasks to these factors of production (Acemoglu and Restrepo, 2019). In fact, we can distinguish, as explained by Acemoglu, two types of technologies that can have different implications for workers. The first are enabling technologies, which complement and increase the productivity of workers in the tasks and functions they perform. Moreover, when the use of these technologies is accompanied by a significant increase in productivity, it becomes possible to generate increase in both wages and labor demand.

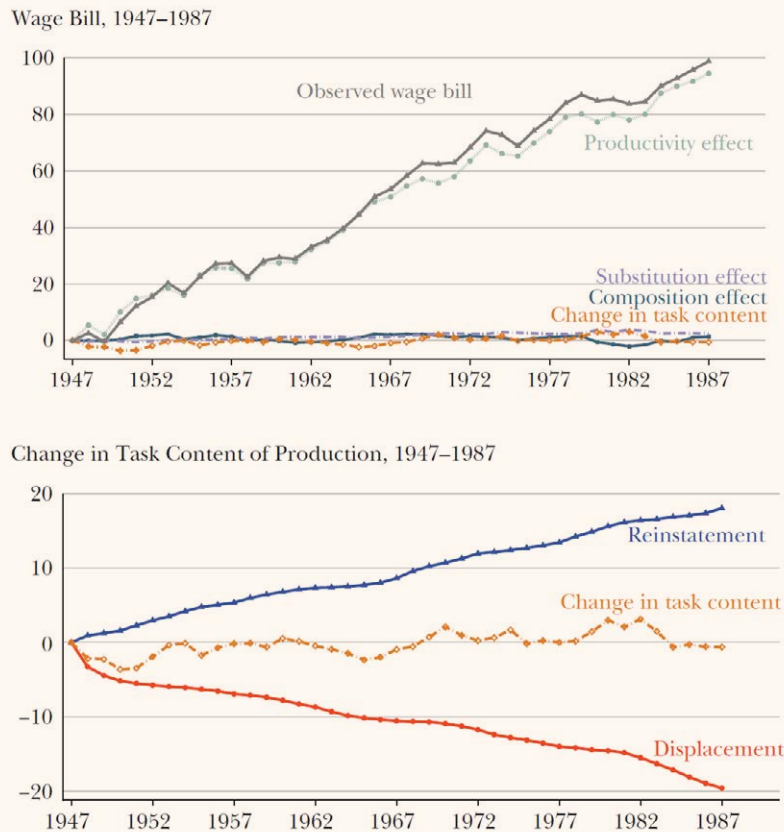
The second type concerns replacement technologies, which, through automation, eliminate and replace work in certain tasks that are repetitive, which subsequently leads to lower wages for these categories of workers. However, it is important to note that the overall impact on the workforce will depend on the productivity effect. In fact, when these technologies allow a significant increase in productivity that is accompanied by a decrease in general price level, then they will tend to create positive externalities by increasing global demand in other sectors and, as a result, increasing demand for labor in additional and new activities that may not have existed in the past. These new tasks create a reinstatement effect, thereby

offsetting the direct negative effect of automation on employment. However, when productivity fails to grow significantly, low-skilled workers face a double blow: many workers will lose their jobs but low levels of productivity do not allow for significant development of new tasks for the displaced workforce.

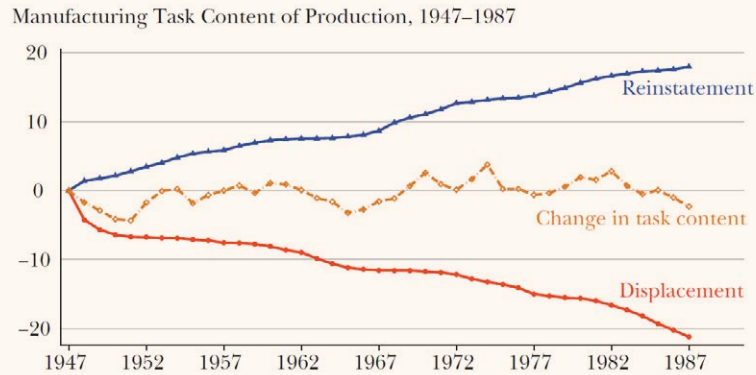
Box 1: The Impact of Technology on the Labor Market: Evidence from the U.S.

Acemoglu and Restrepo's (2019) estimates⁸ showed that during the four decades following the Second World War, the introduction of new technologies generated two completely different effects on employment—in the entire economy and in the manufacturing sector—in the United States. The first was a displacement effect due to automation, which was accompanied by a loss of jobs, and the second was a reinstatement effect—which had a positive effect on job creation—whereby new technologies created new jobs and new employment opportunities for workers. It should be noted that the sum of these two effects was equal to zero, which means that technologies during this period had no negative effect and posed no threat to U.S. job creation prospects over this period. On the contrary, they led to an increase in productivity and an improvement in the population's standard of living.

Figure 10: Sources of Changes in Labor Demand, 1947-1987



8. For more detail on the impact of technology on the US labor market, see Acemoglu and Restrepo (2019).



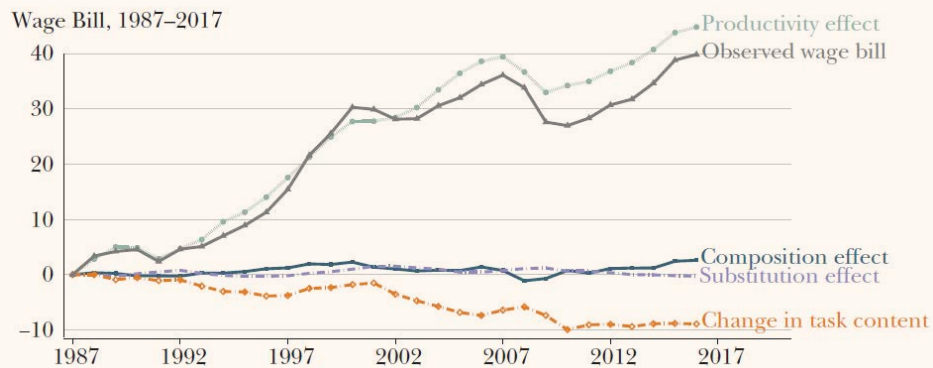
Source : Acemoglu and Restrepo, 2019.

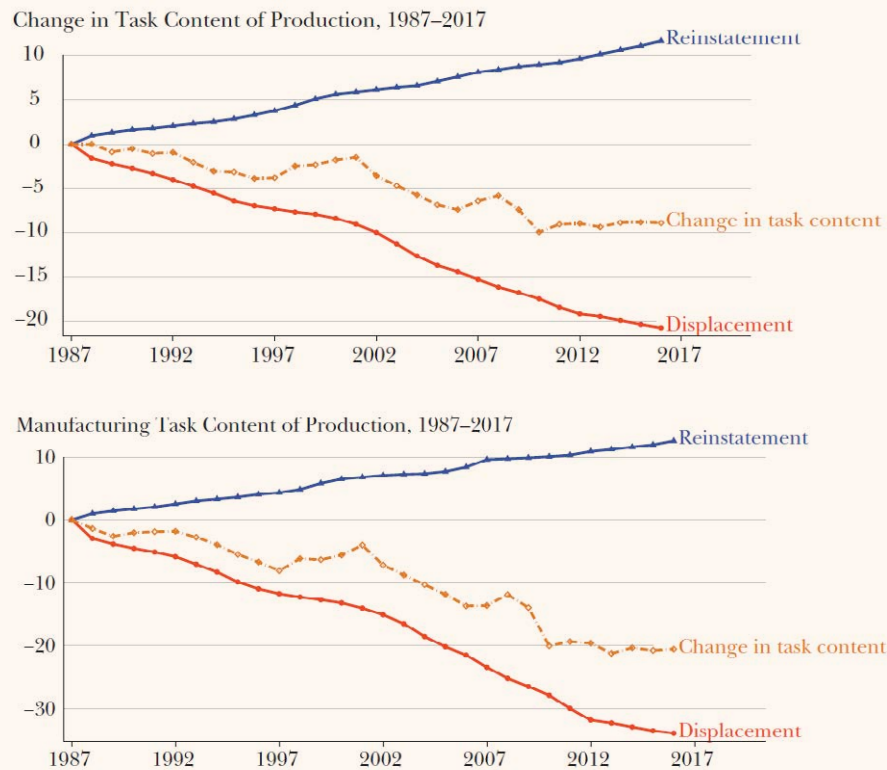
Note: The top panel presents the decomposition of the wage bill divided by population between 1947 and 1987. The bottom left and the bottom right panels present estimates of the displacement and reinstatement effects for the entire economy and the manufacturing sector, respectively.

However, the net total impact of technologies on employment over the period 1987-2017 was negative. Although automation to some extent increased productivity, the sum of the total displacement effect and the reinstatement effect was negative, meaning that technologies during this period had negative implications for workers and destroyed more jobs than they created.

It should be noted that the main reasons behind this slowdown in employment in the United States over the last three decades are: the acceleration of labor displacement in the manufacturing sector, a weaker reinstatement effect, and slower productivity growth compared to previous decades (Acemoglu and Restrepo, 2019).

Figure 11: Sources of Changes in Labor Demand, 1987-2017





Source: Acemoglu and Restrepo, 2019.

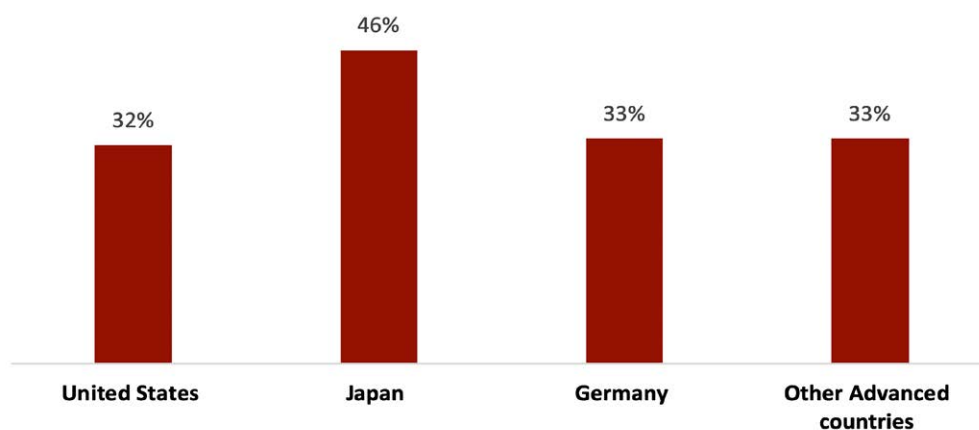
Note: The top panel presents the decomposition of the wage bill divided by population between 1987 and 2017. The bottom left and bottom right panels present estimates of the displacement and reinstatement effects for the entire economy and the manufacturing sector, respectively.

Automation Technologies are Likely to Disrupt in the Future More Jobs in Advanced Countries Than in Developing Countries and in Africa

The trend towards greater automation is expected to continue and even accelerate. According to a McKinsey report published in 2017, 50% of the jobs for which individuals are paid today could technically be automated by 2030, and nearly 400 million jobs could be displaced as a result of automation⁹ by 2030.

Advanced countries that are well ahead in this Industrial Revolution 4.0, will be greatly impacted by this phenomenon of technology-driven labor displacement. On average, nearly one-third of the workforce in industrial countries will need to change occupational category by 2030 (Figure 12).

Figure 12: % of the Total Workforce that Must Change Occupational Category by 2030, Advanced Countries



Source: McKinsey Global Institute Analysis, 2017.

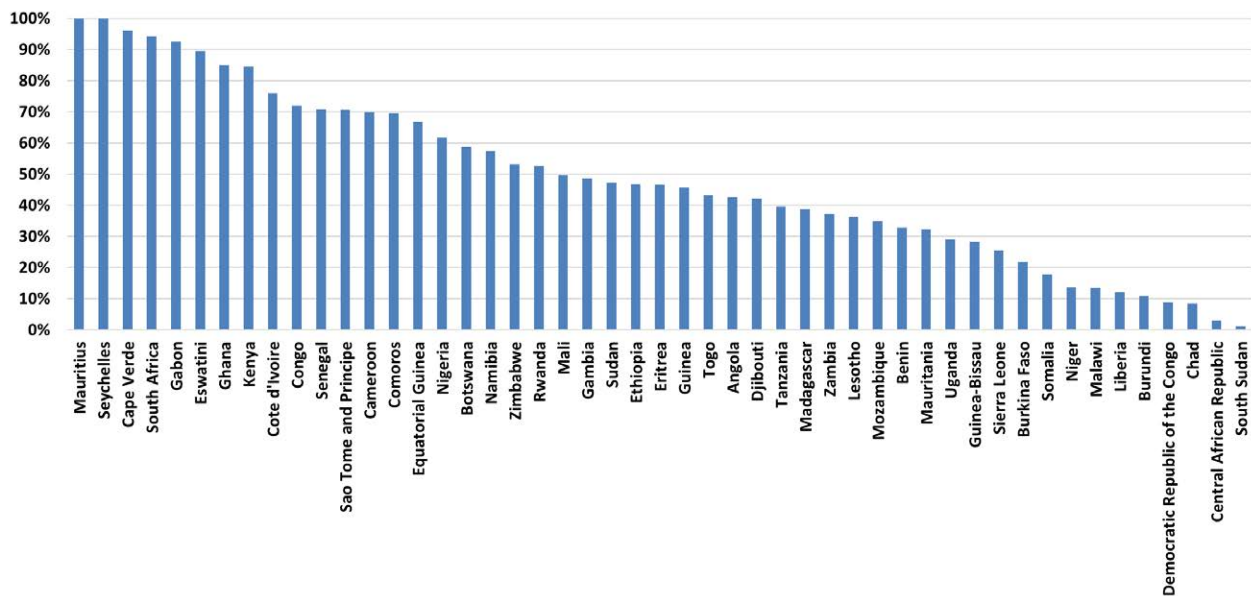
Furthermore, it is important to note that the faster new technologies¹⁰ evolve and are adopted, the more difficult and costly it will be to adapt to skill levels, especially for low- and medium-skilled workers. On the other hand, as the price of technology declines, firms will be encouraged to adopt technology on a large scale and to automate their production processes, ultimately replacing labor with capital.

9. Two major characteristics distinguish recent technological advances from those of the past: first, today's new technologies can have important and major implications for many workers and industries at the same time. Indeed, not all industries were affected at the same time two centuries ago, but all industries now use digital technologies (Ford, 2015). The second concerns the time it takes to adopt and deploy technology. The transition from the agricultural sector to the industrial sector took several decades, whereas with software, AI, and robots, many solutions can be deployed much faster.

10. The speed of adoption of new technologies beyond technical feasibility will depend also on the cost of deploying automation solutions, the suitability of new technologies, the availability of the appropriate workforce and the digital infrastructure needed for their use, and social acceptance of the regulatory framework.

It should be noted, however, that the displacement effect following the adoption of new technologies should be less significant in developing countries¹¹, particularly in Africa, compared to advanced countries, for three main reasons. The first is related to the low levels of employment in the manufacturing sector. The manufacturing sector accounts for only 8% of Africa's total labor force. Therefore, new technologies are not expected to have a big displacement effect on workers in this sector compared to developed countries. The second reason relates to the lack of energy infrastructure in Africa, especially low rates of access to the internet and electricity, which hold back the adoption of technologies. As shown in Figure 13, the proportion of the population with access to electricity is only 48% on average in sub-Saharan Africa, and remains very low in several countries, with less than 10% of the total population having access in countries such as Chad and Burundi.

Figure 13: Proportion of the Population with Access to Electricity (%) by Country in SSA, 2019



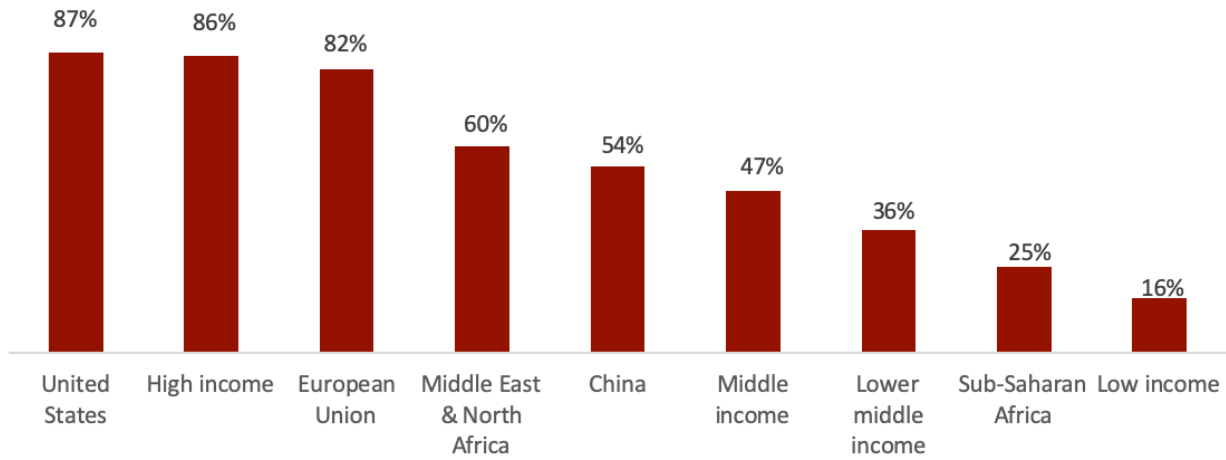
Source: IEA, World Energy Outlook 2020.

Access to the internet remains also a big challenge for several developing countries, where in 2019, nearly 3.7 billion¹² people, about 50% of the world population, still did not have internet access, the majority of whom live in poorer countries. Access to the internet in sub-Saharan Africa is very low and represents only 25% of the total population (Figure 14).

11. According to McKinsey's estimates, only 9% to 13% of the workforce in developing countries is expected to change occupational category by 2030 (McKinsey, 2017). See also the World Bank's 2020 report on the future of employment in Africa.

12. See <https://www.weforum.org/agenda/2020/04/coronavirus-covid-19-pandemic-digital-divide-internet-data-broadband-mobile/>.

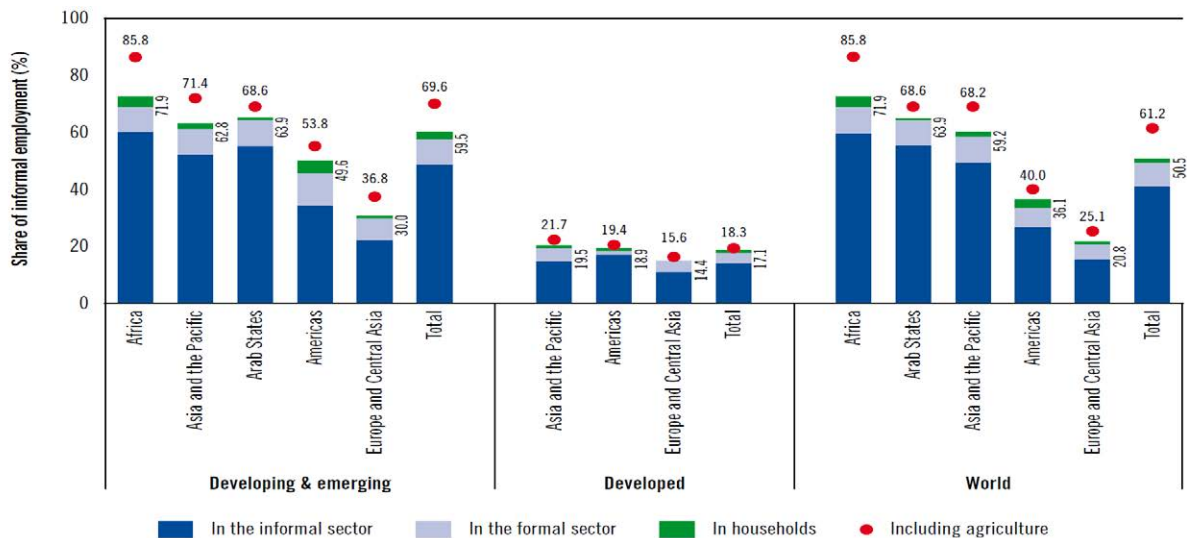
Figure 14: Individuals Using the Internet in 2019 (% of population)



Source: WDI, World Bank, 2021.

The third reason is related to the weakness of human capital and the larger share of the informal sector in total employment, which holds back the rapid adoption of new technologies in developing countries, particularly in Africa, compared to developed countries. It should be noted that the share of the informal sector in total employment in sub-Saharan Africa remains highest among all world regions and represents about 86%, compared to only 20% in developed countries (Figure 15).

Figure 15: Share of Informal Sector Employment, by Region and Level of Development, 2016



Source: ILO, 2018.

Implications for Africa and Policy Recommendations

It is important to recall that developing countries in general and in Africa in particular, have missed the past three industrial revolutions. The first was marked by the emergence of mechanization following the invention of the steam engine and the exploitation of coal. The second was marked by the emergence of new sources of energy: electricity, gas, and oil, and the development of the automobile industry. The third was marked by the emergence of new information and communication technologies. However, Africa and developing countries should not miss out on this new digital revolution, which offers new opportunities¹³ to increase productivity in several sectors, and new prospects for young people.

The adoption of new technologies¹⁴ can be an important factor in fostering more inclusive growth in Africa. Indeed, given the important role of the agricultural sector in African economies, the introduction of modern mechanical and digital technologies¹⁵ can help increase the sector's overall productivity and improve people's living standards. In addition, new technologies can enable small farmers to access new markets and increase their incomes through sales of their products via digital platforms. Furthermore, new digital technologies can play a crucial role in boosting the productivity of workers in the informal sector, and can subsequently foster a transformation of this sector. It should be noted that a significant increase in productivity could encourage a natural movement of very small companies operating in the informal sector to greater formalization, so that they can grow further by gaining access to bank financing (Choi et al, 2020).

However, it is important to note that Africa will face in the future several shocks, both climatic and technological¹⁶, which may result in significant labor displacement. In addition, an acceleration in automation in developed countries may also negatively impact developing countries, particularly African countries, by diverting investment from these countries to advanced nations where the prerequisites for automation are already established (Cristian Alonso et al, 2020). This may promote the substitution of labor in developing countries by robots, software, and artificial intelligence that can perform in the future the same tasks that were performed by cheap labor in African countries (Rodrick, 2018).

African countries must act quickly while they still have time to take advantage of globalization and cheap labor. The continental free trade area offers a huge opportunity to foster the structural transformation of African economies and create a dynamic of job creation at the continental level. Governments must start preparing now to facilitate the future labor market transition by developing the necessary digital

13. New technologies offer many new opportunities, but if they are not adequately regulated, the "dark side" will predominate, leading to greater concentration of power, more inequality, more tax evasion, and other challenges (Stiglitz, 2020).

14. See <http://www.fao.org/news/story/fr/item/1156101/icode/>.

15. New technologies could help increase agriculture productivity and value added, and contribute to Africa's food security and prosperity (FAO, 2018).

16. According to a 2020 World Bank report, climate change is an ongoing threat to poverty reduction, which will intensify in the upcoming years and it is estimated it will push 68 million to 135 million into poverty by 2030. Moreover, it is important to emphasize that the fight against poverty is already a major challenge facing African countries, where the proportion of the population living in extreme poverty was 41% in 2015. The COVID-19 pandemic could drastically increase the number of people living in extreme poverty by 88 million to 115 million.

infrastructure—including better access to the internet and electricity—for better adoption of new technologies.

It is crucial to ensure investment in inclusive technologies that take into account the specificities of the African labor market and that also increase the productivity of low-skilled workers. Investing in human capital and improving the skills of workers are two crucial strategies that will limit the negative impact that technology can have on the workforce, and will also enable workers to take full advantage of the opportunities offered by new technologies. What needs to be emphasized is that the current education system is very ill-prepared to prepare young people for an uncertain, dynamic environment. Access to quality education and vocational training is extremely important to properly promote the employability, resilience, and inclusion of African youth. In the current context, it is crucial to rethink completely education systems and the way we teach our young people, and to start now investing in skills that will be complementary to new technologies. In addition, supporting and sharing useful information with younger generations to make better use of technology will be extremely important to enable young people to take full advantage of the opportunities that digital technology can offer.

Furthermore, it should be highlighted that the current coronavirus crisis has shown that there is also an urgent need to develop in developing countries, particularly in Africa, effective social safety nets to help absorb the devastating impact that future recessions and crises may have on household purchasing power, and also to support workers in the future transition of the labor market (Saoudi, 2019).

Finally, and given the slowdown in growth and the deterioration of fiscal space in several African countries as a result of the COVID-19 crisis (IMF's Regional Economic Outlook for Sub-Saharan Africa, 2020), good governance and policies that aim to reduce corruption and improve the business climate are more than ever necessary to foster a dynamic of entrepreneurship and private investment, which will be essential for more job creation in Africa.

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THE IMPACT OF NEW TECHNOLOGIES ON EMPLOYMENT AND THE WORKFORCE

What are the Implications for Developing Countries, Especially in Africa?

There are fears that new technologies, including automation, advanced robotics, and artificial intelligence, will lead to massive job destruction. However, new technologies could have a net positive impact on employment and create new tasks and opportunities, for which labor offers greater comparative advantage than capital.

Historically, technological advances have driven productivity growth, generated a sustained increase in GDP per capita, and created more jobs than they have destroyed. However, they have brought about several disruptions, particularly in the labor market, creating new jobs and sectors, while destroying and modifying others, with major consequences for certain categories of the population, especially low-skilled workers.

The future of work will certainly depend on how artificial intelligence, robots, and automation impact the allocation of tasks to labor and capital. It will also depend on the preparation and measures taken by governments, in particular, for effective support of the population during the future labor market transition, in order to ensure that new technologies are inclusive and beneficial to all parts of society.

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