Artificial Intelligence, Automation and the Future of Work

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Values, norms and language have evolved over the last few decades. What has remained the same, however, is the fear of the machine. In 2015, Brynjolfsson and McAfee wrote a paper titled "*Will Humans go the way of Horses?*", asking whether disruptive innovations in technology, particularly in Artificial Intelligence will make human labour obsolete. The title of this paper accurately reflects the intent of our research. Mankind is on the brink of the fourth industrial revolution and we live in an age where breakthrough technologies like AI, ML and internet-of-things have enabled tasks that could never be imagined before. On the one hand, there is a lot of optimism about the productivity effects of these technologies, but on the other, there is a growing fear and obsession of potential mass technological unemployment and some commentators see this as a harbinger of a jobless future. The persistence of these contrasting visions is unsurprising given the limited evidence to date on the labour market consequences of AI.

The relationship between AI and jobs is important to analyze because technological advancements fuel fears that machine capabilities might make humans obsolete in the production process and completely change jobs of the future. Our paper analyses this complex relationship and argues that even though AI might change employment across sectors and occupations, AI and future jobs can have a fruitful interaction without necessarily having a disruptive effect. AI might create more jobs than are lost. We also examine the case of India and argue that the apocalyptic notion that automation will cause large-scale technological unemployment is exaggerated, at least in developing economies like India.

Literature Review

On the one hand, there is literature arguing that the pace at which employment is destroyed by the introduction of productivity-enhancing technology may exceed the pace at

which mankind is able to find new uses for those becoming unemployed (Keynes, 1930). Mankind may thus, face mass unemployment and increasing income inequality, which calls for unemployment relief through income redistribution and unemployment benefits (Leontief, 1983). Articles in popular media and consulting reports have argued that AI may create a future with structurally high levels of unemployment (or even the "end of work"), stagnating median wages, and increasing income inequality (Ford, 2015). With such consequences, further automation may well be economically and socially unsustainable in the long run.

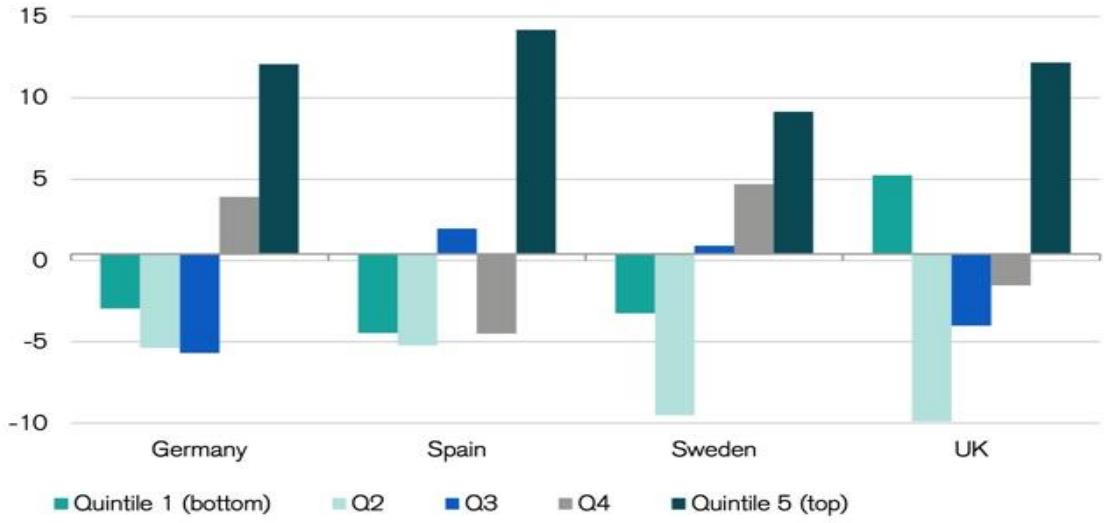
But on the contrary, there is a sizable body of literature which argues that, although automation will displace some workers, the technological change also creates demand for labour. "While automation increases productivity and thereby causes unemployment, there are countervailing effects such as increasing product demand, local demand spill overs, increasing demand for new skills or even new jobs required for new products and services" (Acemoglu, 2002). Autor (2015) aptly states "*automation does indeed substitute for labour—as it is typically intended to do. However, automation also complements labour, raises output in ways that lead to higher demand for labour, and interacts with adjustments in labour supply*".

Acemoglu (2016) believes that automation will lead to polarization of the labour market and give rise to more high skilled and low skilled jobs, crowding out medium skilled jobs. Lalive and Oesch (2019) assess this claim and examine job polarization and educational upgrading[1] in four European countries, based on recent data. The figure below shows the results that the highest paying jobs (the last bar) have increased in all countries, implying upgradation of jobs. It also suggests that automation might lead to a shift in jobs between

[1] Educational upgrading is a phenomenon in which employment in highly-paid jobs grows strongest.

sectors, which might lead to short term technological unemployment in medium skilled jobs. Thus, opinions in the literature are varied.

Figure 1: Relative change in employment across job-quality quintiles 1992–2015
In percentage points



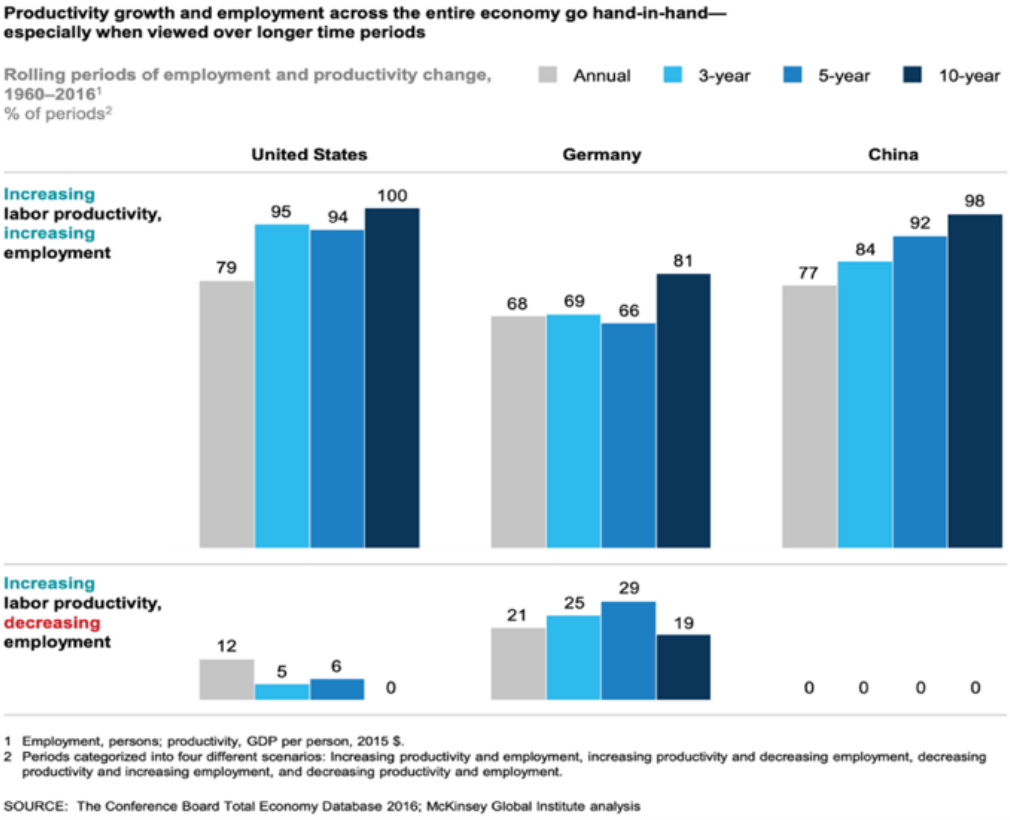
Data: EU-LFS (Labor Force Survey) 1992–2015 for Germany, Spain and the UK, 1997–2015 for Sweden.
Reading example: in Germany 1992–2015, the share of total employment set in the lowest-paid occupations of quintile 1 fell by 3.3 percentage points, whereas it increased by 11.7 percentage points in the highest-paid occupations of quintile 5.
Source: Oesch and Piccitto (forthcoming).

A Productivity Driven Case for Optimism

When firms automate production, the job growth in an economy is affected through different channels (Acemoglu, 2016). First, new technologies lead to a substitution of current jobs and workers (*the displacement effect*); second, there is a complementary increase in jobs and tasks necessary to run and supervise the new machines (*the skill complementarity effect*) and third, there is a demand effect from both, lower prices and increase in disposable income in the economy due to higher productivity (*the productivity effect*). Although unemployment might rise temporarily, if the productivity effect from better technology is greater than the displacement effect, we should see a net positive job growth.

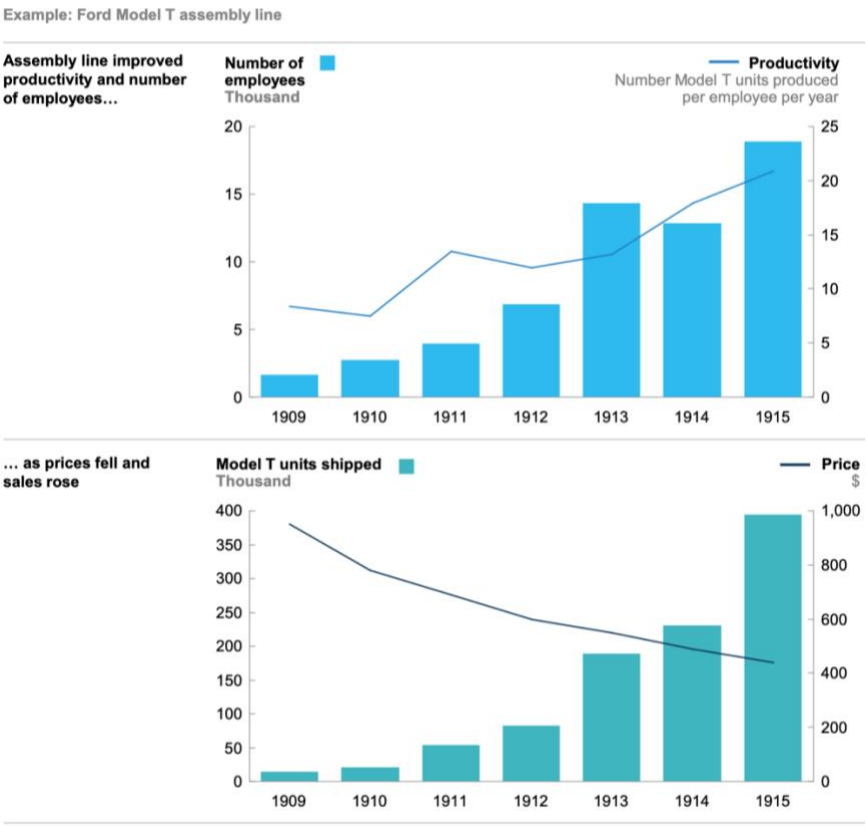
The productivity effect will in turn lower prices and raise wages, either of which leads to more spending and investment, creating more jobs. “From 1997-2015, which were the

boom times for information technology, productivity growth in EU15 nations was positively correlated with growth in labour hours, suggesting that stronger productivity goes hand in hand with more jobs" (Atkinson, 2019). Evidence of the economy-wide positive correlation among technology, productivity, and employment can also be seen in the aggregate data across countries. The graph below suggests that productivity growth and employment across the entire economy usually go hand in hand, especially over longer periods of time (Autor, 2015).



Historical evidence corroborates with our optimism on the productivity effects of these technologies. The 'Ford Model' provides one historical example. "The assembly line dramatically improved the productivity of the process of manufacturing automobiles and the number of models produced per worker annually nearly tripled. This surge in productivity, combined with increasing economies of scale, enabled Ford to reduce the price from $950 in

1909 to $440 in 1915. As a result, the number of cars sold increased 30-fold, and employment rose from 1,655 to 18,892" (David, 1985).



Source: US Bureau of Labour Statistics; MGI Analysis

Why might AI not be disruptive?

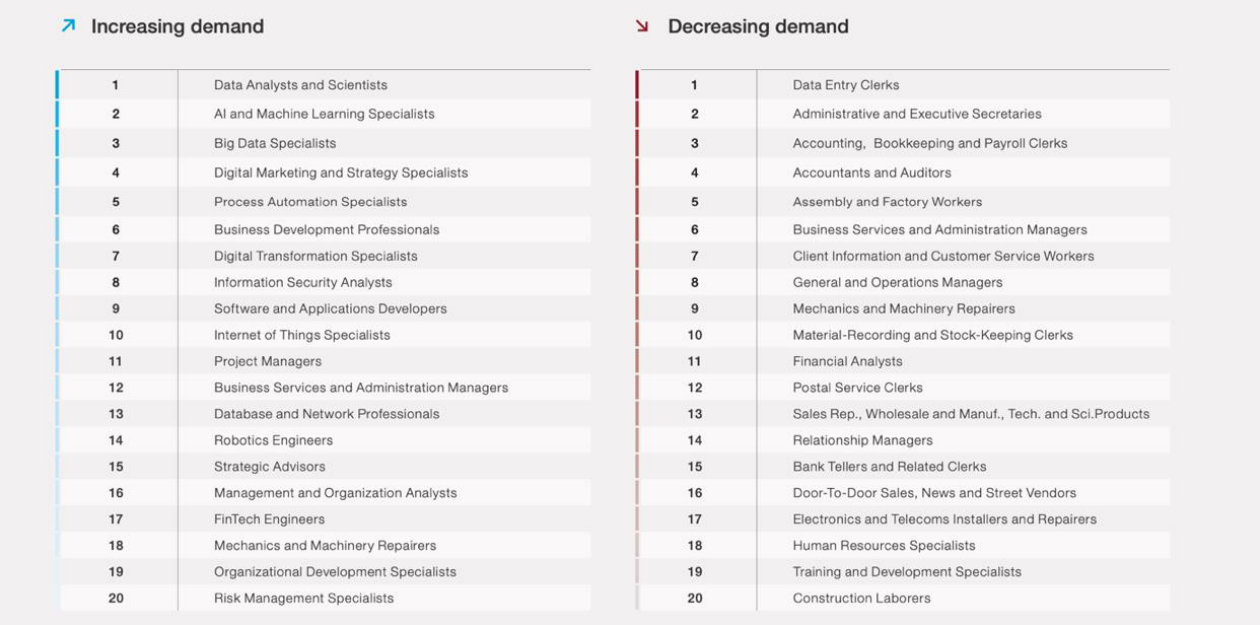
Two OECD studies point towards two very distinctive future scenarios: the scenario of *disruptive change* and the scenario of *continuous change.* The first transition predicts a deep break with sudden and disruptive changes, the second predicts a gradual, inclusive and accommodating change. In our opinion, a continuous change scenario seems more realistic. Workers can continuously adapt to technological change and constantly evolve over time. Moreover, while new technologies might certainly decrease jobs in some occupations and industries, it will also create many new jobs due to countervailing productivity effects.

However, a smooth change also demands *upskilling* and *retraining* of the workforce, which in turn might depend upon the characteristics of workers/resources in different countries.

In the case of AI, *job displacement* rather than *job replacement* may be more likely. Thus, many new jobs or tasks are likely to be created by AI, including jobs that may not at present exist. Empirical evidence seems to bear out that this is already happening. For example, Dauth et al. (2017) finds that there are no net job losses in Germany as a result of automation. Berriman and Hawksworth (2017) reckons that in the UK there will be jobs at risk from automation (they estimate around 30 percent) but conclude that the overall net impact of automation on jobs will be neutral as a result of new jobs being created elsewhere in the economy.

There might be a restructuring of jobs. But if the demand for products and services from the automated sector is highly price-elastic, any increase in labour-saving technology might be more than offset by increases in demand. For instance, "despite the labour-saving nature of ATM, employment in the banking sector grew continuously as the cost of opening new outlets fell, helping attract a larger customer base while at the same time, shifting bank employees from clerk services to sales and counselling" (Bessen, 2015).

Additionally, we believe automation may affect tasks more directly rather than jobs themselves. In that case, the claims of mass unemployment due to automation are exaggerated because automation tends rather to change the nature and content of jobs, such as the tasks that a job consist of, rather than eliminate a job altogether (Autor, 2015). AI will make prediction cheaper and increase the returns to jobs that involve human judgement, as can be seen in the table below.



↗ Increasing demand	
1	Data Analysts and Scientists
2	AI and Machine Learning Specialists
3	Big Data Specialists
4	Digital Marketing and Strategy Specialists
5	Process Automation Specialists
6	Business Development Professionals
7	Digital Transformation Specialists
8	Information Security Analysts
9	Software and Applications Developers
10	Internet of Things Specialists
11	Project Managers
12	Business Services and Administration Managers
13	Database and Network Professionals
14	Robotics Engineers
15	Strategic Advisors
16	Management and Organization Analysts
17	FinTech Engineers
18	Mechanics and Machinery Repairers
19	Organizational Development Specialists
20	Risk Management Specialists

↘ Decreasing demand	
1	Data Entry Clerks
2	Administrative and Executive Secretaries
3	Accounting, Bookkeeping and Payroll Clerks
4	Accountants and Auditors
5	Assembly and Factory Workers
6	Business Services and Administration Managers
7	Client Information and Customer Service Workers
8	General and Operations Managers
9	Mechanics and Machinery Repairers
10	Material-Recording and Stock-Keeping Clerks
11	Financial Analysts
12	Postal Service Clerks
13	Sales Rep., Wholesale and Manuf., Tech. and Sci.Products
14	Relationship Managers
15	Bank Tellers and Related Clerks
16	Door-To-Door Sales, News and Street Vendors
17	Electronics and Telecoms Installers and Repairers
18	Human Resources Specialists
19	Training and Development Specialists
20	Construction Laborers

Source: World Economic Forum: Future of Jobs Survey

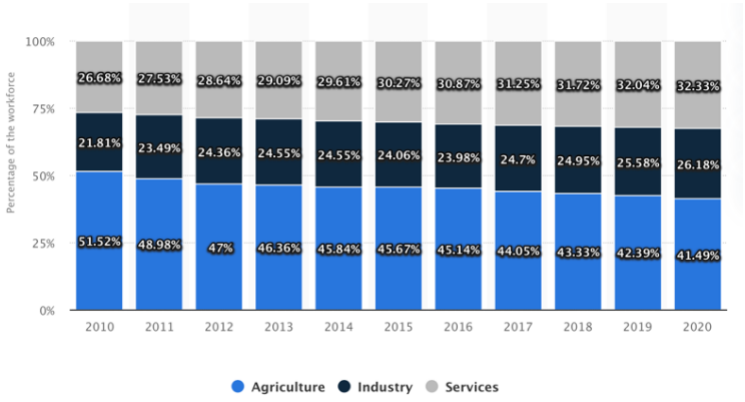
Finally, the diffusion of AI technology is much slower than is thought, especially in developing economies like India (and may even be slowing down), thereby limiting the impact of automation on jobs (OECD, 2015). Thus, the employment impact of automation is not likely to be as negative as predicted (and may even be positive). As we'll see in the next section of the paper, a lot depends on the *pace of technological adoption* and how smoothly individual countries harness these technologies.

Automation and its implications for India

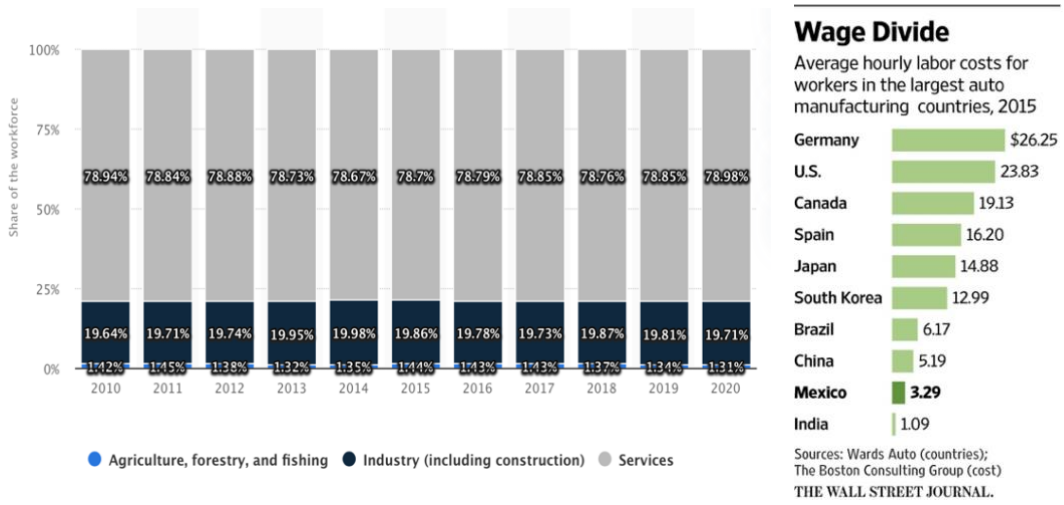
There are many factors which might affect the pace at which different countries harness new technologies. The first is **wage rates**. Higher wages make the business case for automation adoption stronger (MGI, 2017). In addition, **education levels** and the **mix of sectors and occupations** also affects the pace of automation. Among the main differences between emerging and advanced economies is the importance of agriculture in the former. Countries like Germany, USA and Japan, which have a strong manufacturing sector can leverage the potential of automation much better than a developing country like India. Subsequently, AI will create and replace more jobs in these economies than in countries with

a weak manufacturing sector. **Political factors** and government regulations are also likely to play a big role as the government will be hesitant to adopt these technologies in developing economies.

The impact of automation in India will be drastically different from what it might be, say, in the USA, if we look at some data. Majority of the Indian workforce is in MSME's and agriculture, sectors which barely use any advanced technology. Compare that to the USA, which is way ahead in terms of technological implementation and penetration and has almost 80% of the workforce in the services sector. This clearly implies that both, the productivity effects and replacement of jobs due to AI will be negligible in India, at least in the short to medium term, due to lack of technology penetration.



Distribution of Workforce across economic sectors for INDIA



Distribution of Workforce across economic sectors for USA

In India, most of the MSME's are unorganised and we firmly believe that the very structure of these firms acts as a hurdle to productivity and technology adoption as no incumbent has the incentive to adopt sophisticated technology. Further, looking at the wage levels in India (figure above), it is evident that there is a lack of skilled labour. The research on small businesses in India shows that the use of technology is minimal (Kumari, 2014), in that 85% of them do not have access to any technological know-how. Out of all the enterprises, 75% do not even have electricity, indicating heavy dependency on manual labour or practices.

Indian Experience in the light of Global Evidence

The notion of "*automation anxiety*" that lies at the root of an apocalyptic vision that machines will destroy millions of jobs is captured by the graph below. It shows that most populous countries like China and India have a higher risk of joblessness due to automation (57–69%) than either the "rest of the world" (50%) or the OECD countries (57%) (Islam, 2018). We firmly believe that one should exercise caution in interpreting these numbers. The statistics merely show that it is, in principle, possible for a significant proportion of current work undertaken by people to be replaced by machines. Hence, the estimates reveal theoretical possibilities, not actual outcomes.

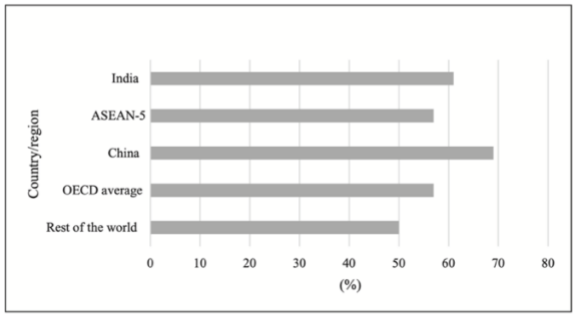
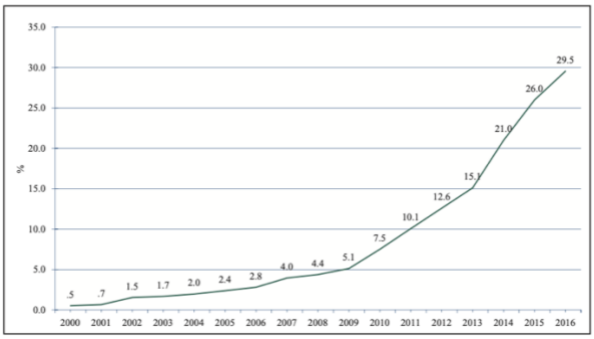


Figure 1. Percentage of Work at Risk of Automation

Source: Adapted from BCG and CII (2017, p. 38, Table 1).

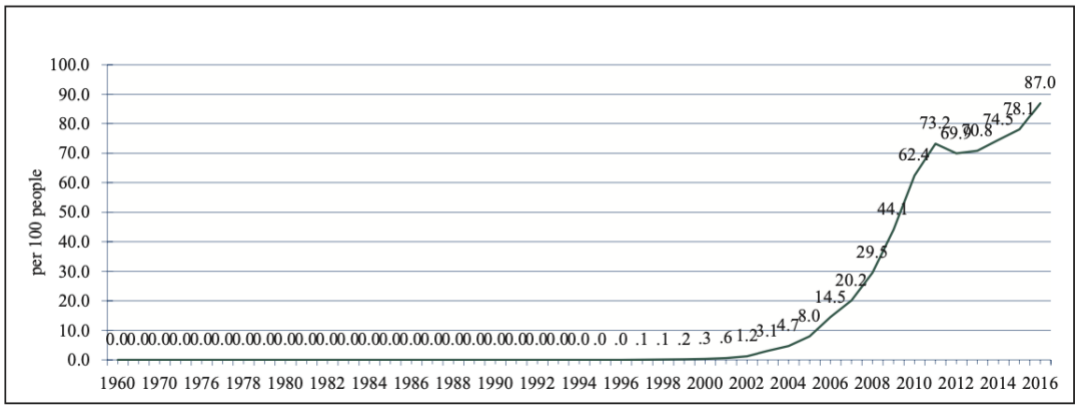
Notes: These estimates were pooled from multiple studies: McKinsey Global Institute (MGI), Frey and Osborne, ILO and CITI GPS and Oxford Martin School. Work is defined in different ways in different studies. In some cases, it is the share of tasks (MGI); in some cases it is the share of employment (ILO, Frey and Osborne); and in others, it is the proportion of jobs (The World Bank). The estimates for India and China are averages of a range of estimates (52–69% for India; 51–77% for China). All original sources as cited in BCG and CII.

Additionally, one should also emphasise that in developing countries like India in general and South Asia in particular, the challenge is not too much use of modern technology but too little use of it. “In the specific case of India, as the World Bank Enterprise Survey (2014) shows, a very small number of small Indian firms (less than 4%) had licensed foreign technology compared with 20.5% for larger firms with 100 or more workers” (Islam, 2018). The graphs below show that although the share of internet users has risen in India over the past decade, most of it is driven by mobile phone cellular subscription, which essentially is use of internet for unproductive activities.



India: Share of the Internet Users

Source: Retrieved from https://knoema.com, drawing on national and international sources.



India, Mobile Phone Cellular Subscriptions

Source: Retrieved from https://knoema.com, drawing on national and international sources.

Even in the manufacturing sector, the role of technology most closely associated with “*Automation 4.0*” is rather modest in India, especially with respect to the global evidence.

Global statistics suggest that two industries, automobiles and electronics, account for 66 per cent of the global supply of industrial robots. Furthermore, only five countries in the world (China, Korea, Japan, USA and Germany) account for 74 per cent of the total sales volume of industrial robots worldwide. In 2016, the latest year for which data is available, India accounted for only 0.9 per cent of the global supply of industrial robots. This is expected to rise to 1.5 per cent in 2020 (Islam, 2018). Thus, these tiny numbers are unlikely to engender employment displacement even in the modern manufacturing sector.

Conclusion

So, are we heading toward a future where AI, machines and algorithms will replace human labour and lead to mass unemployment? The answer this paper gives is rather optimistic and certainly against this conjecture.

According to our analysis, technology can be introduced without leading to the end of work and AI has the potential to increase productivity, thereby enabling employment growth. Further, the apocalyptic notion that automation will lead to technological unemployment is exaggerated, at least in developing countries like India. We are also cognisant of the fact that while AI might not lead to the end of work, it has the potential to displace people from occupation and sectors depending upon the nature of their jobs. Thus, there is a need for an "augmentation strategy", an approach where businesses utilise automation to complement and enhance their workforce comparative strengths.

The most important condition for our optimistic scenario to hold true would be investing in human capital. One cannot deny the fact that new tasks tend to require new skills. But to the extent that the workforce does not possess those skills, the adjustment process is hampered. It is imperative for the educational system to keep up and provide new type of skills, otherwise the adjustment will be greatly impeded and there will be a mismatch

between skills and technologies. Human capital will aid the transition and would be the key to long term, sustained and inclusive growth.

Thus, possibly, we are facing an economically and socially sustainable future in the long run in which the recent wave of automation is merely a period of transition with temporary technological unemployment.

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