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TECHNOLOGICAL CHANGE AND THE FUTURE OF JOBS

Harnessing the Positive Potential of Technology for an Inclusive Future of Jobs

Policy Implications
& Recommendations
for Policymakers

UNDP
Seoul Policy Centre

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This paper has been developed by the UNDP Seoul Policy Centre (USPC) at the request of the Korean Ministry of Foreign Affairs to analyze the potentially disruptive impact of rapid technological change on an increasingly globalized and urbanized labour market. The paper considers the drivers of technological change and the emerging landscape. It explores the changing boundaries and organization of work as the scope and the very definition of jobs are shifting, and distinctions among employers, employees, and customers are becoming fuzzier. It considers major challenges and opportunities and takes a closer look at the implications of a changing labour market in three specific dimensions – societal, youth and gender. It draws on the analysis to offer policy recommendations for both countries ranking high in the Human Development Index (HDI) with a strong focus on Korea, as well as those with lower HDI rankings. The authors would like to thank Pedro Conceicao, Director of Strategic Policy Unit, Bureau of Policy and Programming Support for his guidance and support. The authors would also like to acknowledge the useful feedback on earlier drafts of the paper from Max Everest-Phillips, Devika Iyer, Marc Lepage, and Ben Slay, participants of the November 2017 workshop on this paper, as well as Hye-Jin Park, Ahjung Lee, Artemy Izmestiev, and Sarwat Chowdhury.

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Foreword

New and emerging technologies are shaping the world we live in and our future. Increasingly, policy makers, business leaders, regulators and academics are seeking germane analysis of the current and potential impacts to guide the formulation and implementation of policies for a sustainable, inclusive, and resilient future.

USPC has developed this paper to survey the risks and benefits of technological change and assist policymakers in designing such policies. Developed in consultation with experts and senior public and private sector leaders, this paper highlights key aspects of how accelerating technological change in conjunction with already ongoing seismic shifts—notably globalization, demographic developments, urbanization, and climate change—will shape the future. This paper focuses on the implications on the labour market. Keeping sustainability in mind, it suggests possible policy actions to consider for policymakers. The recommendations from this analysis are not intended to be prescriptive in all cases and need to be adapted to address national priorities and contexts.

Abbreviations

AI	Artificial Intelligence
AR	Augmented Reality
ASEAN	Association of South-East Asian Nations
GDP	Gross Domestic Product
HDI	Human Development Index
ICT	Information Communication Technology
ILO	International Labour Organization
IOT	Internet of Things
MGI	McKinsey Global Institute
MOOC	Massive Open Online Course
ODL	Online and Distance Learning
OECD	Organization for Economic Cooperation and Development
SDGs	Sustainable Development Goals
SME	Small and Medium-sized Enterprise
STEM	Science, Technology, Engineering and Mathematics
UBI	Universal Basic Income
UN	United Nations
UNDP	United Nations Development Programme
USPC	UNDP Seoul Policy Centre
VR	Virtual Reality
WEF	World Economic Forum

Executive Summary

The world is at a fork in the road. Technological change is bringing disruption to economies and societies: the rules have fundamentally changed, but we do not know exactly how. We do not know the timing or even the aspects that will first be disrupted.

Leaders and governments, aiming to shape their countries' path for the long-term benefit of the people in the resulting complex environment, recognize the need to navigate through the unavoidable and partly unpredictable challenges of digital transformation and rapid technological changes. Its interface with and amplification of the impact of megatrends are already in motion, including globalization, urbanization, demographic shifts, and climate change. The concomitant trend of widening inequality is transforming every aspect of our lives, especially the way we engage with the economy, society and work. Attaining scale has become a pivotal source of competitive advantage, while the sharing and circular economies are increasingly shaping both production and consumption decisions.

Economic growth, productivity gains, changing expectations of products and services, innovation and the desire for greater global digital connectivity, as well as the search for solutions to social, economic and environmental challenges, and cures for acute diseases are driving this transformation. The convergence of these drivers is leading to numerous interactions and dynamics that accelerate the transformation further, and have a significant impact on employment as well. Artificial intelligence and robotics, big data, cloud computing, 3D printing, and automation are part of the emerging landscape. Many authors refer to this as the Fourth Industrial Revolution.

Labour markets are experiencing a paradigm shift with an unprecedented, not easily predictable and immensely consequential acceleration of change. Existing jobs fade out, or the individual tasks they entail are being filtered by technology-induced shifts in marginal and relative costs, while a variety of entirely new jobs is emerging and will continue to emerge. This reflects the growing impact of digital technologies complementing and augmenting skills and thus boosting the productivity of some workers, while replacing others. As a result, the division of labour is rapidly evolving and the distinction among employers, employees and customers is blurring. Independent work and stints in the gig economy, including via on-line platforms, are becoming ubiquitous. Independent contractors take up such work as a preferred choice or out of necessity. Digital marketplaces offer many benefits, but they also have tradeoffs.

A widening of inequalities, the increasing digital divide, cyber security threats along with several other uncertainties and insecurities are adverse consequences that occupy the minds of policymakers, employees, labour unions and youth seeking to enter the job market. Most are acutely aware that technological change and digital transformation are accelerating, and that they can either be an opportunity or a threat, with considerable uncertainty about what is the best response for them.

A number of challenges are observed including the emerging polarization of the labour market and deepening inequalities; the need to dispel gender stereotypes; and the demography-driven challenge of an aging population with rising youth unemployment, and its interaction with technological change.

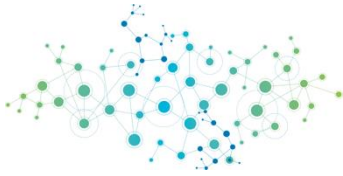
At the same time, opportunities are also appearing. Countries are rethinking social protection systems for the future including Universal Basic Income; unlocking new opportunities by using skills and capacity-enhancing technology; accelerating gender parity with new narratives for more inclusive work environments; harnessing demographic dividends by connecting the young with the wise; and reimagining the models, systems, and processes underlying the delivery of public services.

Governments have a clear interest in harnessing technological change, as well as growing concerns regarding the impact of digital technologies on the future of their economies, jobs, human lives, and society. The anticipated change traverses the entire spectrum between fearful and defensive (dystopia) to hopeful and experimental (utopia).

Digital transformation is no longer a choice – it is an imperative. Change is inevitable. If policymaking continues the way it is conducted today, then it is like driving a car, looking only in the rear-view mirror. Thus, a shift to anticipatory policies is necessary if governments are to maximize the benefits that come with digital and technological transformation while they effectively address and minimize the associated risks.

Scenario analysis needs to become a key component of planning, policy formulation and regulation. Policymakers need to take action today in response to the anticipated changes in a policy environment where uncertainties are the norm and technological and digital transformation are expected to have multidisciplinary and multidimensional impacts.

The first step is to formulate a small number of possible scenarios or uncertainties that jointly cover most of the possible states of the world for a given future period.



Second, for every scenario, identify possible policy measures that minimize related emergent risks and maximize opportunities. Finding the appropriate policies for each scenario is a feasible task, and so is the creation of a master list of the recommended policy measures/strategies pertaining to each scenario.

Third, identify the suite of policy measures that are feasible given the available resources. The recommended policy mix would emerge from imposing a budget constraint while picking policies that fall in at least one of the following categories:

- "Robust" measures which feature in all scenario-specific lists and hence are optimal under any scenario (reforming education may be one);
- Policies necessary to avoid a catastrophic outcome under at least one scenario with a non-negligible probability of materializing (climate change would fall in the first category for many, or in this one for some); and
- Policies that hold the promise of exceptional returns with relatively low cost in one or more scenarios (lottery-ticket-type policies).

Fourth, implement the policy mix through learning by doing and iterative filtering. At regular intervals, policy measures that are proven to be ineffective are adapted or removed while those that work are expanded or replicated. Maximizing synergies across measures, monitoring effects and perennially observing changes in the formulated scenarios themselves are critical.

Lags in impacts of anticipatory and experimental policies are to be expected as change takes time. Policymakers have the opportunity to turn the disruptor (new technologies) into a source of solutions, by using them to reduce bottlenecks, enhance efficiency in production and consumption, and improve scenario analysis and policymaking.

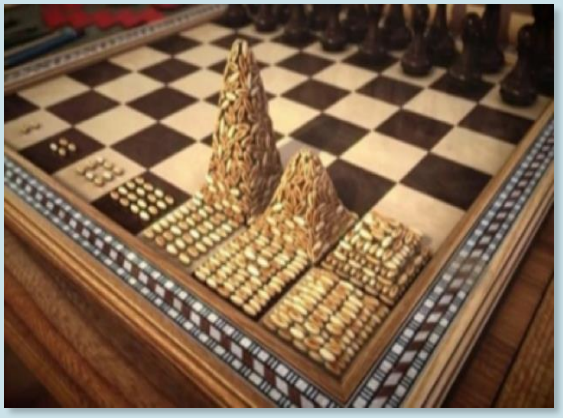
With increasing uncertainties and complexities that can undermine social, economic and environmental sustainability, governments cannot afford a 'wait and see' approach. The economic cost of doing nothing is enormous. Taking a pre-emptive approach, employing scenario analysis-based policymaking and implementing experimental policies, as well as broadly informing the public at large hold the promise of buoying economies, improving skillsets, lowering social strains, and better positioning countries for adaptation to digital transformation.

Introduction

The 2030 Agenda for sustainable development puts people and planet at its centre and embraces all three dimensions of sustainability: economic, social and environmental. SDG 8, which aims for "sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all", highlights the labour market's role in achieving sustainable development.

Technological change is ushering in unprecedented shifts in the world's socio-economic dynamics, reaching a critical mass as key thresholds related to speed, storage, data capture, searchability, analytical capacity and capabilities of algorithms are reached and exceeded. For instance, the number of internet users has more than tripled in a decade—from 1 billion in 2005 to an estimated 3.2 billion at the end of 2015. The number of active linkages and the volume of information flow among them have increased faster by several orders of magnitude.

The drastic change we can expect to affect many aspects of our daily lives is well captured by Brynjolfsson and McAffee, who say "we are reaching the second half of the chessboard—we are like the king who, having agreed to doubling the number of rice seeds on each consecutive square of a chessboard as the reward to the inventor of chess, realizes after reaching the 33rd square how overwhelming the escalation is."

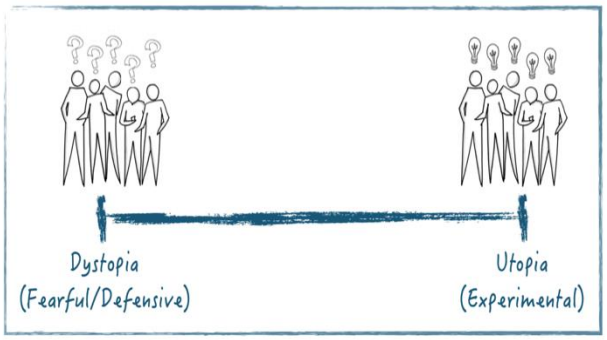


This has knock-on effects on employment, the nature of jobs and the labour market. Digital technologies such as robots, information and communication technologies (ICT) and AI, together with the breakthroughs they are facilitating such as cloud technology, Internet of Things, machine learning, crowdsourcing, the 'sharing' and 'circular' economy and fully integrated global supply chains in production, are some key aspects of technological change. This change is expected to become the key driver of economic growth – improving labour productivity, lowering transaction costs, and revamping barriers to market entry.

Just one of these aspects, the information and communication technologies (ICT) sector constitutes a substantial part of the global economy – an average of about 6 percent of GDP for OECD member countries. Korea, with almost 10 percent, is the OECD country with the second highest ICT share in GDP, after Ireland. This share is considerably less in countries with a low Human Development Index (HDI).[1]

[1] WDR 2016.

Taken together, the aspects mentioned above, especially their escalating interaction, are ushering in a sea of change that drives growth and human development.



ICT is permeating every sector of the economy. Construction firms, heavy manufacturers, transportation services, finance and insurance companies have basically become tech companies. The use of technology across sectors is altering the nature of work. For developed and developing countries alike, there is widespread interest as well as growing concern regarding the impact of digital technologies such as robots, ICT and artificial intelligence on the future of jobs and human lives. The anticipated change on human lives and labour spans the entire spectrum between hopeful and experimental (utopia) or fearful and defensive (dystopia).

This impacts a labour market already in flux. International Labour Organization (ILO) estimates that around 40 million net new jobs need to be created annually through 2030, just to keep pace with the growth of the global working age population. Additionally, ILO calls for improved conditions for 780 million women and men, who are working but not earning enough to lift themselves and their families above the US$ 2 a-day poverty line.

The diffusion process of innovation matters for enabling net job creation. It involves (i) innovators; (ii) early adopters; (iii) early majority; (iv) laggards. Experience shows that efforts need to focus on early adopters and the early majority, which will bring the tipping point earlier; laggards will come along, if diffusion is successful and reaches critical mass. Adverse consequences such as widening inequalities, increasing digital divide, cyber security threats, along with several other uncertainties and insecurities, occupy the minds of policy makers, employees, labour unions, and youth seeking to enter the job market.

Since digital technologies are in the development and early phase of diffusion, statistical data on AI and robotics is incomplete. For the same reason, quantitative empirical studies in economics are limited. While the net impact of these innovations on jobs can be substantial, it is very hard to predict its magnitude, and even its sign.

Nevertheless, based on country experiences and the emerging job market landscape, job destruction, transformation and creation are likely to happen at the same time. Jobs and tasks that can be easily automated or performed by technology using robotics and AI are already disappearing in some countries. Adaptable advanced skills acquired through higher education, particularly in science and engineering, are complementary with new technologies such as AI and robotics. Occupation-specific skills acquired by attending professional schools or holding occupational license, particularly those related to human-

intensive personal services, are similarly compatible and even complementary. Thus, workers with such skills stand to gain from technological disruptions rather than be displaced by them.

Technological advancement does not determine the outcome by itself. It requires a workable ecosystem that allows the free flow of information and ideas, supports implementation, and pieces together supply chains. Such ecosystems require sufficient human capital and regulatory support, and evolve over time. Coupled with other drivers such as urbanization, globalization, and demographic change, technological progress is set to transform every aspect of our lives, especially the way we work or engage in the economy with increasing complexity and uncertainty. It ushers in both enormous gains and major potential disequilibria that can undermine the social, economic, and environmental sustainability, which are key aspirations of global development efforts.

Implementing the SDG agenda globally and fulfilling its core aspiration of 'leaving no-one behind' is a massive challenge. Fundamental societal change – stemming from technological innovation – can be both an "SDG accelerator", as well as a source of risk with huge uncertainties. The world has reached a turning point in modern history as technological change is rapidly accelerating and sharply deviating from the linear path that we, humans are accustomed to. The point-of-no-return has been crossed. Leaders and governments, aiming to shape their countries' path for the benefit of the people, need to navigate through the unavoidable and partly unpredictable challenges that technological change brings.

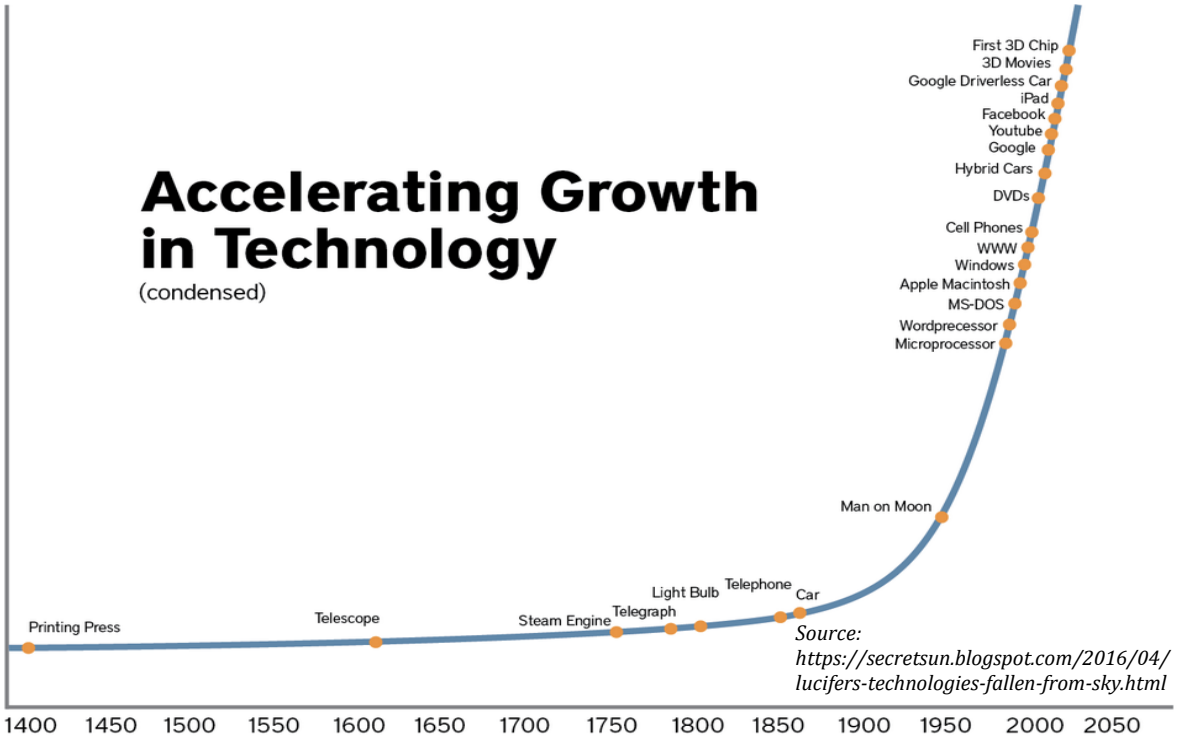
Universal Basic Income (UBI) is a newly relevant aspect that is important for the "leave no one behind" principle—hence is of direct relevance for UN(DP). The starting point is that the general discourse often assumes that technological change is set to destroy jobs and impoverish the entire population. This is incorrect. Bringing immense improvements in output per worker, technological change makes it possible to create the resources to not leave people—even those who lose their jobs in the process—entirely behind. However, the incidence of net gains stemming from technological change are highly unevenly spread, with the benefits accruing to a (potentially very small) group. This is a distributional issue: the total gains are sufficient to generously compensate the technological innovators while also channeling enough to the rest of the population to gain their support.

If governments can capture a good part of the gains without fundamentally undermining the incentive to innovate, work, and invest—not an easy task, but now possible—a two-pronged solution can make everyone better off. First, use the captured funds to drive a redistributive system that ensures a modest but decent level of living for all; and second, use technological tools to allow those who have lost their jobs to connect again to the labour market—and become employable through apps that bridge the skills gap, assisted by algorithms that effectively match people's skill sets with needs.

Even people with absolute disadvantages everywhere can have comparative advantages in some areas; if deployed in these areas, they can often learn on the job to become gainfully employable.

Against this backdrop, this paper highlights the key drivers of technological change and digital transformation and the effect they are having on the changing nature of current and future jobs. The paper provides an analysis of the key challenges and opportunities. It offers policy options to mitigate potential risks and to harness the positive potential of the technological change. The role that UNDP can play in providing country-tailored support and global advisory services is also outlined.

The paper concludes by underlining five key messages: digital technology is entering a rapidly escalating phase, amplifying the impact of megatrends in motion; this leads to a transformation of labour markets and the future of jobs; the impact is multidisciplinary and multidimensional; social protection and support for those that are likely to be the most affected need to be equally transformational to ensure sustainability; and finally, governments need to pursue experimental policies. [2]



[2] Rydberg, 2018. http://www.edwinhrydberg.com/what-is-the-technological-singularity-and-why-should-you-care/

1. Drivers of Technological Change

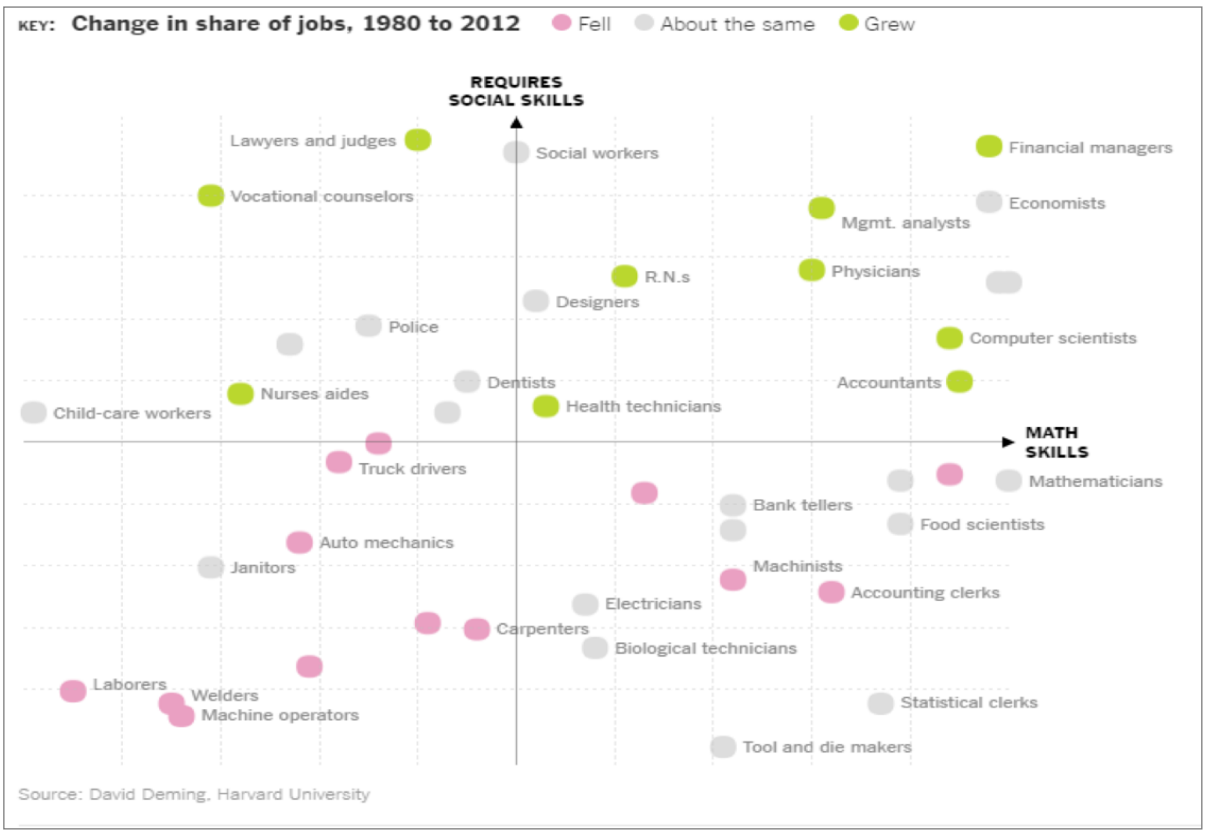
Economic growth, productivity gains, consumers' fast changing expectations of products and services, the search for cures for dire illnesses and for solutions that make us safer and healthier, as well as the desire for greater global digital connectivity are driving new production/consumption technologies and the digital transformation – the 4th Industrial Revolution. A confluence of these drivers is leading to wide-ranging interactions and dynamics that shape and accelerate this transformation further.

New production and consumption technologies include robotics, automation[3], cloud technology, internet of ideas and things, electronic information and sharing platforms; big data analytics, machine learning, artificial intelligence—as well as new materials, 3D printing, nano sensors, clean energy, high-capacity batteries, and others.

> *"We are in the beginning of a revolution that is fundamentally changing the way we live, work, and related to one another, in its stale, scope and complexity, what I consider to be the fourth industrial revolution is unlike anything humankind has experienced before"*
>
> *Klaus Schwab, Founder and Executive Chairman of the World Economic Forum*

Hyperconnectivity and the exploding number of connections and amount of available data for machine-learning algorithms are game changers. Billions of people are rapidly evolving in social and digital communities to provide services, share insights, and engage in commerce as well as social interaction. All the while, new channels for engaging with consumers are created, and new ways for making better use of resources are emerging. On their end, consumers are also radically changing the rules – demanding simple, seamless and personalized experiences at every point.

[3] The concepts of "robotics" and "automatization" are very closely related and may even overlap. To illustrate the difference, once might refer to the distinction between software and hardware. Robots are programmable machines which are able to carry out a series of actions autonomously, or semi-autonomously. They interact with the physical world via sensors and actuators. Because they are reprogrammable, they are more flexible than single-function machines. Automation can be software automation or industrial automation. The latter is about controlling physical processes: using control systems or physical machines to automate tasks within an industrial process. A fully autonomous factory would be an extreme example.



2. The Emerging Landscape – Labour Market

Single skillset jobs are in decline. According to David Deming of Harvard University, between 1980 and 2012, many jobs requiring only mathematical skills, including occupations on science, technology, engineering and mathematics (STEM), have declined due to automation. Bank tellers and statistical clerks have suffered. Roles that require predominantly social skills such as childcare workers tend to be poorly paid as the supply of potential workers is very large.

Deming reveals in his mapping of changing skill needs in the near future, that the labour market increasingly rewards the combination of marketable social and technical skills. In this regard, he argues that soft skills, such as sharing and negotiating, will be crucial. His study shows that workers who successfully combine mathematical and interpersonal skills in the knowledge-based economies of the future should find many rewarding and lucrative opportunities.

The World Economic Forum (WEF) "Future of Jobs" study predicts that 5 million jobs will be lost before 2020 as artificial intelligence (AI), robotics, nanotechnology and other socio-economic factors replace the need for human workers. The good news is that those same technological advances will also create 2.1 million new jobs. However, the manual and clerical workers who find themselves out of work are unlikely to have the required skills to compete for the new roles. Most new jobs will be in more specialized areas such as marketing, social media, computing, mathematics, architecture and engineering.

The evolving division of labour makes the distinction among employers, employees and customers fuzzier. Consumers, for example, are increasingly carrying out tasks that service providers used to do, like entering their own data online and tagging their own luggage during airport check-ins. Similar examples in many different areas, notably in production links in value chains, consumer transactions, and citizens interacting with government, are a direct consequence of slicing jobs into separate tasks and allocating them to various players - including consumers. It is important to note here that this results in significant value creation, albeit one that is allocated in a highly skewed fashion.

As jobs are sliced into a bundle of increasingly finely-defined tasks, new spaces (online platforms) are being created where these tasks are grouped, shifting the balance on what remains in one job description or within a firm and what is contracted out.

Through online platforms that connect offerors and bidders (like Uber, AirBnB and many others) and the gig economy[4], independent contractors increasingly pick up slices of jobs (tasks) that were previously undertaken by workers, or at least often in-house in the firm. While independent (outsourced) work is not a new phenomenon, data on this type of work do not fit neatly into official labour statistics, hence the data gaps.

In an effort to fill this gap, McKinsey Global Institute (2016) used government data, other studies and an extensive survey of more than 8,000 respondents in six countries[5] to gain a deeper understanding of the size of the gig economy (independent work), who does it, why and how satisfied the workers are. Their research reveals that 20 to 30 percent of the working-age population in the United States and the EU-15, or up to 162 million individuals, engage in independent work.

McKinsey identifies four types of independent workers in the gig economy that can be categorized into two main categories: those that take up independent work as a "preferred choice" (113 million workers); and those that do it "out of necessity" (49 million workers). Within the "preferred choice" category, 30 percent (49 million) are "free agents", who actively choose independent work and derive their primary income from it, whereas 40 percent (64 million) are "casual earners," who use independent work for supplemental income and do so by choice. For those who are engaged in the gig economy "out of necessity", 14 percent (23 million) are "reluctants," who make their primary living from independent work but would prefer traditional jobs, and 16 percent (26 million) are "financially strapped" and do supplemental independent work out of necessity.

[4] In a gig economy, temporary, flexible jobs are commonplace and companies tend toward hiring independent contractors and freelancers instead of full-time employees. A gig economy undermines the traditional economy of full-time workers who rarely change positions and instead focus on a lifetime career, receiving a package of benefits though their employment.

[5] The United States, the United Kingdom, Germany, Sweden, France, and Spain. Thus, emerging economies with major share of workforce in self-employment or outside traditional employment are excluded.

Digital marketplaces are providing larger pools of labour supply and demand, with greater ease for workers to join and use the platform, access to payment systems and infrastructure, profiles, reviews and transparent information, as well as better search and matching. Benefits are many for the economy, cushioning unemployment, improving labour force participation, stimulating demand, and raising productivity. Greater availability of services and improved matching that better fulfills the needs of consumers and organizations could benefit them greatly. Workers who choose to be independent also value the autonomy and flexibility that increase as a result.

Despite its benefits, independent work involves some trade-offs. There is more work to do on issues such as benefits, income security measures, tax treatment of gig economy income (only part of which materializes in the formal economy), access to credit, training, and credentials. Some of these may call for policy and regulatory changes; others could be solved by innovators and new intermediaries. Tackling these challenges could make independent work a more feasible option for individuals.

E-platforms and other technological advances are shifting the balance on what remains in a job description or within a firm, and what is contracted out. This in itself is a key driver of globalization, which is also receiving a tremendous boost from the globalization of data flows. Now, arguably, it eclipses the trade in goods and services or cross-country capital flows in its importance.

Artificial Intelligence (AI) and Robotics — Disruptive Forces?

Advances in AI, robotics and machine-learning are already transforming the nature of work around the world, substituting human tasks with computerized ones. Intelligent robots in the civilian sector are driving cars, managing warehouses, performing surgeries, harvesting crops, teaching, writing poetry, reporting news and even providing legal counseling. While their role is still circumscribed in each of these areas by (receding) constraints, these technologies are set to expand to an even broader range of industries and businesses, fundamentally shaping employment and income distribution, as well as the everyday functioning of product and labour markets.

Bill Gates in his foreword for Satya Nadella's book, 'Hit Refresh', points out that in the future, an AI agent could help humans with all the time spent manually organizing and performing mundane activities, from scheduling meetings to paying the bills. An AI agent will know when you are at work and have ten minutes free, and then help you accomplish something that is high on your to-do list. AI is on the verge of making our lives more productive and creative.

No doubt, there will be challenges. Support will be needed to help those whose jobs are replaced by AI agents and robots. Humans may not want or accept the advice that an AI agent provides on work style. Moreover, it will take time for users to feel comfortable with entrusting AI agents with all of their information.

3D-Printing

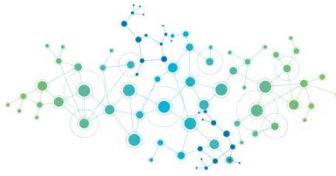
3D-printing technologies can affect the global economy, causing fluctuations in labour markets or instabilities in economic activity. 3D-printing technology "changes two important economic equations: those relating to insourcing/outsourcing and to globalization/localization"[6]. While 3D-printing can reduce fixed costs of production, increase economies of scale, and thus lower barriers to market entry, it poses numerous risks. It fundamentally reshapes the supply chain logistics, sweeping away some parts of supply chains that currently support substantial export flows. It can also complicate issues related to patents, as well as to vital security. For instance, 3D-printers are capable of printing non-metallic weapons or weapon parts, which make them hard to trace—a serious potential threat to air security. Based on the ability to replicate anything described in software locally, 3D-printing technology can be abused to sidestep international sanctions regarding trade, arms-proliferation, and others. The scope for such complications will expand as new materials become commercially available—often produced by big data-based machine learning applications in physics and chemistry.

Cloud Technology

Internet-based cloud technology that relies on ever more powerful computers and quickly-rising data storage capacity is rapidly expanding across the world. It allows users to store and retrieve large amounts of data from central remote servers, eliminating the need for hardware and software installations, in-house IT support, and maintenance. The cloud provides a convenient avenue to deliver on-demand services and application remotely with improved capabilities and collaboration that benefit organizations in reducing costs and complexity, improving customer services, and collaboration capabilities. These, in turn, boost productivity and enable new and complex business models, thus creating new economic opportunities but also altering labour markets.

The cloud's principal contribution is optimization through consolidation. While it does not replace workers with machines, the resulting large efficiency gains in automated mechanisms can make many workers redundant. In the short-term, the net effect could be negative, as in-house IT jobs such as system managers, database, and network administrators are directly impacted. However, the complexity of the existing systems and the length of time required to migrate to cloud-based platforms without disruptions of service will mitigate the near-term impact.

[6] How 3D Printing Changes The Economics Of Outsourcing And Globalization - Panos Mourdoukoutas - https://www.forbes.com/sites/panosmourdoukoutas/2015/07/18/how-3d-printing-changes-the-economics-of-outsourcing-and-globalization/#1ee94f9762a2



In the long-term, the balance will likely be positive given the scope for creating new employment opportunities, including through entrepreneurship. Cloud enables most start-ups to implement and sell ideas with a low initial investment. Without the cloud, many brilliant ideas would never get implemented. Furthermore, some of those start-ups will eventually grow into larger enterprises that boost demand and create jobs over and above the workers they directly hire. However, security risks and failures of cloud services remain the greatest inhibitor to wider adoption. In this regard, Cloud Industry Forum highlights that while 70 percent of organizations in the U.K. have concerns regarding data security and 61 percent about data privacy, 99 percent have never experienced a security breach when using a cloud service. Relying solely on cloud service providers for security assurance may not be adequate. Organizations that wish to benefit from such services need to ensure that they have processes and controls that allow them to consume such services in the most secure manner possible.

Big Data

The big-data aspect of the Fourth Industrial Revolution was mentioned as a key element during the 2016 World Economic Forum (WEF). The global coverage of mobile devices, online sensors, and other means that generate a constant flow of digital information has made it possible to obtain detailed, accurate and real-time data on nearly all aspects of our daily lives.[7] Combined with Machine learning/AI, it can add considerable efficiency and scale to existing ways of doing business in areas as diverse as finance, human resources, consumer interactions, education, as well as basic and applied research. In doing so, it will amplify both the positive and negative aspects of earlier methods. These can lead to reaping enormous gains in productivity. However, they can also contribute to entrenching (and making more obscure) the sources of prejudices and biases in providing decisions on creditworthiness, eligibility for jobs or promotions, and insurability. They can also influence the workings of the democratic process in a non-transparent yet fundamental manner.[8]

[7] WEF, 2016b.
[8] O'Neil, 2017: Weapons of Math Destruction.

Automation

Automation can increase productivity, reduce costs, improve quality and reliability, as well as enhance safety. Many studies predict that automation will be a disruptive force on the labour market and result in massive workforce reductions, job dislocation, and wage stagnation or decrease. Unlike before, the sophistication and convergence of recent technologies are enabling 'near-human' capacities and levels of performance—and beyond—raising the spectre of automating tasks that we never thought possible. Automatization will first affect jobs characterized as "non-cognitive", which consist largely of routine tasks. These are easier to replace/automatize than jobs that include a broader variety of tasks and require individual response and judgement.

According to the WEF, women are more likely to be affected by the coming changes than men. Men stand to lose 4 million jobs and gain 1.4 million of them – close to 3 jobs lost for every job gained. Women on the other hand stand to lose 3 million jobs and gain only 0.55 million – more than 5 jobs lost for every job gained. Women, however, are not a homogenous group, and the changes will not be spread evenly across the female population. In particular, the asymmetric impact may be more pronounced in less developed countries, where the gender skills gap, together with traditional social norms, relegate women to jobs that are more vulnerable to automation.

Fully Autonomous Vehicles

Uber Technologies Inc. is making use of AI technologies to disrupt the transportation sector. In a pilot program initiated in 2016, a fleet of self-driving cars began roaming the streets of Pittsburgh. Equipped with radars, high resolution 3D cameras, and laser scanners, the vehicles gather data, navigate, and map the streets of the Steel city in great detail. This program is well on its way to prove that autonomous driving is viable. Uber is betting "all-in" on this as a springboard for expansion. It is not alone.

A number of major companies (notably Apple, Google, Tesla, and Samsung) are also making such bets. If proven right—and there is a good chance of this happening in the near future—self-driving cars will have a profound effect on millions of jobs in the transportation, logistics, and the broader service sector. The change will be gradual, since fully autonomous vehicles cannot yet handle certain road conditions (e.g. bad weather), and they appear vulnerable to hacking. However, it is probably only a matter of time until technology, driven by market forces, solves these apparently intractable issues—as has happened many times in economic history.

There is no point in trying to stop the process; but the intervening time should be well spent on devising a sound regulatory framework to ensure the safety of autonomous vehicle technology, to create a level playing field for competition, and to develop a mechanism that can capture a part of the ensuing benefits for the society at large.

Many middle-skill jobs in manufacturing, retail trade, and offices characterized by routine tasks with predictable variability that are easy to automate will largely disappear. Classic examples include bank tellers dispensing cash, truck and bus drivers, assembly-line

workers, second-hand car dealers, and lawyers performing routine contract formulation and custodianship tasks. Incumbents in those vanishing jobs can end up unemployed or competing for the shrinking number of remaining lower-skill jobs—with the advantage going to those who can rapidly adjust their skill sets to remain employable.

Automation may thus sharply reduce employment in manufacturing, which can remain a key driver behind economic growth; but unlike in earlier industrial revolutions, it may fail to lift the middle class[9]. The rising importance of intelligent machines and robotics in traditionally labour-intensive sectors such as agriculture, textile industry, production and construction lead to understandable fears of mass unemployment for middle class workers.

Countries with undiversified employment profiles are at risk of being massively affected by automatization. The ILO estimates that in Cambodia, where garment production dominates the manufacturing sector, close to half a million sewing machine operators face a high automation risk. Automation risk is similarly acute for approximately 1 million shop sales assistants in Thailand and about 1.7 million office clerks in Indonesia[10]. More generally, the proportion of threatened jobs is estimated to be around 69% in India, 77% in China, and as high as 85% in Ethiopia.[11]

The key aspect missing from the analysis so far is that technological change also holds the promise of creating a large number of non-traditional jobs. First, it will enable entrepreneurship on a hitherto unimagined scale by lowering entry thresholds and transaction costs, thus productively linking suppliers that can line up into value chains not possible earlier; and linking them with consumers locally and globally. Second, technology can enable people who are unable to pass the threshold of obtaining traditional jobs, to do so by providing them with technology-based assistance in key areas of weakness. This is true not only for handicaps, but also for the lack of social skills, or (soon) language skills, or of ability to drive. Third, escalating technological change also opens up unforeseen areas of work that can employ many people to address medical, demographic (aging), and social problems. Fourth, the slicing of tasks enables people with very narrow skill sets to also find productive employment by focusing on the large technology-enabled flow of highly-specialized requests for the tasks that they are particularly good at. It is important to note that this argument is primarily about comparative, rather than absolute advantage. That is, even people who are not outstanding in any area of work will have areas where they are relatively closer to having outstanding skills than elsewhere. By focusing on these – enabled by electronic platforms – they can attain employment and hence, higher income. Importantly, these positive effects can amplify each other and those who engage in such activities will be learning by doing, becoming more productive over time.

[9] Ford, 2015. Rise of Robots Technology & the Threat of a Jobless Future.
[10] ILO, 2016.
[11] Hoskins, 2016. "Robot factories could threaten jobs of millions of garment workers."

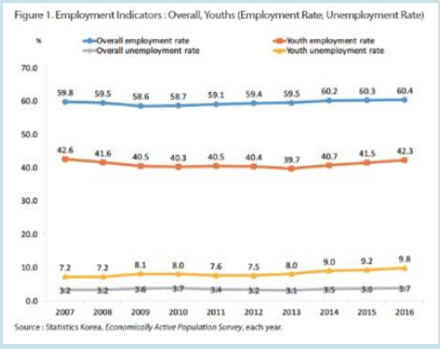
3. Challenges and Opportunities

Most countries are acutely aware that technological change and digital transformation can either be an opportunity or a threat. The sign (positive or negative) of the impact and the extent to which a country is affected depend on the country's socioeconomic structure and the ability of its production and consumption processes to adapt to the implications of the digital transformation. These will also help determine the impact on jobs. The key consideration for countries is to put in place policies and measures that best exploit the multidisciplinary, multidimensional impact of technological change; shape an enabling environment for the private sector to thrive, create jobs, and maintain healthy and sustainable businesses; and enable the public sector to embrace innovation and technological change in ways that augment the delivery of basic and public services that meet citizens' expectations. In addition, governments need to adapt policies, regulations, and governance as markets evolve, while also maintaining and protecting the fabric of society (see Box describing the situation in Korea). It will also be necessary to reform education and training systems to provide workers with the requisite skills. Adapting to the digital transformation is no longer an option – it is an imperative.

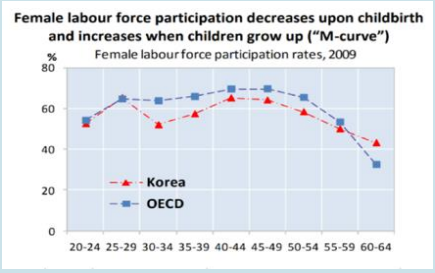
A Look at the Korean Situation

The Korean job market is experiencing job polarisation driven in part by technological change, according to the OECD. The share of employment in manufacturing, the traditional engine of Korea's growth, has declined steadily from 35% of total employment in 1992 to 25% in 2017. The composition of the job market is also changing as entry-level jobs and jobs subject to automation or offshoring are decimated.

The ongoing changes appear to have disproportionately hurt the youth. While Korea's overall unemployment rate was stable at 3.4% from 2007 to 2016, the youth unemployment rate averaged 8.2%, reaching an all-time high of 11.3% in April 2017—the steepest increase in any OECD country. And the picture is even bleaker. First, the significant number of discouraged youth has lowered the youth employment rate to a mere 41.5% as of 2015, a full 10 percentage points below the OECD average. Second, some 11.5% of youth employed in Korea are in non-regular jobs.



Women face particular burdens in the job market. Korea's gender wage gap is the largest in the OECD and its female labour participation rate is also below the OECD average. A key reason is that while females earn similar wages as men early in their career, they leave the labour market after their marriage or first pregnancy. Even if they return after years spent focusing on childcare, they are offered lower positions and/or wages.



This, in turn, reduces the female participation rate, since a large portion of women simply choose not to return to the labour market.

The Korean youth faces a sharp dissonance between what they learn and what they encounter as a worker. Technological change further erodes the value of knowledge acquired through traditional educational approaches. For instance, even though Korea has one of the highest university enrolment rates and educational investment, its college wage premium is negative for the bottom 20% of its universities. Moreover, field-of-study mismatch is quite high at 50% (i.e. only half of what students learned in higher education is applied in jobs). High entry barriers, notably SMEs' regulatory compliance burden and lack of access to financing for investment, limit new employment by these firms. Korea's current administration has promised negative regulations (listing what is forbidden, with all other lawful activities being allowed), and regulatory sandbox policies that free new technologies and related segments of the market from regulations for a limited time. Such policies hold the promise of enabling new and smaller firms to take on old and larger ones on equal terms, raising the economy's level of competition.

Similarly, technological change can facilitate flexible scheduling of work, thereby enabling higher economic participation by women. Recent surveys show that Korean female workers feel that shorter and more flexible working hours are the most urgent and needed labour policies for them. Rather than only securing long maternal leaves, which some argue may erode firms' profitability and workers' skills, making sure that raising children and career can be compatible for women will help create an efficient labour market where women can receive income commensurate with their skills, while adding value to the economy.

Korea has a rapidly aging population that is expected to start falling from 2030. The resulting lack of labour force will suppress output levels and create a heavy demographic burden on the economy. According to the Bank of Korea, the GDP growth rate is expected to fall below zero by 2050 on current trends. Tapping into the large underutilized pool of female labour force with high levels of human capital can offer an efficient solution: raising the female labour force participation rate to the OECD average level could add 0.4% points to the annual GDP growth rate. Moreover, maternity leave and benefits could help raise the currently very low birth rate—a root cause of demographic stress.

3.1 Challenges

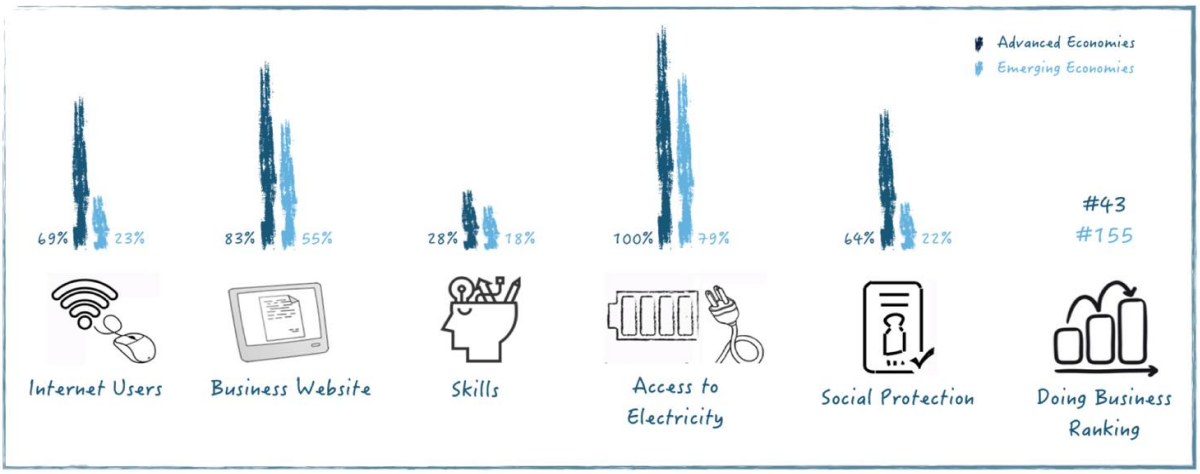
With every new technology, there are challenges. Countries can no longer afford to shy away from the emerging challenges of technological change and digital transformation, because they are enormous with dire consequences if countries do not take urgent actions now. The readiness of governments, as well as of the private sector, to deal with the challenges and minimize risks while harnessing the positive potential that comes with a fast and continuously evolving digital economy, will play a critical role.

Market forces in the context of accelerating technological advances tend to exacerbate inequality and the digital divide within countries, as well as between advanced and emerging economies. Pivotal differences in this respect include those in the capacity of the labour force and its ability to nimbly adapt to change; in the ease of doing business; in the effectiveness and inclusiveness of the social safety net; and in access to and use of internet.

"Without urgent and targeted action today, to manage the near-term transition and to build a workforce with future-proof skills, governments will have to cope with ever-growing unemployment and inequality, and businesses with a shrinking consumer base."

Klaus Schwab, Founder and Executive Chairman of the World Economic Forum

Technological change today also grants disproportionate political influence to special interest groups. Publicly-traded corporations hold vast amounts of information about billions of people in the world. These corporations are driven by profits, which, however, are crucially affected by government regulations. Hence, they are among the most prolific and influential lobbyists. They also have the wherewithal for influencing the public's views on critical issues. In such circumstances, political disillusionment, rise of populism, coupled with further gains in the clout of special interests, can lead to democratic deconsolidation. The effects will differ across countries and population groups within. Some countries also appear to use new technologies to influence public opinion and economic or political outcomes in their own and other countries.



Governments have yet to effectively address these problems in an inclusive manner, in part due to the diminishing fiscal space. Given the concentrated political influence, tax competition among countries, and increasingly fragile tax bases, governments are losing tax revenue. Pressure is rising to enhance public services including education, vocational and lifelong training, health services, infrastructure, and the social safety net - notably pensions and unemployment insurance.

3.1.1. Emerging Polarization of the Labour Market, Reshoring, and Deepening Inequalities

The labour market faces an unprecedented, not easily predictable, and immensely consequential acceleration of change. A key consequence, already in motion, is that existing jobs or the individual tasks they entail will be "filtered" by technology-induced shifts in costs, while a variety of entirely new jobs will emerge. The expected massive substitution of capital and technological innovation for labour will boost productivity, with hours worked—and even employment levels—possibly falling.

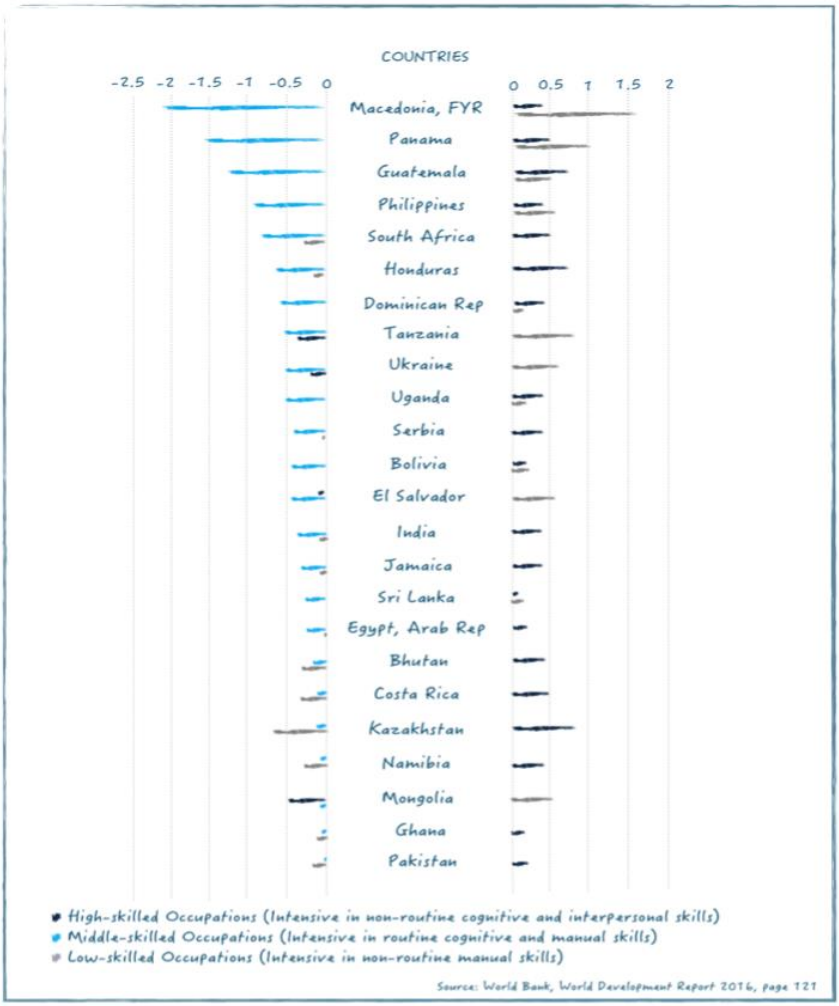
The World Bank, in its World Development Report (2016), predicts a decline in hours worked that is uneven across countries, the working populations, and occupations. This is coupled by an ongoing decline in labour shares corresponding with the polarization of labour markets, which is the most prominent in high-income countries.[12] In particular, employment is rising in high-skilled, high-paying occupations and low-skilled, low-paying occupations (elementary, service, and sales workers), while squeezing out middle-skilled, middle-paying occupations. In high-income countries, on average, the share of routine labour in employment has fallen by about 0.59 percentage points a year since 1995, or almost 12 percentage points for the period.

Employment polarization is also observed in many low- and middle-income countries. The average decline in the share of routine employment has been 0.4 percentage points a year, or 7.8 percentage points for the period. There are some exceptions: in China, mechanization of agriculture increased the share of routine employment; Ethiopia's labour market, with a large share of employment in manual occupations, has so far not experienced significant polarization[13]; the situation is similar in Mongolia and several Latin American countries where other factors—such as a commodity-driven boom benefitting low-skilled workers—may have played a larger role in shaping the labour markets' outcomes.

The World Bank Development Report highlights that declining labour shares in income and employment polarization are only symptoms. Digital technologies complementing and augmenting some skills (and thus some workers), while replacing others, are at their core. Given that skills complementary to digital technologies are not possessed by everyone, many are likely to be left behind. A key conclusion is that inequality will increase if education and training systems do not enable workers to acquire modern skills that are most in demand. If education and training systems increase the supply of workers who meet the continuously changing skills demands, more workers will benefit from technological and digital transformation. This would help realize the promise of digital dividends and contain the rise in inequality.

[12] Acemoglu and Autor 2011; Akcomak, Kok, and Rojas-Romagosa 2013; Autor and Dorn 2013; Goos, Manning, and Salomons, forthcoming.
[13] Period reviewed 2000-2010; WDR 2016 team, based on the National Bureau of Statistics of China, various years

Domestic political pressure is rising in developed countries for reshoring of low and middle skilled occupations in labour-intensive manufacturing and routine services that were previously outsourced to developing countries. Developing countries with export-oriented economic policies, low wages, and a youth bulge, may face acute problems if they do not have astute responses to these pressures. These, however, need to be premised not on the failure of the underlying arguments for globalization, which led by large relative costs, wage differentials, and different patterns of comparative advantages, remain intact. Rather, they need to work with developed countries at the policy level to enable the continued creation of large gains from trade, while ensuring that such gains are distributed more equitably, so that the constituencies losing out can be compensated and thus no longer block trade.



Importantly, technological advances can both enhance the surpluses that can be shared and help distribute them more equitably. If this does not happen, rising and deepening inequality in many countries and large-scale economic migration between countries are likely. Already, unskilled workers are paid ten times more in rich countries than in poor countries.

The highest skilled workers may well increase their work effort, while there will likely be outright declines in demand for medium- and especially for lower-skill workers. This is already evident in distinctly higher unemployment rates for those with limited education and skills. Over time, it will dampen their labour participation rate. Such polarization of the labour market can be expected to further spur inequality.

Another consideration is that even if a job can be carried out by a computer or machine in theory, this does not necessarily translate into its abolishment in the near future. Most modern airplanes could, for instance, be flown—including take-off and landing—by autopilot, yet the number of pilots required on board was not reduced. The situation is similar for trains, modern cargo ships, and trucks. While we have sprinkler systems and high-tech sensors in modern buildings, we will most likely also need a significant number of human fire-fighters in the foreseeable future. It is, however, easy to see how advanced robots and AI software may bring changes in the longer run. Clearly, combining skilled manpower with advanced technology is poised to greatly boost productivity. A salient example is emergency response,[14] where reducing the risks to responders' lives further adds to the potential gains.

It is crucial to acknowledge the contextual differences between countries' economies and labour markets. The world can no longer be distinguished in the binary system of developed and "under-developed". Given the many different development models, it is important to consider differences among countries in the structure of their production—diversified or heavily dependent on a single sector such as agriculture, tourism, or extraction and export of natural resources. There are also considerable differences in socio-economic, technological, or demographic conditions.

The effects and implications of technological advancement on labour markets are likely to differ in countries with high HDIs and internet access rates and those with low ones. Countries with low HDI and internet access rates face potentially harsher consequences of labour market upheavals, as they often have lower government and private sector resources, institutions, as well as the regulatory systems that are equipped to mitigate these challenges. Another strategic disadvantage for such countries is the lack of effective, wide-ranging social welfare policies to reduce the human costs of this transition, which can otherwise lead to social tensions. Worsening environmental conditions—such as deforestation, declining air quality, receding water tables—can (and often do) also become binding constraints. To enhance the effectiveness of government policy, many developing countries need to tackle corruption and strengthen political institutions and governance. Otherwise, as technology races ahead, it can leave many people behind.

[14] The Cincinnati Fire Department uses data analytics to optimize medical emergency responses. Their system analyses variables (e.g. type of medical emergency call, location, weather, earlier similar calls), then uses an algorithm to calculate the best response to the dispatcher. This helps quickly formulate an appropriate response to the call—e.g. to treat the patient on-site or in a hospital. This enables the department—handling 80,000 medical emergencies a year—to strategically place its emergency response team to reduce the number of runs and response time.

3.1.2. Dispelling Gender Stereotypes

Coming to grips with the future of work for females requires a clear understanding of the current barriers that working women face. Company culture often impedes their entry into science and technology-related industries. Instances of overt discrimination, unconscious bias, lack of opportunities for promotion, and wage gaps have been well documented. Despite calls for change, this situation has not improved significantly.
For example:

- 21% of American tech executives are females (the figure is 36% in other industries);
- Only 6% of partners at venture-capital firms are women, down from 10% in 1999;
- Only 7% of the founders of US tech start-ups that raised US$ 20 million or more are women, according to recent research by Bloomberg.[15]

Technological innovation presents challenges for gender equity and has the potential to more adversely impact women. For women who are already disadvantaged — e.g., they are older, immigrants, lack education or formal qualifications, or live in rural areas — existing disadvantages are likely to be further compounded by diminishing opportunities for unskilled work and higher barriers to upskilling. In general, less educated workers and employees earning lower wages (most of whom are women) face higher automation risk.[16] In each of the ASEAN-5 for instance, women are more likely than men to be employed in an occupation that is at high risk of automation.

Rapid technological change will continue to transform the nature of jobs from being physically intensive to intellectually intensive. As a result, biological differences for established gender roles are becoming increasingly irrelevant. Intelligence and creativity are not correlated with gender; individual success is dependent on opportunities that are available and the appropriate nurturing of talent. As countries transition to a labour market that necessitates innovation, life-long learning, and critical thinking, failing to take advantage of the intellectual capacities of half the population would be a major blunder.

[15] Silicon Valley's sexism problem https://www.economist.com/news/leaders/21720621-venture-capitalists-are-bright-clannish-and-almost-exclusively-male-silicon-valleys-sexism
[16] ILO, 2016.

Since traditional gender roles and the binding constraints associated with them are becoming increasingly irrelevant, gender-based comparative advantages are diminishing as the skills and capacities that are now required do not differentiate between genders. Structural barriers and societal perceptions must be addressed to create a greater equality of opportunities across genders, so that individuals are judged only on their intellectual capacities and the skillset that they bring to their teams at work.

Promoting gender parity in the labour market is a mutually beneficial process. It raises productivity within individual companies and increases the overall economic gains, while promoting gender equality and the empowerment of women. The corporate sector can significantly benefit from greater participation of women in the technology sector by helping companies address skills mismatches—noted as a major issue by 97% of multinational company CEOs in a recent McKinsey Global Institute report. Since this implies shortages in many technology-related fields, increasing the participation of talented women would not create a large number of displaced male workers, reducing the opposition against such moves.[17]

Additionally, the facilitation of discussion among individuals from diverse backgrounds with varying perspectives and skill sets leads to greater innovation with fewer blind spots in generating and analyzing ideas, as well as in honing and perfecting strategy. The differing comparative advantages of males and females imply that optimal teams require both in a balanced manner.

Recent research has observed a link between gender diversity in top management and superior financial performance. In 2013, McKinsey & Company and the Credit Suisse Research Institute and Catalyst each published studies demonstrating a striking correlation between higher returns on sales, equity and invested capital, and gender diversity at the board of directors and executive management level. As one example, according to 'Ensuring a Level Playing Field for Women in Private Equity' by the World Economic Forum, companies with at least one female board member outperformed comparable businesses with all-male boards by 26 percent worldwide over a period of six years.

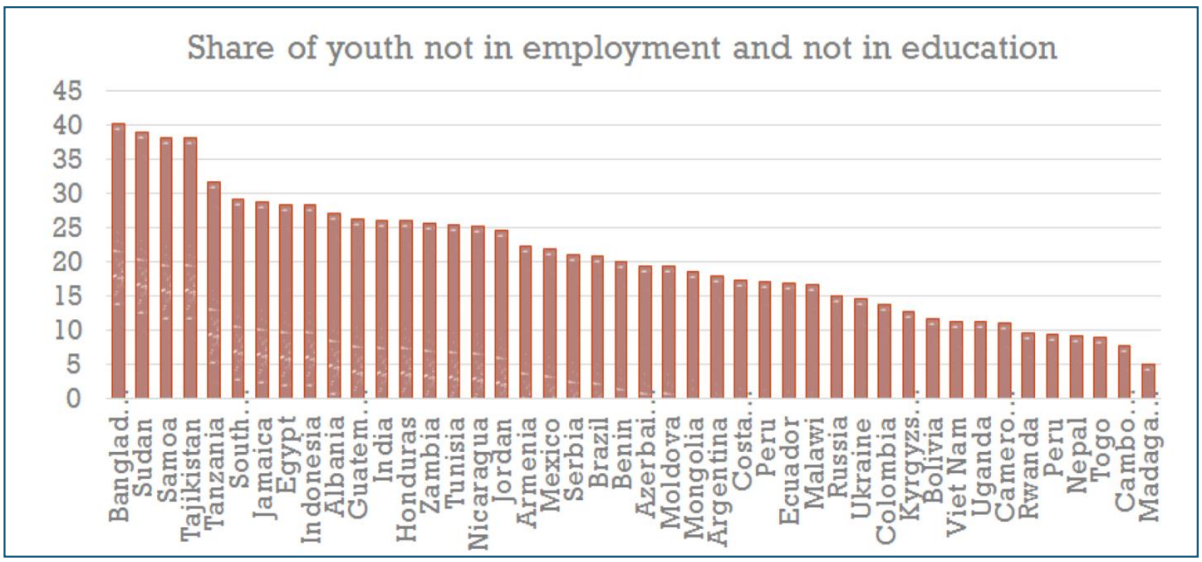
3.1.3. Demographic Challenge: Rising Youth Unemployment and Aging Population

Young people are likely to be one of the most vulnerable groups to technological change. The world is home to the largest generation of young people aged 10 to 24 in its history – a total of 1.8 billion. Youth (15-24 years) comprises 18 percent of the global population with the majority (60%) residing in Asia. Rising youth unemployment is one of the deepest socio-economic problems facing economies over the world. Youth

[17] About 60% of the surveyed job openings required a basic digital or science, technology, engineering and mathematics (STEM) literacy, 42% at the advanced level.

unemployment rates are already three times higher than non-youth unemployment rates and in some countries, the youth unemployment rate exceeds 50 percent. While the youth unemployment rate in South and East Asia is lower than that of other regions, their quality of employment is poor. Some regions, such as North Africa and the Middle East, already have extreme levels.

Using an even more relevant definition, around 358 million youth globally are inactive: not in school, training, or employment—220 million of them in the Asia-Pacific region.



Informal employment remains pervasive for young people in many developing economies. At present, a lack of work experience, social capital, relevant skills, training, or mentorship, as well as poor educational preparation are key factors causing such youth inactivity. Similar impediments are faced by young entrepreneurs, who lack access to adequate and relevant information, credit and financial services, skills training, and support in the pre- and post-creation phases when setting up and managing their own businesses.

Estimates suggest that within the next 15 years, 600 million jobs need to be created for young people globally to contain the current spread of unemployment and to cope with the growth in the working age population. [18] The unprecedented levels of youth unemployment and the proliferation of substandard work contracts in many countries reflect the daunting entry barriers for new workers and a severe insider-outsider divide. The resulting high levels of joblessness impose massive costs on society in terms of de-skilling, soaring inequality, rising social tensions, and political instability.

[18] United Nations. Young People Need Skills Training, Jobs to Help Create Better World for All. See https://www.un.org/press/en/2017/ecosoc6808.doc.htm

Two important features among the anticipated changes in the labour market, due to rapid technological changes, stand out as directly affecting the prospects of young people. First, the lack of a requisite combination of experience and qualifications makes it difficult for youth to get a firm foothold in the labour market. In a McKinsey survey of young people and employers in nine countries, 40 percent of employers said lack of skills was the main reason for unfilled entry-level vacancies. Sixty percent said that new graduates were not adequately prepared for the world of work. There were gaps in technical skills such as STEM subject degrees but also in soft skills such as communication, teamwork, and punctuality. Private sector firms, having the choice of more experienced workers, often balk at the larger costs of training for youth applicants, both in terms of formal courses and in terms of longer time needed to learn on the job—when their productivity is lower.

Second, technological change, especially AI and automatization, undermines the traditional path for youth to enter and gradually rise in a job, since simple, entry-level tasks are systematically taken up by machines and algorithms. This markedly raises the skills threshold for first entry into the labour market and eliminates a crucial avenue for initial learning on the job for entry-level workers. Entry-level jobs increasingly require a set of skills that are usually associated with mid-career status, such as some degree of systems-oriented thinking, ability to flexibly organize information, analyse and shape it to be directly relevant to the task at hand, and to present it in a compelling manner. The higher threshold for entry reduces the number of available entry-level positions for many youths, who earlier would have found a first job. Youth not in school, training, or employment are likely to be worse off. Lacking the requisite skills, potential new entrants face increasing competition in a rapidly shrinking portion of the "old" labour market.

For example, Germany, Europe's strongest economy and manufacturing powerhouse, has quadrupled the number of installed industrial robots in the last 20 years, without causing economy-wide human redundancies. Robots have not dented the total number of jobs in the German economy, but they are changing the career dynamics. On average, a robot has replaced two manufacturing jobs. Between 1994 and 2014, roughly 275,000 full-time manufacturing jobs were not created because of robots. Essentially, the robots have resulted in fewer jobs created for new entrants, thus blocked the entry into manufacturing jobs.

Earlier, typically, close to 25 percent of young workers in Germany went into manufacturing, while the rest took up other options. Today, many more young workers are starting in the service sector. In addition, educational systems have not kept pace with the changing nature of work, resulting in many employers saying that they cannot find enough workers with the skills they need. Some of the mismatch is locational: qualified workers may not be available where there is demand for work. Observed across regions, within countries, as well as between countries, such geographic mismatch requires a different policy response (focused on transportation or enhancing spatial mobility, rather than on vocational training).

The interaction of large-scale demographic transition and technological change is complex. As the discussion shows, countries experiencing a youth bulge may face exacerbated labour market pressures. On the other hand, labour market adjustments that enable more labour-saving and productivity-enhancing technology would help address the contraction of the share of working-age population in aging societies. This would have a dampening effect on the demand for immigrants in aging societies, in which many people, expecting to live longer, have increased their savings in anticipation for longer periods of retirement— and many are likely to do so in the future. Finally, the coming cohorts of older persons have benefitted from higher levels of education, income, and wealth relative to today's older population, and are therefore more likely to be able to support themselves during old age. However, there are considerable inequalities and the risk remains that in the absence of targeted policies, new and digital technologies may not cater to the special needs of the aged population.

3.2 Opportunities

3.2.1. Reducing Inequalities and Rethinking Social Protection Systems for the Future

Self-employment will play an important role in providing work for the increasing number of unemployed people—many of them young. It will be critical for them to learn how to secure work in the gig economy, to successfully establish a self-owned business, to mitigate the related risks, and to benefit from the opportunities. Other options include self-employment through companies providing temporary work. While these forms of employment and sources of income will often only help make the ends meet, they constitute a viable entry point and a pathway toward a decent and stable source of income.

This kind of work is difficult to measure and often not accurately reflected in official statistics. Thus, the consequent data gap precludes a full understanding and analysis of a large—and increasingly important—share of labour-market activity. A related important issue to be addressed is the considerably weaker social safety nets available to those engaging in the gig economy—notably unemployment, work accidents, pension insurance, parental and sick leave, paid holidays, etc. The lack of effective labour regulations is also a serious problem as greater access to work does not necessarily imply improved quality of work or of working conditions. For example, only few of the platforms that connect clients with domestic help have adequate mechanisms to protect them from abuse.

Existing welfare policies based predominantly on traditional employment contracts and relying on collective arrangements in formal job settings may increasingly lose their relevance. There is an urgent need to revisit current policies and labour market institutions that may soon become outdated. This need arises from the expected risk of

rising and deepening inequalities stemming from the emerging polarization of employment across occupations and skill-sets. Wage premia are expected to be offered for ICT and STEM skills, strong foundational cognitive and socio-emotional skills, and for more advanced non-routine 21st-century skills such as critical thinking, complex problem-solving, creativity, and expert communication. Lower-paid and lower-skilled occupations, which are intensive in routine skills, are much more vulnerable to wholesale replacement by automation than higher-skilled ones, hence the risk of worsening income inequality between socio-economic groups.

As such, Universal Basic Income (UBI) is being considered to reform and potentially replace the existing social welfare and social protection policies and programmes, in a number of countries, including China and India. UBI has several advantages, including its potential to enhance personal freedom by providing a more diversified range of work arrangements. It has the potential to empower people, especially the vulnerable (young and women) and the poor, and to improve the operational efficiency of welfare programmes. It can also contribute—e.g., through reduced inequality—to a society with better-incentivized, happier citizens, and improve the levels of trust and cooperation between them.

Despite the divergences in current thinking related to UBI, it is being seriously considered or already piloted in different parts of the world. In Finland, a UBI pilot has been recently launched as part of a reform to its existing welfare. In China, pilots on a small geographical scale already exist in Macau and Huaidi. UBI is, more broadly, seen as an alternative welfare policy to address the social challenges of the future stemming from digital advancements coupled with changes in demography, globalization, urbanization, and climate change. In India, UBI at US$113 (7,620 rupees) per person per year is being considered to reduce extreme poverty from 22% to less than 0.5%, with three pilot projects conducted in West Delhi and two in Madhya Pradesh. These pilots are demonstrating powerful positive outcomes, notably better nutrition among children, healthcare and sanitation, school attendance/performance, and women taking more initiative in decision making on household finances.

However, it needs to be sustainably funded. To finance its UBI, India is considering to free up funds from approximately 950 existing in-kind welfare schemes to the poor and to cutting additional subsidies (e.g., transport, oil, loans) for the middle class. These measures would substantially streamline the existing welfare system and garner funds equal to 4.9% of GDP, sufficient to cover a UBI that serves 75% of the population. More generally, technological change boosts output by a sufficient amount to facilitate sustainable redistribution through a UBI. (See box **on page 43**)

A broad UBI could be supported by technologies, such as big-data and cloud-computing that generate relevant, low-cost data to underpin effective monitoring and reporting.

3.2.2. Unlocking New Opportunities Using Skill and Capacity-Enhancing Technologies

New technologies have considerable potential to unlock new opportunities for marginalized groups and can help integrate them into labour markets. They can be used as assistive technology to enhance the capabilities of individuals, help them overcome their disabilities, or compensate their lack of skills, thus enabling their participation in socio-economic life.

One example of these technologies is powered exoskeletons, which are wearable or remotely-operable robotized devices that amplify human physical capacities. These 'power suits' could be used as assistive technology to support and expand the capabilities of people with physical disabilities and of workers in arduous or hazardous jobs. For instance, the Human Universal Load Carrier (HULC) is an exoskeleton system that augments ability, strength, and endurance. Cyberdyne's Hybrid Assistive Limb (HAL) is another example. It allows the wearer to lift ten times more weight. HAL is the first powered exoskeleton to receive a global safety certificate and is currently used in 150 hospitals across Japan.

New technologies can also be used to enhance cognitive capabilities or to overcome mental disabilities. Virtual Reality (VR) technology is increasingly used to train workers, enhance their skills, and assist them in performing their tasks and duties. Deutsche Bahn (DB), a worldwide logistics and delivery service provider, is increasingly relying on VR technology to provide simulation-based trainings for its employees. According to its virtual product training head, the entire workforce will be trained using VR simulators by the end of 2018.

In the healthcare industry, Virtual Reality (VR) is being used across various countries in physiological therapy. The technology has proved effective in curing mental health disorders such as Post-Traumatic Stress Disorder (PTSD) and anxiety, conditions that have direct implications for employment and earnings.

DB - Training using VR technology

Beyond skill-upgrading, the challenge is to ensure that labour regulations facilitate and do not impede these transitions, and that social protection systems support workers when they are between jobs or not working regularly.

3.2.3. Accelerating Gender Parity: New Narrative for More Inclusive Work Environments

Technological innovation can act as an accelerator for the process of reaching gender parity by providing greater flexibility within traditional jobs and unique digital platforms for pursuing work and entrepreneurship. The capacity to effectively communicate with colleagues, share information, participate in meetings from a different location, greatly empowers those—often women—who cannot be in the office on a consistent basis.

Similarly, the ability to work from home has the potential to empower women who face scheduling constraints or societal barriers. It is a critical tool for promoting greater gender equality. For example, labour participation of women in Pakistan is unusually low at 23%; most women are employed in the informal sector with low wages and few legal protections, owing to traditional familial values and barriers in the workplace. There has been a steady rise in female entrepreneurs in Pakistan, facilitated by digital platforms allowing them to set up online stores and services from home with minimal capital. These platforms help provide the flexibility that educated women require to pursue financial independence, while adhering to deeply-ingrained cultural values (which will take a long time to change).

There is a strong gender dimension in the informal sector, with the average share of women exceeding that of men by 4.9 percentage points (by 8.7 percentage points if agriculture is excluded).[19] Men tend to be overrepresented in jobs at high risk of automatization such as public transport in countries with high HDI, while women on average are overrepresented in such jobs—mostly in the service or textile industry—in lower-HDI countries. Development projects that aim to empower women through education and vocational training need to take this evolving landscape into account to ensure that they provide skills with long-term feasibility. To allocate scarce resources wisely and to anticipate the impact of technological change, to the extent feasible, investment must be directed towards future-proof projects and longer lasting skill sets.

One aspect of technological progress—the rapid spread of electric labour-saving household appliances—has already contributed to higher participation of women in the labour market. The spread of such technologies is associated with increased school attendance. It shows that technology-driven advantages apply not only to advisory services, entrepreneurship, and other gig opportunities, but also to consumption and chances to engage in learning and networking. In fact, educational attainment is a main direct determinant of women's labour force participation.[20] Considering that women tend to have a greater burden of responsibility in housework and childcare, these advancements have benefitted them comparatively more, allowing them to have more time and flexibility to pursue education and labour market participation.

[19] ILO, 2017.
[20] DESA, 2017.

Furthermore, improvement in women's education has a positive impact on their children. Better nutritional status of mothers has been associated with better child health and survival.[21] In addition, women's education has been positively linked to a range of health benefits for children—higher immunization rates, better nutrition, and lower child mortality. Mothers' (and fathers') schooling has been positively linked to children's educational attainment across a broad set of countries. In Pakistan, for instance, children whose mothers have even a single year of education spend one extra hour studying at home every day and report higher test scores. Women's lack of agency—as evidenced in domestic violence—has consequences for their children's cognitive behaviors and health as adults.[22]

3.2.4. Gender Equality and Responsive Labour Markets

A recent study by Accenture argues that gender gap in the labour market would be reduced twice as quickly if governments and businesses raised the pace at which women become digitally fluent. However, this also requires progress in educational levels, financial and digital inclusion, legal protection, and recognition of unpaid care work, coupled with economic development.[23] Key contributing factors to digital fluency include equal access to and control of technology, along with changes in social perceptions and encouraging the entry of women into technology-related fields. Barriers include inequality of opportunity, social perceptions that divide types of work as suitable for either men or women, and an increasing digital divide in the society.[24]

Government policies need to help remove gender biases, stereotypes, and barriers to entry or "glass walls". Studies show that despite girls showing interest in STEM subjects in school, few aspire to work in those fields. Furthermore, changes in the private sector's corporate culture and resolute action to dispel misperceptions about women in technology are required. Increasing vigilance against discrimination, creating gender-balanced teams, reducing wage gaps, and increasing the number of women in management positions are some ways to help remove the entry barriers and glass walls.

There is still a widespread misperception that women are less capable than men when it comes to careers related to science, math, engineering and technology. Encouragement should start during early stages of education to counter these myths. An education system that better integrates technological devices and platforms into its curriculum can help reduce these entrenched biases. Teachers and parents need to be aware of these and must actively work to dispel these stereotypes. Harvey Mudd College, a small science and

[21] "Gender Equality and Development", World Bank Report (2012)
[22] World Bank p.5
[23] McKinsey Global Institute (MGI) report
[24] The OECD defines digital divide as the "gap between individuals, households, businesses and geographic areas at different socio-economic levels with regard both to their opportunities to access information and communication technologies (ICTs) and to their use of the Internet for a wide variety of activities" (https://www.oecd.org/sti/1888451.pdf).

engineering powerhouse in Claremont, California, raised the percentage of women graduating in computer science from less than 15% in 2006 to 55% in 2016, primarily by removing intimidation in the classroom and abolishing all notions about certain people being good at computer science and others not.[25]

3.2.5. Harnessing Demographic Dividends: Connecting the Young and the Experienced

Technological change raises the threshold for youth to enter into productive employment, because it reduces the availability of entry pathways that are typically led through simple, easy-to-automate activities, which are increasingly unavailable. As a result, the skillset required for entry-level jobs increasingly contains features that typically come with experience. This leads to a catch-22 situation for the youth: lacking experience, they cannot qualify for jobs; and not entering the labour market robs them of the ability to build up such experience. A related problem for students and young entrepreneurs is to find a good mentor, since their professional networks are limited.

In addition to specific pathways for entering employment created by vocational and other forms of education, connecting youth with recent retirees can be another channel for providing the experience-dependent components of the skillset necessary for employment. They have complementary skillsets: while retirees often lack the computer savvy agility of the youth, they have decades of experience in dealing with typical labour-market situations – discipline, reliable and timely delivery of results, coordinating work, and working as part of a team, etc. As such, they can often contribute their skillsets without significant time constraints, either on a volunteer basis or for a reasonable fee.

ICT technology, social networks, and electronic sharing platforms offer an effective way of linking the demand for extensive employment experiences and mentoring ability sought by youth and the supply of the same offered by recent retirees. They can assist, advise, and mentor recent graduates, unemployed youth searching for jobs, and young entrepreneurs. Similarly, establishing Senior Internship Programs can connect retirees and senior citizens who are interested to contribute in meaningful ways to the economy and society with young businesses start-ups or development projects led by a young person or group. 'The Intern' is a movie that serves as an adequate illustration of the mutual benefits of such programs and reinforces the thought that experience never gets old.

[25] A blueprint for getting more women into information technology https://www.economist.com/news/science-and-technology/21711632-blueprint-getting-more-women-information-technology-high-techs-missing-xx-factor

Existing technologies and increased digitization offer excellent opportunities for such initiatives to also occur virtually. This way, the youth are able to connect with senior mentors and interns from their own country as well as from others. The retirees become mentors, counsellors, or business advisors. All would benefit if countries were to draw on the wealth of knowledge, experience and skills of their aged population to help amplify the job-specific skills and knowledge of the young. This would also help senior citizens to gain a sense of meaningfully contributing to the society.

The wisdom and experience of the aged group can help students and young people fit into employment situations and make career-advancing decisions. Young business entrepreneurs could greatly benefit from such platforms, especially if the mentoring services from senior citizens are readily available and clearly aligned with their needs. This makes career advice, business ideas, and counselling only a click away.

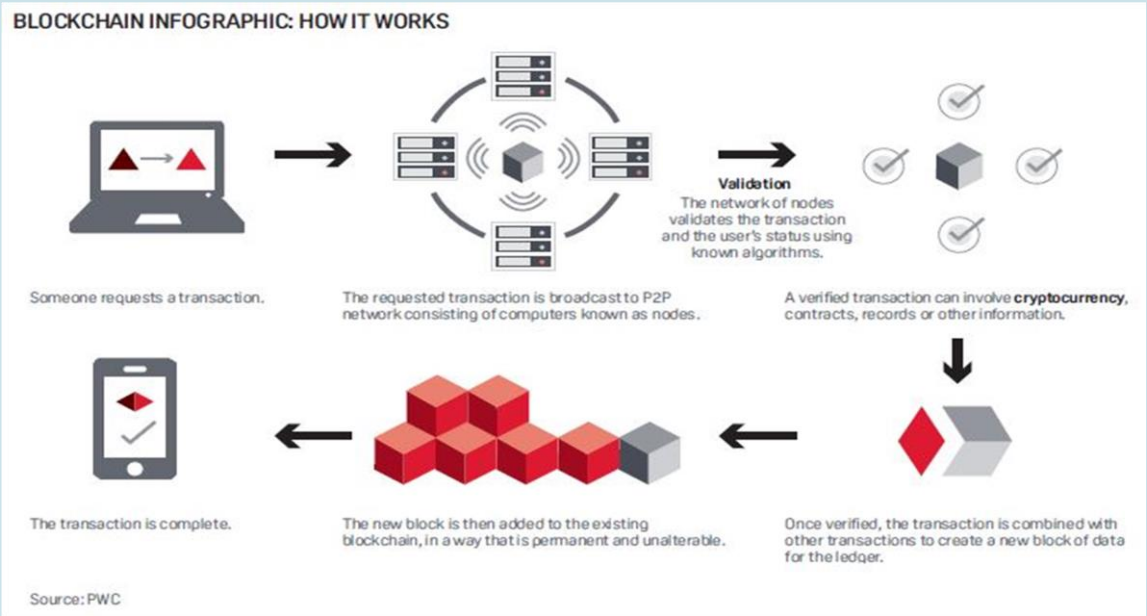
Interested countries can draw from the many existing on-line platforms to develop their own. For example, MentorNet reaches out to science, technology, engineering, and mathematics (STEM) students through a vibrant community that is committed to student success. Another student-focused program, iMentor, empowers students from low-income communities to graduate high school and succeed in college. Students meet with mentors one on one, either online or in person. The end result is a strong connection that encourages students to pursue their dreams. In New York City, iMentor partners with public schools to ensure that every student receives a mentor. For a similar idea to channel the wisdom of highly experienced professionals to educating young people, see the "Now Teach" website founded by Financial Times columnist, Lucy Kellaway.

3.2.6. Reimagining the Delivery of Public Services: Models, Systems, and Processes

Innovative governments are experimenting with promising new approaches. These include employing AI, partnerships with private and civil societies in interacting with citizens and providing public services, flexibly outsourcing selected components of public service jobs, industry platforms, and introducing blockchain-based registration systems. Further examples include adopting self-driving vehicles for public transportation, integrating all government-citizen interactions into a single secure and low transactions-cost platform, handling identification, provision of a universally-accepted digital signature, payments, and access to all government services (including filing and paying taxes, as well as e-voting).

Blockchain — Game-Changing Disruptors

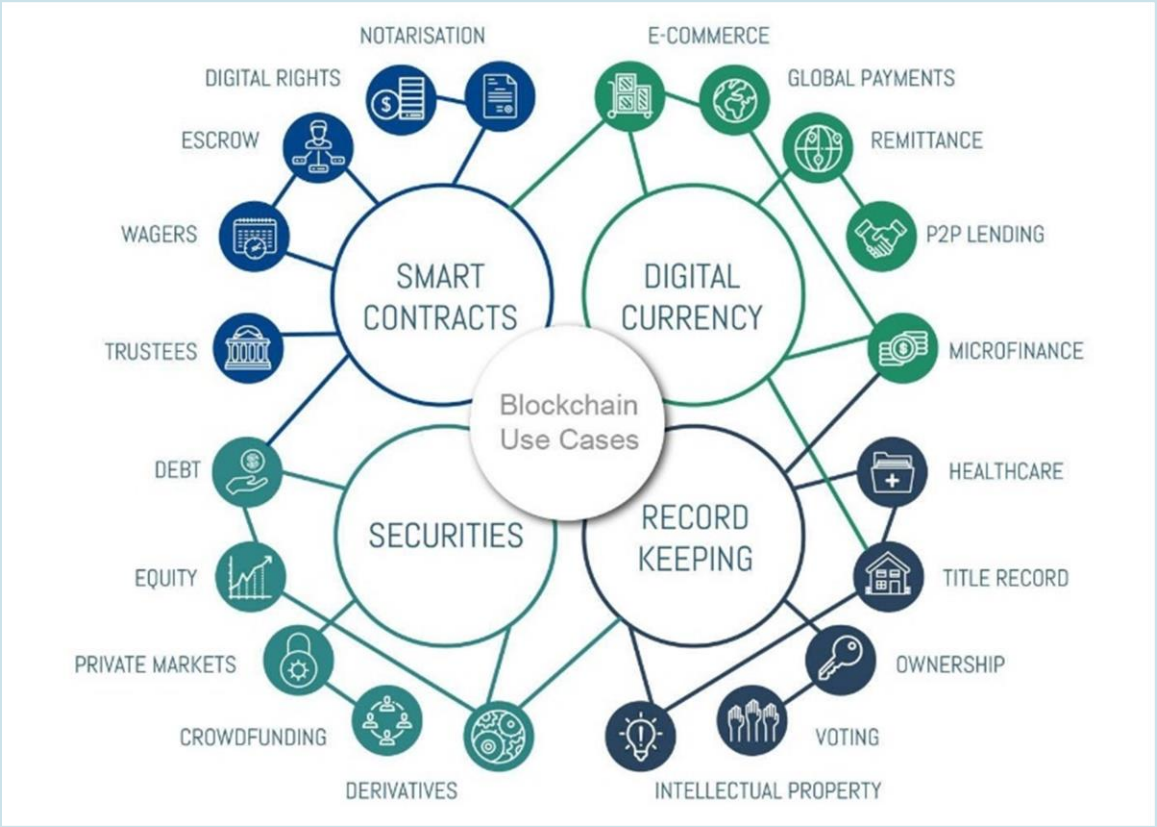
Blockchain—a list of records maintained by a network of computers that validate and update new records—is a distributed ledger-based database methodology. Regular additions made to the existing information set are broadcast to a network of computers that maintain the blockchain to update it and verify its integrity, without relying on a single centre. Each computer in the network has a copy of the previous blockchain— identical, previously validated information. Upon validation of the added record, it is combined with other relevant information to form a 'block' that is cryptographically linked to the previous blockchain. This new, longer blockchain replaces the old one and is kept in all computers of the network, replacing the previous blockchain.



Blockchain's open design has two characteristics that make it immutable—and hence enticing. First, information is compiled in a chronological order with each block containing a cryptographic reference, or a key, to the previous block (which has a similar reference to the block before it). Thus, tampering with a single block is impossible without replacing the entire chain that came after the target block. Second, the blockchain is shared by every computer in the network, thus, tampering with a single computer or server is rapidly revealed since the rest of the network will broadcast the previous ledger; and no one has enough computing power to convince the entire network to change their ledgers.

In a sense, blockchain technology is an upgrade to the internet—which had leveled the playing field in access to information but was susceptible to data corruption and replication. Blockchain enables functions that were technically feasible on the internet but were not run because it was too risky to do so. People trust the integrity of the resulting database because of its immutability, rather than because they trust a central database manager. Such trust is critical in today's complex world where geographical distance no longer imposes serious limits and we constantly interact with unknown parties. We need a fool-proof verification method of the counterpart's integrity to make this work.

Elaborate, costly, and slow processes are currently used to verify the identity of buyers and sellers, the actual ownership and integrity of the transacted asset, and of intermediaries. These include complex regulations and auditing, central government registries of assets and their ownership, of financial and legal practitioners. Online digital payments also require verification by trusted third parties owing to the risk of double-spending (spending the same, easy-to-duplicate, digital token twice). The process is further complicated with loan underwriting or cross-border deals. There are also risks. Third parties may mishandle personal information or succumb to ever-advancing hacking techniques, leading to data breaches and possibly identity theft; and information asymmetry creates moral hazard. Depending on what goes into the records, potential applications can encompass all sectors of our society that currently depend on trusting a centralised third party. Blockchain Embassy Asia, a blockchain advocate organization, illustrates some of these functions nicely (https://www.bce.asia/).



Any transaction among actors who are geographically or socially distanced from or cannot (afford to) build trust with each other can rely on and benefit from blockchain technology. For instance, this includes integrated global supply chain management to verify each item's path and origins with time stamps that are immutable and accessible for all in the supply chain, including consumers. The resulting boost in production efficiency opens the door for entering the value chain for new businesses that can start small, credibly verifying their integrity through transaction trails on the blockchain. It also strengthens the ability to exercise consumer rights.

The greatest mediators and facilitators of trust in our world, governments, are also affected. Every execution of welfare, taxation, criminal justice, and socio-political rights depends on recording and verifying citizens' personal information. Using blockchain, public services can work with much lower risk of being corrupted, safer from attacks or data mishandling. This opens up ample space for digitized e-governance, with concomitant gains in efficiency, transparency and accountability. Records on voting, property rights, and court rulings can be accessible to the public and trusted to be fabrication-free.

This has direct implications for the future of jobs. Blockchain is set to disrupt the modus operandi of businesses and governments, in ways beyond replacing human labour, owing to superior physical or computational strengths. Blockchain is a technology that augments trust, a source of social capital. This disruption is happening within central hubs of society and the economy: government, finance, and key registries, not in the peripheral spokes. Business models that profitted from the rent stemming of the established trust in companies and institutions, passed down as legacies, will be contested by new entrants and superseded. Highly-rewarded labour contribution in such sectors will be subject to change, as will the skillsets that they require—biased in favor of skills that can maximize the potential of the new technology. Consequently, technological innovation and disruptions are entering areas previously thought to be less vulnerable, in intriguing and complex ways unconnected to labour automatization.

Blockchain also holds the promise of making the world "flatter". Earlier, certain asset transactions may not have materialized in politically volatile or less developed countries that lack reliable real estate ownership and individual civil registration. Blockchain has the potential to endow such communities with trust and hence the chance to leapfrog the phase of traditional institution-building and of the gradual emergence of business-friendly social norms. Currently, an estimated US$20 trillion of assets are not reflected in registries. These assets could begin to be used as much needed collateral for the poor, those in rural districts, and small businesses to gain access to financial services and rise out of poverty.

Such flatness does not only pertain to inequality between countries, but also within. Nicolas Berggruen, Chairman of the Berggruen Institute, argues that blockchain technology can help avoid the stereotypical dystopian scenario of a winner-takes-all economy that necessitates heavy redistribution. Immutable database technology makes fractional ownership of capital possible, enabling the "pre-distribution" of gains from robots and artificial intelligence through distributed mass public ownership of firms. Don Tapscott, author of Blockchain Revolution, also criticizes the current modes of shared economies, where intermediary firms take the lion's share from the common value created. He envisions a future where individuals could receive rightful profit from the value that they are contributing to the society, including not only labour and capital, but also data that individuals create.

Blockchain's disruptive implications reach core functions of our governments and economies, challenging the status quo, rather than just improving efficiency. Governments cannot remain in a simple reactive or observing mode, and need to consider the potential benefits and costs of adaptive policies and formulate strategies that are forward-looking best responses to the expected future domestic and international environment. Governments diverge widely in their response—affecting the extent to which blockchain technology reaches its potential. The Estonian government, for example, is readily adopting blockchain-based systems for various registries and health records. The UK government is expanding its regulatory sandbox into a global platform to invite innovation and to encourage fintech entrepreneurship. Meanwhile, a March 2018 US Government Accountability Office report criticized complex US regulations that are making fintech innovators avoid the US as a destination.

However, some governments may have little intention of facilitating trust. Internet itself is sometimes used as a propaganda tool, with anti-democratic regimes censoring criticism and dissent. Similarly, blockchain is technological advancement with the potential to empower individual citizens, but also open to abuse by governments. Depending on how it is used and regulated, different societies will move in different directions and speed with the same technology. Importantly, opportunities for gaining leadership in innovation and application may not necessarily arise from the regions that initiated the blockchain movement, since many blockchain platforms are open-source and up for adaptation.

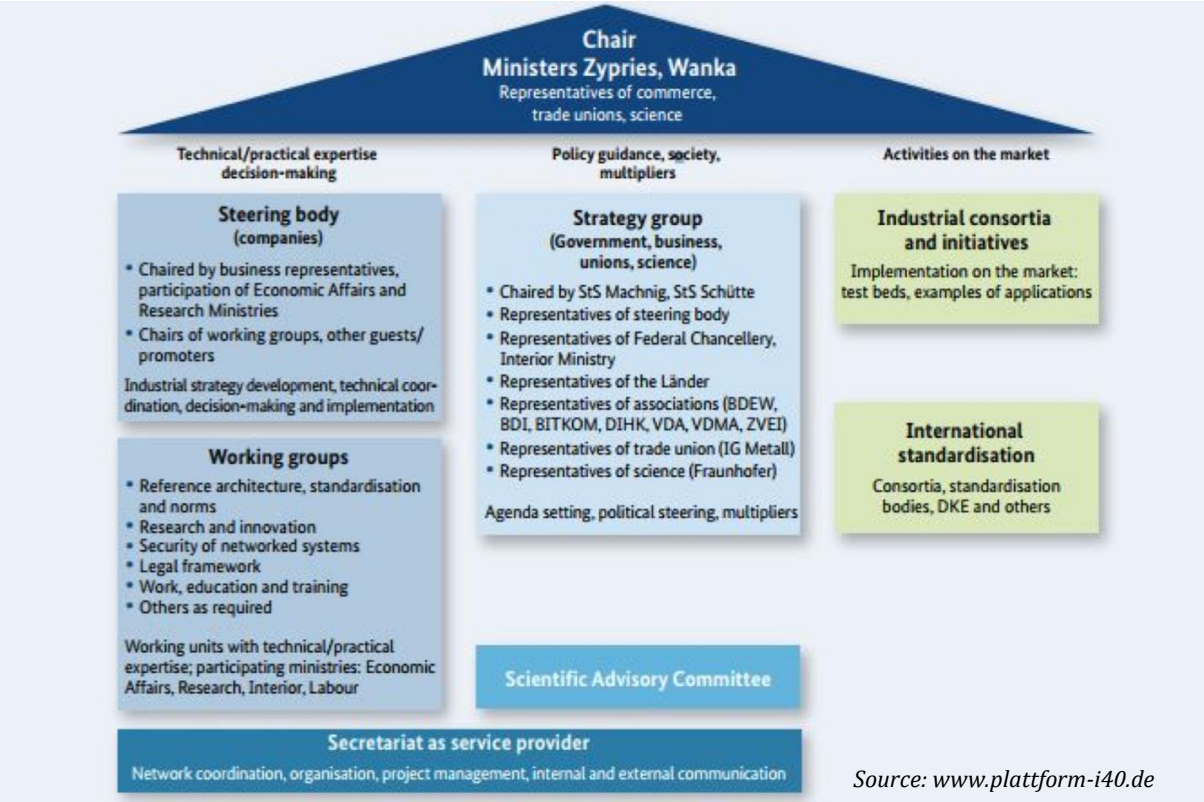
Serious challenges remain. Blockchain needs to overcome major technical limitations to become a dominant database technology. Transaction speed, for example, is too slow. Ethereum processes about 15 transactions per second as opposed to Visa's speed of 2000 transactions per second. The system of a massive overseer network, comprised of dispersed, competing miners that maintains blockchain-based cryptocurrencies' integrity, has been criticized as inefficient in its use of computing power and of energy.

Furthermore, blockchain technology itself may be disrupted or replaced by other competing technologies. For instance, quantum computing, which uses countless superpositions of 1 and 0 rather than just these two digits, could make information processing much faster. Advancing rapidly,[1] it may challenge blockchain's role as a cryptographic safeguard, since the computing powers of the existing network may face a disruption when vastly greater computing powers enter the stage. Quantum encryption would pose an even more direct challenge to blockchains. Already under development, it aims to use quantum computing to send, receive, and store data that is immutable and un-hackable.

Blockchain ushers in a new type of technological disruption: it threatens functions once thought to be outside the scope of automatization because of their societal nature related to social capital. Since potential benefits will not self-propel themselves as time goes by, governments must proactively manage this disruption. The lessons learned in the process of doing so will better prepare us for dealing with future technological advances that will inevitably emerge.

For example, preparing for the upcoming technological revolution is firmly on Germany's agenda. The government recently introduced ***Plattform Industrie 4.0 - "Digital Transformation Made in Germany"*** to better coordinate the digital transformation of industry and to serve as a basis for strategic planning.[26] The platform is a collaborative ecosystem that draws on the participation and coordination of more than 250 stakeholders composed of politicians, industry leaders, scientists, academics, associations, and trade unions. Together, they examine various future-related topics such as standardization, cyber and network security, legal frameworks, working arrangements, among others. The platform also serves as a basis for strategic planning that identifies priorities and recommendations for action, based on findings from research and business operations.

[26] http://www.plattform-i40.de/



Source: www.plattform-i40.de

In the United Kingdom, **Catapult Network** comprises of **new centres for innovation.**[27] It is a strategic government initiative that aims to bridge the gap between businesses and academia to catalyze growth. The network of centres aims to accelerate business innovation, minimize the risk of innovation, develop the knowledge and skills necessary to improve the business climate and competitiveness of the country, and drive future job growth and sustainability.

Each catapult has a specific technology focus area and supports businesses and researchers with the facilities and expertise that they need in order to jointly address key issues and to develop new products and services.

In its 2017 report, Catapult reported that it has supported over 2,800 small and medium enterprises (SMEs), creating 2,473 industry collaborations and 636 academic collaborations. The Catapult Network is now working in 24 different countries. In the past year, it has trained 900 apprentices and engaged with 4,700 fast-growing technology businesses.

The UK's 10 Catapult Centres:

I. Cell and Gene Therapy
II. Compound Semi-conductor Applications
III. Digital Catapult
IV. Energy Systems
V. Future Cities
VI. High Value Manufacturing
VII. Medicines Discovery
VIII. Offshore Renewable Energy
IX. Satellite Applications
X. Transport Systems

[27] https://catapult.org.uk/

4. The Way Forward - Policy

Recognizing that change is inevitable and will affect all parts of society, governments play a critical role in steering their countries through technological change and digital transformation. They must provide an enabling environment where existing policies are adjusted and new ones are shaped to facilitate the necessary structural shifts, allow the private sector to thrive and create jobs, while ensuring that the public sector embraces innovation and technological change to augment the delivery of quality public services that meet citizens' expectations. Governments need to adapt governance and regulation as markets evolve, ensure that gains are broadly shared, and that displaced workers can find new, decent jobs so as to maintain the fabric of society.

In a policy environment where uncertainties are the norm and technological and digital transformation are expected to have multidisciplinary and multidimensional impacts, governments and policymakers need to employ scenario analysis as a key component of planning, policy formulation, and regulation.

Policymakers must not allow the transition and the insecurities associated with it to become a political tool for opportunistic leaders. Failure to prevent a drift towards populistic nationalism carries a considerable risk and impedes the formulation of effective, strategic policy-making that can sustainably address structural problems. Misinformed policymaking creates a self-destructive cycle of economic mismanagement and hardship. This threatens to delegitimize liberal democracy as a political system and opens the door to political instability, intolerance of diversity, and tyranny of the majority. These dynamics pose an even greater challenge for countries that are unconsolidated democracies with fragile democratic institutions and significant levels of corruption.

Against this backdrop, the paper lays out five policy directions, noting the need for multidisciplinary, multidimensional policy responses and for tailoring them to country-specific contexts.

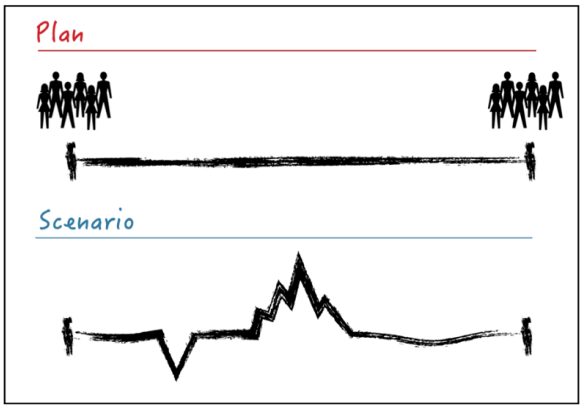
4.1. Experimental Policies and Adaptive Laws and Regulations

Governments may consider experimental policymaking as the best response to adjustments required in the face of rapid, disruptive technological progress and increased uncertainties. This calls for trying new approaches that hold the promise of working with inherent flexibility and agility to respond to changing circumstances.

The main areas of focus are:

i) adjusting the domain of government activities, reflecting the changing role of government;
ii) reorganizing the way government operates; and
iii) strengthening public trust in the government.

Mitigating the risks of the upcoming transition may require the formulation of a small number of scenarios that jointly cover most of the possible states of the world in the future. Finding the appropriate policies in each scenario is a feasible task. The recommended policy mix would emerge from imposing a budget constraint, while choosing policies that fall in at least one of the following categories:



- "Robust" measures, which feature in all or most scenario-specific lists and hence are optimal under any scenario (reforming education may be one);
- Policies necessary to avoid a catastrophic outcome under at least one scenario with a non-negligible probability of materializing (climate change would fall in the first category for many, or this one for some);
- Policies that hold the promise of exceptional returns with relatively low cost in one or more scenarios (lottery-ticket type policies).

Governments need to continue to provide classical public goods like human security, key components of workable public health and education systems, regulation to internalize externalities imposed by market players or to preclude market capture, workable standards for sharing national and global data flows, disaster risk reduction, rule of law (including enforceable property rights), and access to justice. However, the domain of government activities is likely to shift as technological change enables the government to hand over some of its tasks to the private sector, while it creates effective instruments to address market failures—mainly those associated with some public goods, high transactions costs, and incomplete information flow. Meanwhile, this can also aggravate existing problems (e.g. monopolistic markets) or create new ones (e.g. hacking or influencing public opinion through social media).

Markets can take over the provision of some public goods, where they are better placed to provide them (e.g. postal service). Governments may wish to consider outsourcing such services to the private sector and focus instead on providing only the necessary legal and regulatory frameworks. Regulation can be reduced in some areas previously considered as natural monopolies (e.g. phone service). At the same time, governments may be called upon to strengthen regulation in areas showing new strains (e.g. monopoly

positions in AI and its top applications), and ensure the provision of new public goods (e.g. internet access, basic public housing, and minimum income).

At this juncture, governments have an excellent opportunity to leverage between the existing and new technologies. The aim is to shape the public service culture to embrace change, foster innovation, and position the government, its agencies, and departments to best deliver quality services to the public. However, organizational inertia is likely to pose serious problems in the highly dynamic environment created by technological change.

The way forward will also depend on how the government is conceptualized. Government can be thought of primarily as:

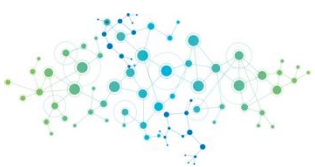
i) **control tower** — paternalistic, centrally organizing citizens' lives through rules and commands; this requires superior information and effective organization.
ii) **vending machine** — resources (tax and other revenues) are put in, then taken out in the form of public services and public goods.
iii) **platform to serve citizens** — convening and arbitrating to provide the best possible public services and public goods to citizens; technology is best placed to contribute here.

Against this backdrop, a key decision for government to make will be which public services are to be outsourced and which are to be delivered by the government itself. With technology increasing the risk of a "digital gap" and potentially broadening the global divide, human capital will be key. To enhance that, the provision of education and health services need to step up.

A judicious use of technology can enable some countries to leapfrog others in their development paths. This is because they are farther away from the technological frontier, hence have more to gain from embracing the latest technology. They typically do not have large legacy systems, hence the inertia stemming from massive sunk costs does not hold them back. On the negative side, they often face more constrained fiscal space and have less human capital than developed countries. Examples of such leapfrogging include the omission of creating a landline telephone system in many African and Asian countries, Kenya's M-Pesa payment system, and Estonia's advanced e-government features.

Governments are responsible for guiding the technological transition of the labour market. Governments are also key sources of employment and will be affected heavily by labour-saving technologies. For instance, in most Middle Eastern countries, the public sector provides between 40 and 90 percent of formal employment. India's large efforts for digitalization and efficiency have already reduced the number of government jobs by 2.5 million over the twenty years, to 17 million in 2015/16. Progress toward e-government and organizational restructuring will substantially enhance efficiency, but it will also further render a considerable part of the workforce redundant.[28]

[28] Yusuf, 2017.



Governments will need to find a proper balance between being reactive and proactive in policymaking and engaging in new technologies. They need to move toward a more customer-centric approach, implying far greater interoperability among their various parts and attaining a stage where all government agencies can operate flexibly with a single purpose, in multiple dimensions. This will require effective ways of handling organizational inertia to take on new technologies where it makes sense—e.g. allowing blockchain to drive asset registries. With increasing specialization, it is also critical that public servants are able to work as productive parts of multidisciplinary teams, some of which are assembled in an ad-hoc manner in response to emerging challenges.

4.2. Revamping the Social Welfare and Protection System

For workers, digital technologies generate new opportunities for employment and earnings, but they also have downsides. Key among these is the widening income inequality. Although technologies are becoming widespread, the economic payoffs are not. Positive impacts from using digital technologies—as with other technologies in the past century—are most likely to be captured by those that are already better off. This raises the concern that digital technologies effectively "pull away the ladder to the middle class" as they decimate middle-skilled jobs or fundamentally transform them. Governments may wish to consider revamping existing social welfare and protection systems that better reflect the current and future labour market and nature of jobs.

UBI could be a relevant policy option for many countries to consider, given the likely worsening of inequality and job losses as economies transition, societies age, and digital transformation advances. Financing an unconditional cash payment to all citizens is possible with the political commitment to widely share the benefits from new technologies through progressive tax policies. These benefits amount to sizable additional real resources that—if captured in part by government as public resources for redistribution—can easily fund a modest amount of UBI for all. A key point in this regard is that UBI does not need to be fully additional to existing elements of the social safety net (hence claims less of the fiscal space than generally assumed). It can replace or complement several of those, notably socially-oriented subsidies, tax exemptions, means-tested income transfers, unemployment benefits, etc.

Guaranteed Minimum Income and Universal Basic Income

"Guaranteed Minimum Income" (GMI) or "Universal Basic Income" (UBI) are (un)conditional cash payments to all citizens, which substantially strengthen the social safety net. They guarantee all citizens with a minimum income, calibrated to provide a modest and socially acceptable level of sustenance. A modest level helps contain the overall fiscal costs and limits the erosion of the incentive to work. Fiscal affordability can be further enhanced by some simple means, such as testing to determine eligibility.

Countries with a strong and wide-ranging welfare system have broad-coverage income support that is functionally close to implementing a GMI/UBI. Many countries, however, can benefit from a well-structured GMI/UBI to help manage the soaring inequality and job losses as the economy transitions, society ages, and technology progresses. Such financial support has the potential to enhance personal freedoms, particularly by providing a more diversified range of work arrangements and empowering the vulnerable (e.g. women, poor).

In particular, it would:

- *be an effective tool to reduce extreme poverty, especially in vulnerable groups, bolstering social peace and hence contributing to social sustainability.*
- *reduce the cost of failure, therefore, allow people to take risks, even outsized ones, in pursuing highly risky ideas that offer a large payoff if successful. This can lead to enhanced job creation and solutions to many issues that would otherwise not materialize.*
- *replace or strengthen existing elements of social safety nets—e.g. support for persons with handicaps, unemployment insurance, and/or old age pensions.*

However, there are concerns over the high costs associated with a GMI/UBI, as well as the possible socially and morally corrosive effects, especially on the incentive to innovate, work, save, and invest in human capital.

To address these concerns, governments could consider: (i) limiting the period over which it would be available, after which it would drop to low subsistence level; (ii) applying additional conditionality, notably participation in training, in public works, or in launching a start-up or NGO/CSO within a year of beginning to receive income transfers. Providing low-wage workers with complementary income would help reduce the disincentive to emerge from recipient status (poverty trap).

Restricted GMI/UBI schemes already exist in many developed countries. In a sense, all social security payments act in that direction. The important additional element is to make the coverage universal. There is a long line of thinkers who supported GMI, including Abu Bakr (the first Caliph of the Rashidun Caliphate in the 7th century), Napoleon Bonaparte, Martin Luther King Jr., Friedrich Hayek, and at least four other Economics Nobel laureates.

Independent work or gig economy platforms are, at times, set up with the explicit purpose to circumvent existing regulations as well as taxation. As this sector of the labour market includes the collaborative and gig economy, and circular and sharing economy platforms continue to grow, governments will need to effectively regulate them to enhance inclusion.

This involves formulating appropriate protection and safety regulations and enhancing taxation and statistical monitoring, notably through:

- Complementing the existing labour market statistics with indicators that reflect new work arrangements, such as independent/gig work, and provide the evidence base for labour market policies to cover workers becoming redundant or whose jobs are revamped.
- Putting in place effective labour regulations that cover independent work platforms to protect workers from abuse, address the erosion of workers' bargaining power (as reflected in the marked decline in the share of labour in GDP of many countries), and safeguard access to social benefits, such as unemployment and health insurance, severance pay, or pensions.
- Developing policy mechanisms to provide affordable insurance against unemployment, work inability, and other risks.
- Revising tax laws to adequately reflect and capture online-based work, self-employment, and other trends resulting from changes in the structure of labour market.
- Providing feasible options to cover the costs of training and equipment where they are no longer provided by employers under new informal work arrangements.
- Creating a balance between efficiency and protection to avoid a "race to the bottom" in terms of workers' protections, irrespective of their type of work contract.
- Strengthening the ability of labour and human rights institutions to monitor and shape the working conditions of the self-employed. Key aspects to cover include security of data, regulation of commissions and fees, the modalities of determining the eligibility of workers for jobs to preclude biases, and ensuring uniformity of employment terms.

4.3. Transforming Education

Education providers such as schools, universities, and vocational training institutions will need to better prepare students for the dramatic changes that are underway in the labour market. Governments have a critical role to play in transforming education policies, systems, curricula, and institutions for both teacher-training and student-learning that allow all actors to be ready for the direct and multidimensional implications of technological change and innovation. Critically, the increasing need for lifelong learning requires education policies to also cater for learning needs of mid-career and unemployed people.

There is a significant potential in governments working with education and training institutions, districts, local communities, and the private sector to jointly inform educational solutions and outcomes, as well as to identify the skills that workers need to

navigate through the rapidly-transforming economic landscape.[29] Importantly, education needs to equip graduates with skills that help nimble adjustment when—inevitably—circumstances change. These skills include "learning to learn" to facilitate mid-career retooling, enhanced ability to work in teams, job-search, interviewing skills, and a broad-based understanding of the technological landscape. Key enabling actions include:

- **Curricular transformation** to make work-related experiences a significant component of learning to build relevant skills and equip graduates with analytical, interpersonal, as well as computer and STEM skills.
- **Targeted vocational training using electronic platforms** to align vocational teaching with the shifting needs of private/public employers; and creating career centres and other means of effective two-way information flow to ensure stronger job-skills match.
- **Explore partnerships** with e-commerce platforms and other tech actors for the provision of targeted training.
- **Enhance early education** as well as life-long learning and cater for the needs of students with mild-to-moderate learning and behavioural disabilities.
- **Digitize the issuance of education certificates** using blockchain technology to allow students to receive certificates on their smartphones. Students can share such credible virtual credentials with any potential employer free of charge, without delay.

4.4. Gender

Policies are needed to promote the removal of gender biases, stereotypes, and barriers to entry or promotion ("glass walls/ceilings"). They require a review of and changes to the existing employment laws, public/private sector human resource policies, strategies to remove established gender roles, and adoption of a paradigm where individuals are judged on their intellectual capacities and talent. Vigilance against discrimination, gender-balanced teams, reducing wage gaps, and increasing the number of women in management positions are some ways to remove entry barriers and glass walls.

Changing societal perceptions is a slow and challenging process. Policies are needed to create a more inclusive work environment, raise the labour force participation of women, enhance access to education, life-long learning, and foster critical thinking for females (half of the working-age population). Similarly, the widespread misperception that women are less capable than men in science, math, engineering and technology need to be dispelled and their STEM education encouraged.

Employment laws and organizational human resource policies in all sectors need to be reviewed, given the changing nature of occupations, tasks, and skill requirements. This includes ensuring adequate maternity leave benefits and support to mothers with small

[29] Acquiring more education and skills through previously-established pathways does not necessarily offer effective protection against job automation in the future. For example, even radiologists with extensive training are increasingly outcompeted by computers that rapidly get far better at analyzing medical images (Ford, p.15).

children to retain talent and to promote greater gender parity in the workforce. Furthermore, organizational/company culture needs to be supportive of taking paternal leaves—an important means of changing work culture and social perceptions. Implicit biases among employers that take maternity leave into consideration when hiring and promoting employees would lose significance if both parents were expected to take leave.

4.5. Harnessing Demographic Dividends and Technological Change

The interaction of large-scale demographic transition and technological change is complex. Labour market policies and adjustments that enable more labour-saving and productivity-enhancing technology would help address the contraction of the share of working-age population in aging societies. On the other hand, they can exacerbate youth unemployment in countries that are experiencing a youth bulge. Targeted policies will allow new digital technologies to cater for the special needs of youth and the aged population:

- Unleash the potential of specific population groups—young, mid-career, and aging; women and disadvantaged groups—in national and sub-national plans through targeted policies and strategies. For instance, on-line platforms for senior internships and mentoring programmes can benefit the youth and vulnerable groups.
- Strengthen inclusive participation of youth, especially young women in policy and decision-making processes at the local, national, regional, and global level. Enhance their capabilities through education that is geared towards future employment opportunities and universal provision of health, nutrition, and sanitation services.
- Promote regional cooperation as countries are at diverse stages of demographic transitions, providing an orderly opportunity for welfare-enhancing labour migration. This would include more flexible visa regimes for organized and freer movement, protection for migrants' safety and rights, and targeted transfer of knowledge and skills.

Countries with larger working populations may consider following policy options:

- Enhance the capabilities of youth by providing them with learning opportunities to develop professional, technical, and entrepreneurial skills through vocational training and on-the-job learning through internships.
- Strengthen policies to facilitate school-to-work transition to increase employment of young women and men, with targeted measures for disadvantaged youth.
- Improve partnerships between governments, academia, social partners, and the private sector.
- Promote the development of a thriving private sector to ensure inclusive and sustainable economic growth and job creation.
- Make decent and productive work and livelihoods for young people into an attainable reality. Avoid exploitative work and lengthy unpaid traineeships/internships. Ensure equal pay for work of equal value in the formal, informal, and gig economies.

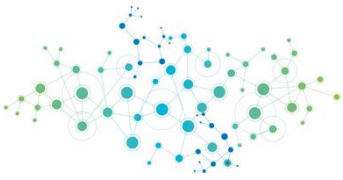
- Where a country is yet to develop a National Innovation Policy, it should consider doing so to foster innovation-led growth and to create space for young people to innovate and test their ideas. Enhance domestic capacity to absorb technologies that are conducive to sustainable development and broad-based job creation, allowing countries to reap demographic dividends.
- A country with a large young working population may agree, as part of its economic and/or development cooperation, on programmes for its youth to work in an aging population country, under a long-term arrangement. The curriculum could incorporate education on the aging country, including learning its language. A credible arrangement along these lines could help avoid social tensions associated with migration.

Key Enabling Actions to promote productive employment for young people and to reduce the youth not in employment, education, or training, include the following:

- Acquire accurate information on skills that are needed in public and private employment to enable demand-oriented skill development in general education, vocational, and lifelong training.
- Enhance capabilities of females in ways that promote gender parity and eliminate the gender pay-gap.
- Equip the youth with tools and information that they need to plan their careers. These tools include financial literacy, infrastructure for effective job-search, and affordable high-speed network access. These will help minimize regional disparities and socio-economic inequalities among youth. On-the-job training via widely available internships help youth to gain meaningful work experience and further their careers.
- Create effective electronic applications, platforms, and other interfaces for youth and other entrants to the labour market to lower entry barriers.
- Ensure universal global access to adequate social protection and decent livelihoods for young people in the formal and informal sectors, in accordance with the labour standards of ILO.

UNDP's Role

UNDP can help countries respond to, manage technological change, and harness its potential for sustainable development, with a focus on the labour market. It will do so as an integrator of the development agenda; innovator for development solutions; connector of ideas and resources; broker of knowledge, thought leadership, and expertise; and promoter of South-South cooperation. UNDP offers transformative solutions through two main channels: Country Support Platforms for SDGs and global development advisory and implementation services.



Country Support Platforms provide country-tailored advisory and policy support that integrate the 2030 Agenda and SDGs in a single long-term vision. Two examples are UNDP-led MAPS (Mainstreaming, Acceleration, and Policy Support for SDGs) missions and the SDG support team. Both assist governments in designing SDG-conforming short- and medium-term national and subnational development plans that incorporate proactive resilient responses to demographic challenges and efforts to harness the potential of digital technologies and advances in AI.

A key focus is on helping governments to utilize advances in technology to transform the quality of public services and the ways in which they are delivered to reach all citizens. These include health, education and training services, access to livelihoods and housing, clean water and improved sanitation, as well as steps to improve equality. UNDP also works on promoting productive employment for youth and women through engagement with the private sector and citizens (See Nepal box).

Country Support – Nepal

Nepal is a post-conflict country and a young democracy, while at the same time, a low-income country with high youth and female unemployment rates. Micro-enterprises, supported by UNDP under its microenterprise development project, created 119,000 new microenterprises and 187,000 new jobs across 38 districts. It also enhanced social relations and the resilience of marginalized and excluded groups, such as women. The government scaled up the project to cover 69 districts and passed a new law acknowledging micro-enterprise as a tool for poverty alleviation.

During the major earthquakes in Nepal in 2015, the micro-enterprises have helped the entrepreneurs to quickly get their families back on their feet. Economic empowerment is also enhancing individuals' capacity for civic engagement and leadership roles. Many UNDP-supported micro-entrepreneurs, the majority of whom are women, ran as candidates for the recent 2017 Nepal local elections and 277 won seats. In partnership with Microsoft, UNDP Nepal engaged hundreds of young Nepalis in developing innovative solutions geared towards human-rights promotion and micro-enterprise development. The mobile phone apps that they developed in a series of brainstorming sessions, [APPATHON] involving over 4,000 students, have demonstrated how the smart use of technology has the potential to bolster the human rights promotion system and to ensure the efficiency of results.

Using the microenterprise network, UNDP created an internet-based idea factory for young people to share business ideas, which are then linked with potential investors within and outside of Nepal. In 2016, in partnership with Microsoft, UNDP developed and rolled out an innovative smart-phone-operated software application—the first of its kind in the world—on debris management. The app enabled a better handling of large-scale crisis-response and helped manage UNDP's early recovery work project in the immediate aftermath of the disaster. It recorded workers' attendance, prepared their payrolls, measured GPS locations of quake-damaged houses, and helped calculate the cost of clearing debris.

UNDP will draw on the proven experiences of developed countries with high HDI, such as Korea, to inform solutions delivered through the Country Support Platforms. Emphasis will be placed on the timely transfer of country experiences, knowledge and lessons learnt across developing countries, and on south-south cooperation at the regional and global level. In addition, UNDP will advocate for early policy actions in the face of escalating inequality, rapid climate change, and the converging impact of megatrends. These can unleash powerful and self-reinforcing feedback loops, threshold effects (e.g. extinctions), and tipping points (e.g. on climate change, water, and air quality).

Conclusion

There is a key, slowly-emerging but critical megatrend: the loss of wisdom of crowds in democratic processes, owing to social media that can create inward-looking echo-chambers with a self-shaping worldview. If unchecked, this will interact strongly and unpredictably with the pressures manifesting primarily through inequality stemming from urbanization, globalization, demographic changes, and technological change. But this trend can be countered if social media algorithms are revised and politicians rise above the zero-sum game view of national and international politics.

Digital transformation and rapid technological change interfacing with and amplifying the impact of megatrends in motion, including globalization, urbanization, demographic shifts, and climate change, are transforming every aspect of our lives, especially the way we work and engage with the economy characterized by widening inequalities, increasing complexity, and uncertainty.

Countries have a widespread interest in enhancing the impact of digital technologies such as robots, ICT and AI on the future of jobs and human lives. However, they also have growing concerns. As a result, the anticipated impact on human lives and labour spans the entire spectrum between fearful and defensive (dystopia) or hopeful and experimental (utopia).

Leaders and governments, aiming to shape their countries' path for the benefit of the people, recognize the need to navigate through the unavoidable and partly unpredictable challenges of technological change as well as other megatrends that are already underway. Governments need to take action now to respond to anticipated changes of the future. Given the high levels of uncertainties and complexity, together with the potentially huge economic costs of doing nothing, governments cannot afford to adopt a 'wait and see' approach.

The net impact on jobs can be enormous. The key point to note is that its magnitude and composition will critically depend on policies. The impact is multidisciplinary and multidimensional. Job destruction, transformation, and creation are likely to happen at

the same time. Jobs and tasks that can be easily automated or performed by technology using robotics and AI are already disappearing in some countries. Adaptable skills acquired through education, particularly in science and engineering, are needed to make the most out of new technologies such as AI and robotics. Occupation-specific skills acquired by attending professional schools or holding occupational license, particularly those related to human-intensive personal services, are also compatible and even complementary to AI and robotics. Thus, workers with such skills stand to gain from technological disruptions rather than be displaced by them.

Relentlessly widening inequalities, the increasing digital divide, cyber security threats, along with several other uncertainties and insecurities, are adverse consequences that are occupying the minds of policymakers, employees, labour unions, and the youth who seek to enter the job market. Social protection and support for those that are likely to be most affected needs to be revamped and expanded to ensure social sustainability. Most countries are acutely aware that technological change and digital transformation can be both an opportunity and a threat.

A shift in policymaking approaches from reactive to anticipatory policymaking is required. Scenario analysis needs to become a key component of planning, policy formulation, and regulation. The recommended policy mix will consist of "robust" measures that are optimal under all scenarios, policies necessary to avoid catastrophic outcomes, and policies that hold the promise of exceptional returns with relatively low costs. The policy mix will need to account for lags in impacts as change takes time.

Implementation of the policy mix is through learning by doing and iterative filtering. Policy measures that prove ineffective are adapted or removed, while those that work are expanded or replicated. Maximizing synergies and managing trade-offs across measures, monitoring dynamic effects of feedback, and continuously updating the scenarios themselves are critical. Governments have a key role in carefully managing the fiscal space, maintaining a level playing field for the private sector, and regulating to keep the market failures in check, while ensuring social peace. These are necessary for unleashing the private sector's ability to create jobs.

This way, policymakers can turn the disruptor (new technologies) into a source for solutions, by using them to enhance scenario analysis and policymaking, thus improving the accuracy of complex analysis. Governments need to take a proactive stance that includes informing the public at large and enabling the private sector to adjust and manage change. Such policies hold the promise of placing countries on a dynamic path, where they are better positioned to adapt to digital transformation – mitigating the risks they face and optimizing the benefits that they can reap.

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