

In collaboration with the UC Berkeley Center for
Human-Compatible AI and Roland Berger



Positive AI Economic Futures

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Foreword

As technology advances rapidly and relentlessly, the task of thinking through positive futures cannot wait.



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Current trends in AI are nothing if not remarkable. Day after day, we hear stories about systems and machines taking on tasks that, until very recently, we saw as the exclusive and permanent preserve of humankind: making medical diagnoses and drafting legal documents, designing buildings and even composing music. The possible future trajectories for these technologies are equally striking. In a recent survey, leading computer scientists claimed there is a 50% chance that machines will outperform human beings at “every task” within 45 years.

These predictions generate considerable disagreement. Some see these technological developments happening more swiftly, others far more slowly – if at all. Such differences of opinion abound in the recent literature on the future of AI, from popular commentary to more expert analysis. Even the variances themselves can be revealing: in the previous survey of computer scientists, for instance, Asian respondents expected machines to outperform humans at every task 44 years earlier than their North American counterparts did.

In spite of these conflicting views, one thing is clear: if we so much as entertain the notion that this kind of outcome is possible, then it ought to demand our attention, given the extraordinary impact these technologies would have on all of our lives in the future. It is hard to imagine any aspect of our life being left untouched: the ways in which we earn a living, what we do for fun, how we interact with one another in society – all of these would be transformed.

Yet although the future might look very different from the past, it is not set in stone. On the contrary, the nature of the technologies we develop, the ways in which we use them and the manner in which we respond to their consequences are all the result of collective decisions that we must make together in the coming decades. If we choose to do so, we can shape these technologies and how they affect our lives.

That said, one of the greatest obstacles to taking action is that, at present, there is no consensus on what future we should target – perhaps because there is hardly any conversation about what might be desirable. This lack of vision is problematic because, if these technological developments do

transpire, we could quickly find ourselves adrift without a compass, buffeted by different events as they unfold, passively swept along into an unknown future by the currents of technological change and economic forces. This would be a vast opportunity squandered.

The report you are reading is a response to this problem. It marks a first step towards articulating positive visions of the future. In April 2020, an ambitious initiative called Positive AI Economic Futures was launched by the World Economic Forum’s Global AI Council (GAIC). In a series of workshops and interviews, experts from a wide variety of backgrounds gathered virtually to discuss possible positive visions and their implications for policy-makers. This report is a summary of their views and aspirations.

Many of the challenges we are likely to face in an automated future are economic ones. Accordingly, this report reflects the views of leading economists who, over the past few decades, have increasingly recognized how disruptive technological progress could be for workers. However, the report goes well beyond economics and economists alone, also capturing the hopes and aims of a wide variety of thinkers and scholars from a broad spread of disciplines. Their views are critical, too.

The visions that have emerged from these workshops and interviews are bold and ambitious. But the conversations have also shown how difficult and challenging achieving them would be. Not only are there practical difficulties in implementing them, but there are also ideological challenges – deep disagreements about the nature of the technological challenge we face and the outcomes we want to achieve.

Nevertheless, the exercise has shown that articulating positive AI visions is possible – and valuable. This report can be thought of as the first chapter in a new conversation about the future, begun by an interdisciplinary group of thinkers and scholars. It is a beginning, not an end. The questions and issues it raises require far greater research and reflection. That said, as technology advances rapidly and relentlessly, the task of thinking through positive futures cannot wait.

Executive summary

“ Many computer science experts believe that, in this century, machines will be able to do most tasks better than humans.”

Many computer science experts believe that, in this century, machines will be able to do most tasks better than humans. Clearly it is difficult to predict how artificial intelligence (AI) will develop. However, given these sorts of predictions, it is important to think about the possible consequences of AI for the future of work and to prepare for different scenarios. Continued progress in these technologies could have disruptive effects: from further exacerbating recent trends in inequality to denying more and more people their sense of purpose and fulfilment in life, given that work is much more than just a source of income.

The purpose of this insight report is to start a discussion about what positive AI economic futures we want in light of these technological trends and how to overcome the challenges we might face in achieving them. In workshops and interviews we asked more than 150 thought leaders, drawn from a variety of different fields, to come up with desirable visions for economic life in the future. These scenarios represent possible trajectories for humanity. None of them, though, is unambiguously achievable or desirable. And while there are moments of important agreement and consensus among the visions, there are often revealing clashes, too. **Here are just some of the possible futures:**

1

Shared economic prosperity

The economic benefits of technological progress are widely shared around the world. The global economy is 10 times larger because AI has boosted productivity. Humans can do more and achieve more by sharing this prosperity. This vision could be achieved by adopting various interventions, from introducing a global tax regime to improving

insurance against unemployment. Empowered international institutions would distribute the benefits of AI adoption. Challenges to the realization of this vision include the very uneven impact of technological progress, the progressive disappearance of middle-class occupations and the difficulties of achieving international cooperation.

2

Realigned companies

Large companies focus on developing and using AI that benefits humanity, and they do so without holding excessive economic or political power. Policies to achieve this vision include changing

corporate ownership structures and updating antitrust policies. To achieve this, society will need to overcome current dynamics that lead to a concentration of power and wealth.

3

Flexible labour markets

People adapt to technological change and continue to find new work. New jobs are created that did not exist before. Human creativity and hands-on support enable people time to find new roles. This vision could be achieved by improving educational

and retraining opportunities, as well as strengthening social safety nets for those who would otherwise be worse off due to automation. Challenges to this vision include the fact that more education may not be enough to solve persistent unemployment.

4

Human-centric artificial intelligence

Society decides against excessive automation and labour substitution. Business leaders, computer scientists and policy-makers choose to develop technologies that increase rather than decrease the demand for workers. Society finds the “sweet spot” in which humans and machines can work together. This vision could be achieved by introducing incentives that encourage companies to develop human-

centric AI; for example, by taxing automation where necessary. Challenges to this vision include difficulties in distinguishing during the development phase between technologies that will ultimately complement human workers and those that will substitute for them. Another is overhauling the tax structure, which currently incentivizes companies to automate by placing a heavier tax burden on labour than on capital.

5

Fulfilling jobs

New jobs are more fulfilling than those that came before. Machines handle unsafe and boring tasks, while humans move into more productive, fulfilling and flexible jobs. This could be achieved by strengthening labour unions and increasing worker

involvement on corporate boards. The challenge to this vision is that, in the absence of intervention, AI could actually make jobs less fulfilling and more stressful – for instance, by supporting new types of surveillance in the workplace.

6

Civic empowerment and human flourishing

In a world with less need to work, well-being increasingly comes from meaningful unpaid activities. People can engage in exploration, self-improvement, volunteering or whatever else they find satisfying. This vision could be achieved by supporting meaningful

unpaid activities and experimenting with some forms of universal basic income. Challenges to this vision include uneven access to meaningful activities and the difficulty of maintaining social solidarity in a world where some people work for a living and others do not.

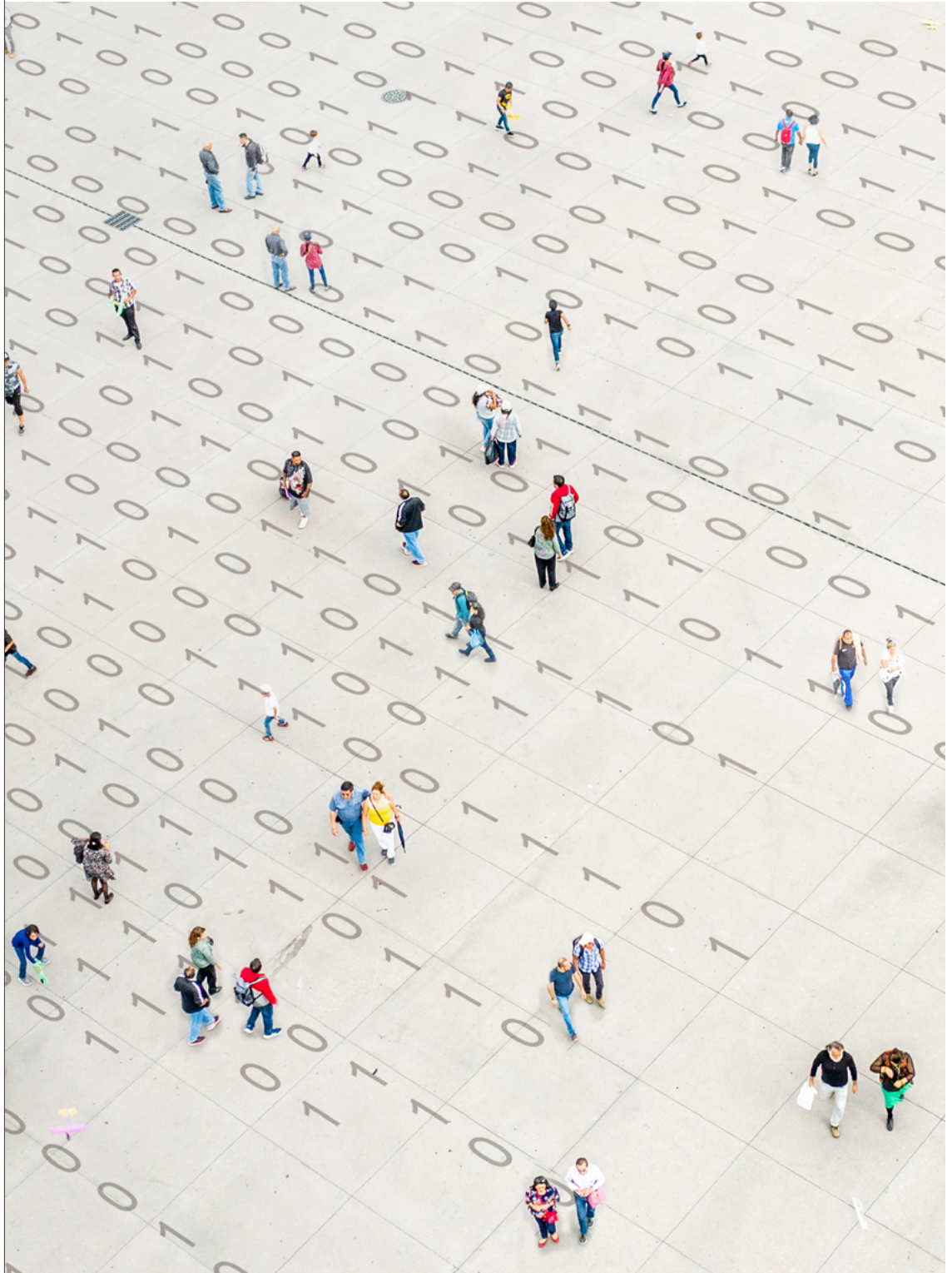
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Part 1: Situation

Although researchers disagree on the timing of new developments, most expect high-level machine intelligence to be reached within the next few decades.

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1.1 High-level machine intelligence: prospects for the future of AI

What is artificial intelligence?

The State of AI Report describes AI as a “broad discipline with the goal of creating intelligent machines, as opposed to the natural intelligence that is demonstrated by humans and animals. It has become a catch-all term that nonetheless captures the long-term ambition of building machines that emulate and then exceed the full range of human cognition.”¹ In the same vein, Stuart Russell and Peter Norvig define AI as a field

that aims “not just to understand but also to build intelligent entities”.² Right now, though, most AI systems still have very narrow capabilities: They are very good at particular tasks and nothing else. Computer vision systems, although adept at interpreting visual information, cannot adapt or apply this ability to other tasks. In contrast, humans have general capabilities that they can apply to a broad range of tasks.

Developing AI that can do most of what we currently call work

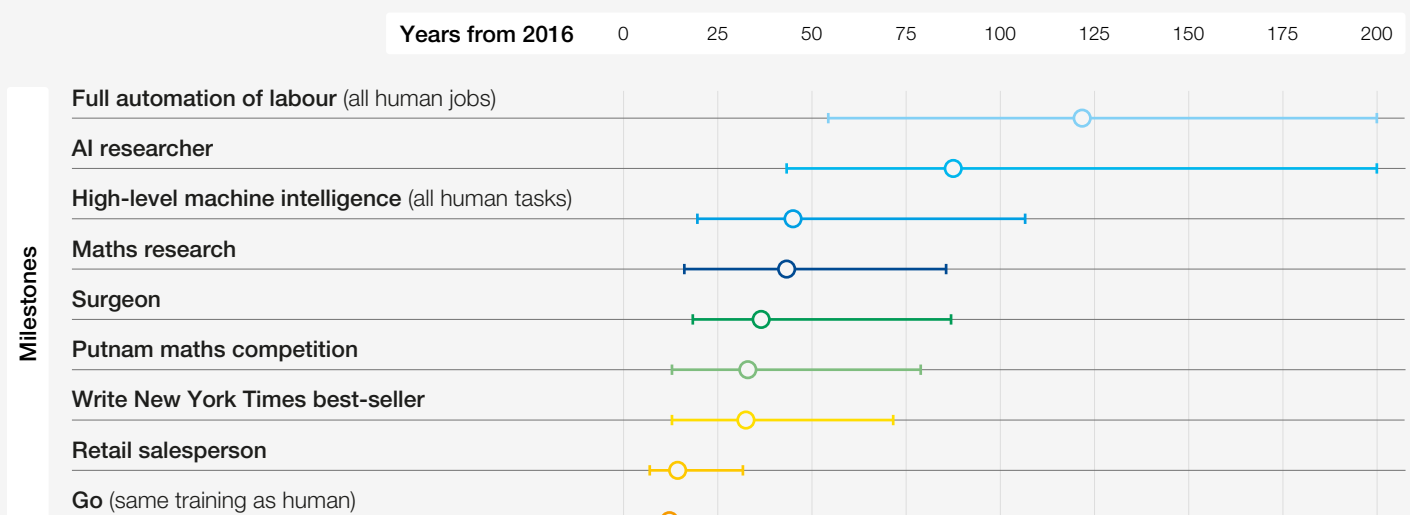
In contrast to existing AI systems, high-level machine intelligence (HLMI) is achieved when unaided machines can accomplish every task better and more cheaply than human workers, without human aid.³ HLMI could be delivered as one AI general-purpose system or by several narrow-purpose systems collaborating.

How far are we from developing this kind of advanced AI? We are still waiting for conceptual breakthroughs in a number of areas, including a better understanding of language, the integration of learning with real-world knowledge, the capacity for long-range thinking at multiple levels of abstraction, and the cumulative discovery of concepts and theories. Since the timing of these breakthroughs is inherently unpredictable, it is impossible to say precisely when or if we will achieve HLMI. Despite this, the field of AI has been expanding rapidly, and progress seems to have been accelerating in the past decade. When Grace and others (2018) asked AI researchers about the rate of

progress during their careers, 67% said progress was faster in the second half of their career and only 10% said progress was faster in the first half.⁴

Although researchers disagree sharply on the timing of new developments, most expect HLMI to be reached within the next few decades. A 2013 questionnaire found that experts predicted a median 50% chance of high-level artificial intelligence emerging around 2040 to 2050, rising to a median 90% chance by 2075.⁵ In 2017, 352 AI experts who published at the 2015 NIPS and ICML conferences (two of the leading venues for peer-reviewed machine learning research) were surveyed.⁶ The aggregate forecast indicated a 50% chance of HLMI developing within 45 years and a 10% chance within nine years. Interestingly, respondents offered more conservative estimates when asked about the possibilities for the full automation of labour: the median of individual beliefs saw a 50% probability 122 years from now and a 10% probability in 20 years.

FIGURE 1 Time until machines outperform humans



In short, expert predictions suggest that machine intelligence may very well exceed human levels by the end of this century.

In contrast to the popular view that transformative AI will be a discontinuous, single entity, and that research and policy-making should focus on this scenario, we argue that the implications are similar even if a network of collaborating narrow AI systems is developed. Most progress towards HLMI so far

has emerged from work on narrow, special-purpose applications, which together could still prove transformative. One possibility is that a collection of narrowly capable AI systems working together in the future could coordinate to perform most of what we currently call work, without a single general-purpose system orchestrating them. The implications are clear: we must be as cognizant of the impact of advancing narrowly capable AI as we are of the impact of developing general-purpose techniques.

Developing HLMI is neither inevitable nor necessarily desirable. The development of AI systems that can do most of what we currently call work poses large-scale societal risks, including those to safety and fairness. There are additional economic risks, including increasing inequality and loss of well-being from work. To avoid these outcomes, it is essential to outline the desirable economic arrangements for a time when most work is done by machines. It is quite plausible that many of the necessary adjustments – e.g. in education and in scientific research – will take decades to implement and, according to many experts, we have only decades left. Governments frequently talk of “transition plans”, but without a destination, there can be no transition planning. Our goal is to provide positive visions to articulate those destinations and the policy pathways to get there.

1.2 How to imagine positive futures with AI

Humans are always thinking about the future. It starts with pondering what we need to do to prepare for tomorrow. From weather forecasts to financial planning, we try to anticipate what might lie ahead. We love thinking about the future, but we often struggle to turn these thoughts to our practical advantage. We are inconsistent. We overestimate and we underestimate. We fail to anticipate the unexpected.

It is important to distinguish between our ability to project and our ability to envision. The former is a function of our ability to predict future events, the latter a function of our ability to imagine them. Because the Positive AI Economic Futures initiative aims to explore a future that is not only ideal or desirable but also believable (and perhaps even probable, given the right foundation), it is worth examining what hinders our ability to do both.

As far as projection is concerned, one tactic often used to inform our predictions is to use historical data. Peering into the past helps us better understand the path we took to arrive at the present and, in doing so, identify trend lines that might point to what comes next.⁷ Several studies evaluating past attempts at forecasting advancements have shown them to be fairly accurate.⁸ The trouble is that while historical data typically measures that which is readily quantifiable and accessible, considering future human behaviours is a different matter altogether. Nor is past performance always an indicator of future performance. Although historical data can offer a glimpse into what is statistically likely to occur, focusing on probabilities has often been criticized for excluding possibilities. Such failures of imagination have come back to haunt governments that, in hindsight, wish they

had considered more “far-fetched” ideas – for example, US leaders reflecting on the failure of the American public and domestic intelligence agencies to accurately forecast and prepare for the deadly 9/11 terrorist attacks.⁹ Likewise, in the context of technological unemployment, excessive reliance on history can make us overly susceptible to what economists call the Luddite fallacy: the argument that fears of long-term unemployment triggered by technology have been proven wrong time after time. But what if this time really is different?

When it comes to envisioning the future, we also draw on the past by evoking our memories. Neuroscientists have found that those regions of the brain involved in envisioning future events are the same as the ones with which we recall the past.¹⁰ However, perceptual blind spots present a further obstacle: while we often make accurate predictions about technological changes,¹¹ we tend to underestimate cultural and social changes. In a phenomenon termed “projection bias”, people “tend to exaggerate the degree to which future tastes will resemble current tastes”.¹² It appears that we do the same when considering how our collective behaviours and perspectives will change over time.

Perhaps for this reason, social progress has been called the “Achilles heel” of futurism.¹³ For example, the economist John Maynard Keynes’s 1930 essay *Economic Possibilities for Our Grandchildren* projected that, in 100 years, we would have a 15-hour working week and a five-day weekend. Occupying leisure time would become our biggest challenge in life.¹⁴ Looking back, Keynes correctly projected that technical progress would accelerate the takeover of more and more tasks. What he did not foresee was that, even if we reached a level

of collective prosperity at which we might be able to stop working so hard, we might nevertheless continue to work so hard – either out of necessity (e.g. because that collective prosperity is not automatically shared out equally in society) or out of choice (e.g. because our expectations for what constitutes a “good standard of living” have risen over time).¹⁵

Imagining the future forces us to make certain calls on a wide range of possible outcomes, and strongly held personal beliefs can subconsciously affect how we believe events will unfold. This plays out in several ways, one of which is our tendency to be

unrealistically optimistic¹⁶ and predict events that will benefit us.¹⁷ At the same time, when thinking about the world at large, we seem to adopt a rather pessimistic outlook on the future state of the world even if ample evidence suggests otherwise.¹⁸

These tendencies make forecasting in the near term hard enough. As the time horizon expands and the range of variables widens, forecasting long-term futures is an even greater challenge. Importantly, this project does not aim to predict the future, to be clairvoyant. Instead, it seeks to imagine a desirable future state and inspire leaders globally to develop plans to build that future.

1.3 A brief history of technology and work

Until recently,¹⁹ the most influential economic models that explore the impact of technology on the labour market did not allow for the possibility that technological progress could harm certain types of workers. New technologies might make some workers better off than others and leave some relatively worse off, the theory went, but no worker would be harmed in absolute terms.

Not all economists have always agreed with that, though. The Russian-American Wassily Leontief, winner of the Nobel Prize in 1973, was one who begged to differ. In a series of articles written in the 1980s, he set out his fear that what cars and tractors had done to horses at the end of the 19th century, computers and robots would ultimately do to human beings: drive us out of work.²⁰ His view was far from mainstream, however, and largely ignored in the models used both at the time and in the decades that followed.

Economists are now starting to change their minds – and their models. There is a growing recognition that recent technological advances are hard to reconcile with common economic assumptions about machine capabilities. To put it bluntly, new technologies are taking on more and more tasks that it was once assumed only human

beings could ever do. At the same time, there is a rising awareness that emerging trends in labour markets around the world are hard to explain using traditional models. The latter tend to imply that technological change benefits all workers, even though the data often contradicts this view: Acemoglu and Autor (2011), for instance, note that “low-skill (particularly low-skill male) workers [in the US] have experienced significant real earnings declines over the last four decades”.²¹

For these and other reasons, economists have begun to rethink the stories they tell about the labour market. As a result, newer models do admit that technological progress might harm particular workers. It is now understood that technological change can have a far more disruptive impact on work than was possible in the most popular models of the past. And for the purposes of this insight report, this shift is important, because we can now take seriously the issue that motivates it: a world whose technologies far outstrip existing capabilities – a world in which there might not be enough work for everyone. What follows, then, is a brief intellectual history of how economists have come to think about technology and its impact on work. This is useful to bear in mind when reflecting on positive visions and proposed interventions.

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Skill-biased technological change

Economists often represent the economy with a so-called “neoclassical production function” that describes how inputs – such as labour and capital – combine to produce output. And it is through the lens of these functions that economists have traditionally studied technological progress (see Acemoglu and Restrepo 2018a).

The neoclassical production function can take many forms. It was, for instance, used to explain an empirical puzzle that emerged in labour markets in the last two decades of the 20th century: in some countries, while there was huge growth in the number of high-skilled people leaving colleges and universities, their wages still rose rather than fell compared to people with no comparable education. To express that in more formal terms, the “skill premium” (the wage of an average college graduate relative to an average high-school graduate) increased.²² Why is this a puzzle? Because conventional economic wisdom would normally anticipate an increase in the supply of something leading to a decrease in its price. Here, however, an increase in the supply of

educated workers was accompanied by a rise in their relative wages (the “price” of those workers).

The popular explanation developed by economists was that technological change was “skill-biased”. New technologies, such as the personal computer, needed skilled people to use them effectively. Although the supply of high-skilled workers was increasing, so, too, was the demand for high-skilled workers. And the argument was that demand increased so significantly that high-skilled workers’ wages went up relative to other workers.²³ This view was so widely accepted that some began to treat it as the “canonical model” (Acemoglu and Autor 2011).

Helpful as it was in relation to this particular puzzle, this general approach was of limited use when thinking more broadly about the future of work. While new technologies were seen to make high-skilled workers better off, the implication was that low-skilled workers would likewise be better off, albeit less so than their more high-skilled peers. In other words, it was still very difficult to see how technological progress might make any workers worse off in absolute terms.

Labour market polarization

The canonical model did a good job of explaining the rising skill premium in many parts of the world. But it was unable to explain a different empirical puzzle that emerged in labour markets around the dawn of the 21st century. The new conundrum was that, worldwide, new technologies appeared to harm middle-skilled workers while helping neither low-skilled nor high-skilled workers. Among middle-skilled workers, both pay and the share of jobs (as a proportion of total employment) appeared to decline. This phenomenon has become known as the “polarization” or “hollowing out” of the labour market.²⁴

The canonical model was unable to explain this puzzle. In part, this was because the model focused on low-skilled and high-skilled workers to the exclusion of middle-skilled workers. Another problem was that, while the canonical model could explain only why some workers might benefit more than others, this new dilemma involved technology harming workers as well.

A new account was therefore needed. Over the past decade or so, intellectuals have favoured a different way of thinking known as the Autor-Levy-Murnane (ALM) hypothesis (named after its authors).²⁵

The ALM hypothesis draws two important distinctions. The first is between “jobs” and the different “tasks” that make them up. A lawyer, for example, engages in a wide range of tasks, from reviewing, retrieving and compiling documents to standing in court and defending clients. The second

distinction is between “routine” and “non-routine” tasks. The argument was that, while systems and machines could readily perform “routine” tasks, they would struggle to perform “non-routine” ones. These terms are now widely used in popular commentary. People frequently argue that machines can perform tasks that are “repetitive” or “rules-based”, “easy to explain” or “well defined” only – all of which are just different words for “routine”.

Importantly, this view of machine capabilities was derived from a very traditional notion of systems and machines having to follow an explicit set of instructions or rules articulated by a human being. Back in the 1980s, that was true. According to economists, a task was “routine” if a human being could articulate how they performed it²⁶ and it could be automated. If not, the task was “non-routine” and out of reach for machines.

The ALM hypothesis was thus able to explain the hollowing out of the labour market. Low-skilled and high-skilled jobs were composed of “non-routine” tasks that could not readily be automated, while the “routine” tasks in middle-skilled jobs were far easier to automate. The nature of “non-routine” tasks differs according to specific roles: low-skilled jobs, for instance, often involve interpersonal faculties (e.g. in service roles, such as waiting on tables or serving as shop assistants) or manual dexterity (e.g. in factories and warehouses). High-skilled roles often involve faculties such as “creativity”, “judgement” and “empathy” (e.g. an architect conceiving a new building design, or a

“ The ALM hypothesis has become outdated. Its understanding of machines is rooted in the first wave of AI (the so-called “expert systems” approach), not in the new technologies that have since emerged.

doctor drawing on experience to make a medical diagnosis). Both, however, were “non-routine” and thus hard to automate.

Alongside this ability to explain the polarization of the labour market, the general task-based approach was powerful for other reasons. To begin with, it provided a far deeper explanation of why new technologies might help particular types of workers (i.e. by boosting demand for the sorts of tasks in which human beings had a comparative advantage over machines). At the same time, it also explained in a formal way how

technological progress could harm workers in absolute terms: by causing human beings to forfeit their comparative advantage in particular tasks to machines. Under the ALM hypothesis, however, this sort of harm was contained by the assumption of a hard boundary between the “routine” tasks machines could do and the “non-routine” ones that were beyond them. “Non-routine” activities therefore constituted a safe haven to which displaced human beings could always retreat to find work. It followed that economists who adopted the ALM hypothesis still tended to be optimistic about the future of work.

The automation of ‘non-routine’ tasks

What do driving a car, making a medical diagnosis and identifying a bird at a fleeting glance have in common? These are all tasks that economists had thought were “non-routine” and thus out of the reach of machines. Yet all of them can increasingly be automated. Almost all major car manufacturers have driverless car programmes. Countless systems can make medical diagnoses. And there is even an app, developed by the Cornell Laboratory of Ornithology, that can tell what a bird is at a glance.²⁷

The ALM hypothesis has become outdated. Its understanding of machines is rooted in the first wave of AI (the so-called “expert systems” approach), not in the new technologies that have since emerged. These newer technologies, harnessing advances in processing power, data storage capabilities and algorithm design, no longer follow top-down rules articulated by human beings. Instead, they learn from the bottom up – suddenly bringing a whole universe of “non-routine” activities within reach.

In response, economists built new theories around the strengths and limitations of the ALM hypothesis, keeping the task-based approach but dropping the old-fashioned conception of machine capabilities. A very brief review of the emerging literature reveals several important features.

To begin with, the new approaches are far more agnostic about the capabilities of machines. Previous models relied on an explicit articulation of what machines could and could not do and why. The skill-biased technological change hypothesis, for instance, assumed that technologies helped make skilled people more productive. The ALM hypothesis then assumed that machines could perform only “routine” tasks. Very few such claims can be found in the new models. Rather, the models accept a “moving target”, with the line between what tasks machines can and cannot do continually shifting as technology progresses.²⁸ As a consequence, the new approaches are far more open to the idea that technological progress could have a harmful impact on workers. For instance, in Acemoglu and Restrepo (2018b), an influential new task-based model in the literature, a “horse equilibrium” is identified whereby, following Leontief’s concerns

(see above), people find themselves out of work like early 20th-century horses.²⁹

New models also focus far more on the inequalities created by new technologies – an important argument in Susskind (2020), for example.³⁰ It is no coincidence that worries about inequality are intensifying at the very time when concerns about automation are growing: the two problems are very closely related, and both are driven by technological progress. Along the same lines, Korinek and Stiglitz (2019) make the important argument that “economists set ourselves too easy a goal if we just say that technological progress can make everybody better off – we also have to say how we can make this happen”.³¹ In Moll and others (2021), the authors formally explore the exact ways in which automation might make certain types of worker, and owners of capital, far more prosperous relative to others.³²

Perhaps the most important shift in recent literature is a more explicit recognition that technological change has two very different effects on the labour market – and that these two effects can change over time. First, it substitutes workers in particular tasks, decreasing demand for their involvement in these activities. But it also complements them in others and thus increases demand for them to do these tasks.³³ For a simple example of the first effect, take the case of driving a car. A satnav system, such as a GPS system, might be thought to “complement” human beings – it allows them to navigate unfamiliar roads and makes them better behind the wheel. If drivers are able to pass those improvements on to their customers in the form of lower prices or a higher-quality service, the demand for their work might rise. In contrast, for an example of the second effect, a driverless car system would simply “substitute” for human beings altogether, reducing the demand for their work. While the skill-biased technological change literature focused too heavily on the complementing force, the ALM hypothesis imposed too strict a limitation on the substituting force (in “routine” tasks, but not in “non-routine” tasks).

Demand for human labour depends on which of these forces is stronger. In the past, the

complementing force has trumped the substituting force. Ever since modern economic growth began three centuries ago, automation has sparked off repeated bouts of anxiety. However, there has never yet been widespread technological unemployment, and a large part of the new literature explores why this helpful force has been so strong. One important new claim is that, over time, technological progress has created entirely new tasks for people to do, which has kept demand for human beings sufficiently high to keep them in employment.³⁴ Of course, in thinking about the future, the key question is whether we will again create sufficient new tasks in which people have a comparative advantage – or whether, as with horses, we will run out of economic uses for them.

The fear is that, as new technologies continue their relentless advance into the realm of tasks once performed by human beings alone, the balance between these two forces will tip to the detriment of workers. The substituting force could grow stronger, causing residual activities in which new technologies complement workers to wither away. In the new literature, there is a recognition that the future of work is not a foregone conclusion: there is no hard and fast

law that says the complementing force must necessarily triumph over the substituting force. Indeed, there is a growing perception that “excessive automation” may already be under way, and that appropriate interventions – tax and regulatory, in particular – may be necessary to nudge the direction of technological change towards systems and machines that complement rather than substitute for human beings.³⁵ It nevertheless remains unclear whether such interventions would even be feasible in a world where machines have the absolute advantage over human beings in more and more tasks.

And in practice, it is likely to be very difficult to identify in advance whether a particular technology will complement or substitute for human beings: even in the simple case where a new technology increases a worker’s productivity, this may not necessarily lead to an increase in demand for that worker, but would depend upon a variety of other features of the labour market (e.g. how sensitive the demand is to a change in the price or quality of the good or service that worker provides; see Bessen [2019], for instance, for a discussion of this sort of uncertainty).

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Part 2: Challenges and positive visions

This is the start of a discussion about the positive AI economic futures we want and how to get there.

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2.1 Research approach

Between April and December 2020, we organized a series of workshops with leading scientists, economists, writers and AI researchers to paint a picture of what potential economic futures might look like. Participants were invited to explore three fundamental questions in three workshops:

1. What could a positive AI future look like?
2. What kind of economic arrangements are necessary to achieve these positive futures?
3. What challenges will humanity have to overcome to achieve those positive futures?

In addition to the workshops, we also spoke with 14 leading economists in semi-structured interviews, asking them a wide range of questions about the opportunities and challenges we might face in a more automated world. The questions are detailed in the Appendix and all of the experts are listed in the Acknowledgements. Although

we tried to ensure the experts were from diverse backgrounds and with a fair gender balance, this was still not a representative sample of the future of work experts because we were interested in hearing about a range of visions rather than determining which are most supported in the entire field.

Part 2 of the report distills the views of these workshop participants and interviewees. To help frame these perspectives, the report also provides brief literature reviews on the main themes that were discussed. The ideas and arguments that follow are not presented on the basis of any consensus or judgement about which are the “right ones”: while there were often moments of agreement among participants, there were revealing disagreements, too. Instead, from the hundreds of insights that were shared, the views are chosen to try to capture a wide range of perspectives, and to encourage further debate and discussion. Indeed, it is important to remember that the experts explicitly focused on positive futures – these may or may not be the most likely outcomes.

2.2 Positive visions in response to AI and inequality

Introduction

The challenge

In most of the developed world, a rise in the Gini coefficient, a measure of income or wealth inequality, in recent decades points to greater income inequality.³⁶ In most advanced and many emerging markets, this widening economic inequality has been characterized by a greater share of income flowing to the top 10% of earners.³⁷ Likewise, in most Organisation of Economic Co-operation and Development (OECD) countries, the incomes of the top 10% of households have grown faster than those of the bottom 10%,³⁸ while the top 1%, or even the top 0.1%, have attracted an even larger share of total income.³⁹

Apart from these general trends in inequality, the way in which income is shared between workers and the owners of capital has started to change, as well. In the past few decades, labour’s share of income has shrunk and capital’s share of income has risen around the world, increasing the gap between the two sides.⁴⁰ Over the past 20 years, for example, productivity has risen by 30% but workers’ pay has increased by only 16%. Most of the extra income generated has gone to the owners of capital.⁴¹ This shift in labour’s share of income relative to that of the capital owners (as well as the increase in income inequality) is likely to have been driven, in large part, by technological changes.⁴² It is important to acknowledge, though, that the exact

causes of these changes are still hotly debated: alongside technology, the advance of globalization and institutional changes are also thought to be important factors.⁴³

There are growing concerns that continued technological development and the progress of AI could further exacerbate these inequalities. In particular, it is feared that AI systems might gradually substitute for labour in more and more tasks. This could leave some humans less able to compete for jobs, while the work of others might become more valuable. This would again concentrate wealth in the hands of a small number of individuals.⁴⁴ Faced with this worsening of a challenge that already exists, the question is: how can we ensure that the economic gains born of AI-enabled automation will be fairly distributed in society?

Inequality between workers

As we have seen, one challenge of automation is that it can have different effects on different types of workers. In the short to medium term, some workers might struggle to find work if AI takes over their jobs. Conversely, others might find themselves in well-paid work if they are able to carry out the non-automated tasks that remain. The precise extent of automation’s impact on worker inequality will largely depend on which types of task technological change substitutes for and which it complements. In the past few

decades, largely “skill-biased” technological change has favoured more skilled workers by replacing tasks performed by unskilled labour.⁴⁵ This has driven up wage inequality, as the wages of college graduates have increased relative to those of high school graduates.⁴⁶ Workers without college degrees have seen their wages stagnate or – in the case of high-school dropouts – even decline.⁴⁷ AI could further exacerbate these inequalities. However, there are other possibilities, because AI has the potential to replace tasks performed by middle-skilled and high-skilled workers, too. The belief that AI could make inroads into a wider set of roles is reflected in some expert predictions, as noted before.⁴⁸

There is, however, an emerging consensus about the sort of work that might remain out of reach of automation for some time. One influential but controversial piece of research by Frey and Osborne (2017) argues that about 47% of US jobs could be computerized in the decades ahead.⁴⁹ The authors contend that occupations that depend on social intelligence, are generalist in nature, require a knowledge of human heuristics or involve developing novel ideas are the least likely to be automated: examples include chief executive roles in management, business and finance; most jobs in education, healthcare, the arts and media are also put in this category. In contrast, the bulk of transportation and logistics workers, many office and administrative workers and production staff nevertheless face a high risk of their roles being automated. The McKinsey Global Institute arrives at similar conclusions: the jobs that will prove hardest to automate are those requiring personal interaction, advanced levels of cognitive capabilities and higher levels of education.⁵⁰ Yet McKinsey also notes that, since advanced and developing economies differ, the nature of automation will vary, too: demand for physical activities (e.g. leisure, accommodation and food services), for instance, will diminish in advanced economies but rise in developing economies due to increased consumer spending.

Inequality between companies

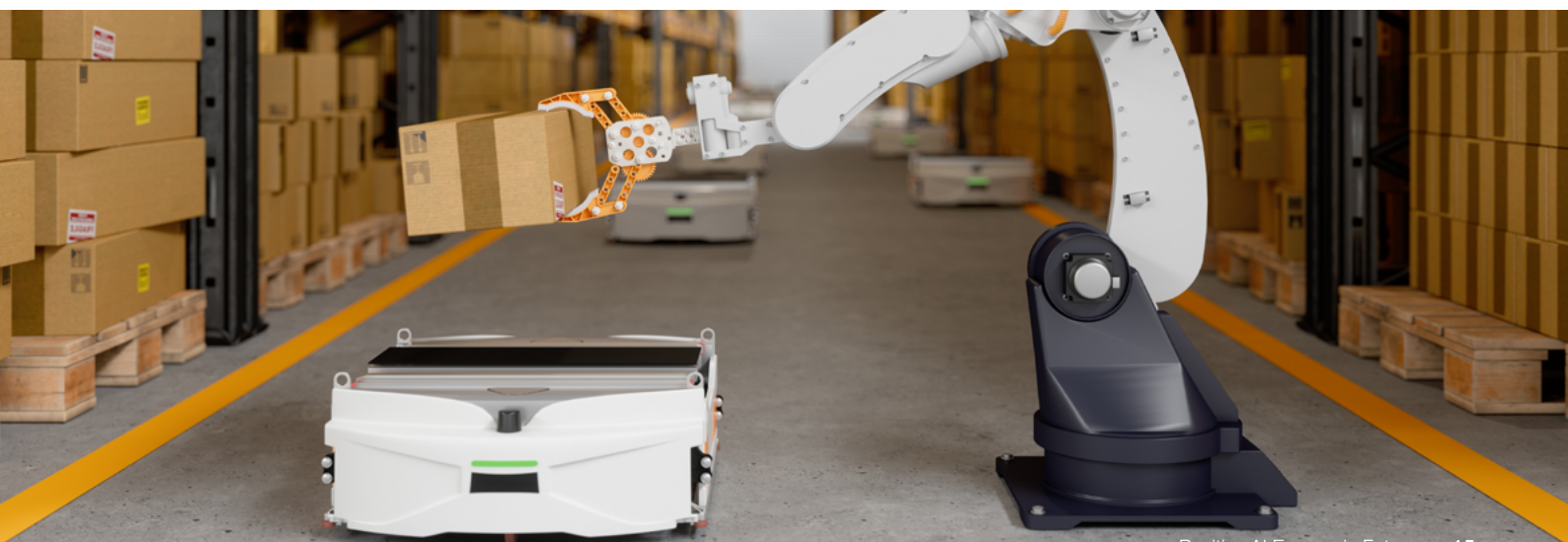
Another way in which AI could increase inequality is by concentrating the economic gains of new technologies in the hands of a small number of

superstar technology companies: digital technologies offer cumulative benefits to first movers.⁵¹ After the initial cost of developing and deploying products and services, it is possible to scale up and grow with almost zero marginal costs.⁵² Once an online travel website has been set up, for example, it can scale at virtually no cost.⁵³ The resultant superstar technology companies tend to require less labour, so labour's share of income falls.⁵⁴ There is countervailing evidence as well, though: Microsoft and IBM have both lost their initial dominance in the digital technology market, and a similar fate could soon await today's technology heavyweights.

Brynjolfsson and McAfee (2014) explain that in a traditional market, profits are determined primarily by absolute performance, whereas in a digital winner-takes-all market, profits are more likely to correlate to relative performance.⁵⁵ This means that, when it comes to digital products and services, consumers want only the best. And because they have access to the best due to the ease of scaling, the second- or tenth-best players – even if their performance falls only slightly short – might struggle to gain a significant share of the market. Moreover, many digital services are free, so the second-best producer cannot sell at a lower price, as car manufacturers do. Autor and others (2020) also suggest that firms with superior quality, lower costs or greater innovation benefit more than in previous eras.⁵⁶ According to them, high-tech sectors, retail and transportation have become increasingly “winner-takes-most” markets. In addition, leading firms have greater lobbying power and make it more difficult for others to grow.

Furthermore, these first-mover companies can take advantage of network effects. If many consumers already use a particular service, this can attract others to use the same service as well because of the value of the network.⁵⁷ To many people, Facebook tends to be more attractive than other social media sites because of how many of their friends use the site. Network effects can be more indirect, as well.⁵⁸ For example, if more people use iPhones, then developers have an incentive to create new apps for the phone and the entire ecosystem becomes more valuable.

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Why would it matter if a handful of companies dominated the market? First, society would depend on a few actors to distribute economic gains equitably to the rest of society. There is reason to be sceptical that they would do so, as global corporate tax avoidance is currently put at around \$500 billion to \$650 billion annually.⁵⁹ Dissatisfaction with such inequality could fuel civic unrest, crime and violent conflict.⁶⁰ Second,

if income from capital increases and income from labour decreases, this augments the power of a few companies over most others. Amassing this level of power would seem to run counter to democratic values, as the views of the few would likely hold sway in societal matters.⁶¹ This constellation could also encourage the big players to spend more on lobbying and protecting their dominance than on innovation.⁶²

PV1

Positive vision 1: Shared economic prosperity

We asked experts to imagine positive futures in a world in which AI plays an important role in society. The general hope was that, if we rise to the challenge of inequality and find a way to share the economic benefits of technological progress more widely (what some experts called the “distribution problem”), then the future can be better than anybody could imagine. In short, the overall productive capacity of society could be vastly increased: we could all do more, achieve more and have more. Susan Lund, a partner at McKinsey & Company and a leader of the McKinsey Global Institute, acknowledged that, 100 years ago, our grandparents would be astonished to see how comfortably many of us live in today’s advanced economies: we have washing machines, groceries delivered to our door and floors vacuumed by robots. A hundred years from now, we, too, could be astonished by our grandchildren’s lives.

In general, experts thought that sharing prosperity more widely would require greater state intervention in the forms of taxation, spending and regulation. But perhaps the most hopeful outcome was described by Anton Korinek, Professor of Economics at the University of Virginia. His take was that the large technology companies would want to redistribute economic gains in society of their own volition. His optimistic reasoning? We would have so much wealth that sharing some of it would be much easier, just as it is easy for someone in an affluent country to donate \$1 without thinking, because for many, \$1 is less than 0.01% of their income. The world economy could potentially be 10 times larger than it is today due to AI-driven gains in productivity. Some of the experts we interviewed do indeed expect a productivity boom very soon as investments in new business processes, skills and other capital resources help AI to grow the economy.⁶³ Such vast wealth generated by technological progress could make everybody better off.

Key challenges to positive vision 1

The main challenge experts identified to positive vision 1 is that human capital (i.e. the skills and capabilities of workers) is becoming less valuable relative to traditional capital (i.e. everything from tools and factories to software and computer hardware). This is a problem because, in a world where labour is important, there are forces that encourage prosperity to be widely shared: work is the norm, and compensation for our time in the form of wages creates some (though not always enough) convergence. However, in a world

where labour is less important and capital becomes more valuable, issues such as inheritance, ownership and the accumulation of wealth grow in importance and those existing forces for convergence are weakened. Some experts even fear that, in such a world, we might end up with a few billionaires owning all of the significant assets in the economy.

Policies to achieve positive vision 1

The set of policies suggested to achieve positive vision 1 involved various redistribution programmes. On the economic front, appropriate instruments might involve progressive taxation, wage subsidies and tax credits for those in work, alongside benefits and other types of support for those outside of work. Korinek noted that the richest people are earning tens of billions of dollars, which is more than the share of income they need to have proper incentives to invest. Hence, their excess returns could be taxed. He added that the global system of taxation has been undermined and many gains have been “reallocated” to tax havens. He did, however, acknowledge that efforts are being made to improve global institutions. For example, in October 2021, the international community agreed to a 15% minimum tax rate on multinational enterprises.⁶⁴ He added that, alongside the global tax regime, other international governance programmes such as global competition policy, global intellectual property rights and global data policy should also be considered.⁶⁵

Robin Hanson, Associate Professor of Economics at George Mason University, said his main policy recommendation for extreme automation scenarios is for people to insure themselves against automation. While this could be arranged by governments, individuals could also purchase their own insurance. Insurance could be triggered at a specific level of unemployment or automation – if 75% of all jobs are done by machines, for example, or based on some other threshold relating to the level of income accounted for by automation. When this trigger is activated, the people affected would get their insurance payments indefinitely or until death. Hanson saw this as a robust, generally applicable solution to the question of what we do about people who lose their jobs. Glen Weyl, economist, nevertheless objected to this idea. In his view, large events such as climate change destroy the capacity of insurance markets to function and the disruption created by mass technological unemployment could be even greater.

The second positive vision highlighted by experts, such as Daron Acemoglu, Professor of Economics at Massachusetts Institute of Technology, is the reawakening of civil society to put pressure on companies and elected representatives. The preferred outcome would be that governments, companies and society work together to steer technological change in a more human-friendly direction: this has already happened, for instance, with renewable energy, prompting greater efforts towards environmentally friendly technologies and changing norms among consumers.⁶⁶ Assuming the right changes, digital developments could strengthen democracies, improve online information and deepen political engagement.⁶⁷ Furthermore, in a strong democracy, both corporations and politicians would be kept in check by citizens, civil society and the media.⁶⁸

Some experts added that this positive future would also involve the effective regulation of the political power of large corporations. For example, Susskind (2020) envisioned the creation of a new agency to identify the misuse of political power by large corporations.⁶⁹ In such a world, companies would be far more transparent about their operations and

consumers would have more information available to them when deciding whether or not to use certain AI systems. If necessary, companies would face restrictions on certain behaviours or could even be broken up.

Key challenges to positive vision 2

The experts interviewed identified two main challenges to achieving positive vision 2: the “superstar” effects of digital and AI technologies, and the accompanying concentration of power and wealth. Experts highlighted the huge returns going to a small number of workers and owners of capital – such as the growing share gravitating towards the top 0.01%, the top 0.1% or the top 1% of the US wage income volume – plus the rise of superstar firms (as well as superstar individuals such as chief executive officers and celebrity artists). The fear is that these trends would boost not only the economic power of a small number of individuals and large corporations, but also their political power. In other words, this is not just a matter of greater profitability or market concentration, but also of the impact these individuals and corporations can have on wider issues such as liberty, democracy and social justice. Facebook’s influence in the 2016 American election

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is but one small example of this. Max Saunders, Interdisciplinary Professor of Modern Literature and Culture at the University of Birmingham, stressed that, in the attention economy, companies such as Facebook will seek to maintain this power by fighting against legislation.

Policies to achieve positive vision 2

The experts identified various possible interventions, from changing corporate ownership structures to updating antitrust policies. Marie-Christine Fregin, Research Leader at Maastricht University's Research Centre for Education and the Labour Market, said that one idea worth considering is modifying capitalism to allow for common ownership. Different forms of common ownerships could be explored. Profits could be shared with employees rather than having all wealth go to a few stakeholders. Governments could own some of these technologies, or perhaps everyone

could indirectly own some of them. Pascual Restrepo, Assistant Professor of Economics at Boston University, mentioned that the key element of ownership could be the intellectual property that is required to run the machines and all of the algorithms. Similarly, antitrust policies must be updated to ensure that a larger number of firms can compete and benefit in a fair market, in place of a small number of monopolies. Existing antitrust tools are obsolete and unable to deal with AI. Acemoglu, for instance, argued that the focus of antitrust policy must change to recognize perhaps the most important implication of the dominance of a few companies: that Facebook, Google, Amazon, Microsoft, Netflix, Baidu and Alibaba are also shaping the future direction of technological change – often towards excessive automation. Beyond that, Weyl aired the idea that policy should favour open standards and interoperable protocols, helping to diffuse the otherwise heavy concentration of power.

PV3

Positive vision 3: Flexible labour markets

The third vision described by the experts was a world in which humans adapt to new technologies and continue to find new employment – perhaps in new roles that do not even exist today. Experts took comfort in this vision from various angles: first, most of the work we do today was unheard-of in the early 1900s, and this trend could simply continue in the future. One of the experts interviewed, Anna Salomons, Professor of Employment and Inequality at Utrecht University, recently reported that most of the jobs available in 2018 did not exist in 1940.⁷⁰ By the same token, people will continue to want to consume new products and services and will not be satisfied with current levels of production. If this development continues and workers are helped to transition to new roles, there should be plenty for most people to do.

Hanson said that having people switch to other jobs should be a perfectly adequate strategy for many decades to come, but that we would eventually need a different solution. Katya Klinova, Head of AI, Labor and the Economy at the Partnership on AI, said that AI could be used to provide individualized learning, increase the quality of education and make it accessible to more people. She also mentioned the need to make sure that the work of caring for elderly people and children is valued in society and well compensated, as currently neither is generally the case. Klinova stressed that love and care cannot be automated: Even if the act of changing a nappy is one day automated, a child will always benefit from human love and care.

Key challenges to positive vision 3

The experts identified one main challenge to positive vision 3: the impact of technological progress on workers has so far been extremely uneven. Many workers have been made worse off, and some occupations are more at risk of being automated. The “digital revolution” may have lifted

the “average boat” in most countries since the 1980s, but not by as much as we would have liked, and a surge in inequality has accompanied this in many places. Others noted how many middle-class occupations have already disappeared due to the “hollowing-out” or “polarization” of the labour market, as discussed before. And while new technologies do create opportunities for displaced workers, the problem is that those who are most likely to lose their jobs are often the least well-placed to take advantage of new opportunities. Acemoglu emphasized that this issue is not sufficiently appreciated because the most influential people in society – the engineers, entrepreneurs, designers, academics and others – are not part of the vulnerable groups whose jobs are likely to be replaced. On the contrary, they benefit from designing and working with new machines.

Policies to achieve positive vision 3

How do we achieve positive vision 3? Some experts argued that the best response to uncertainty about which jobs will and will not be available in the future is flexibility – a willingness to retrain and reskill later in life with the same intensity as people do in early life. Others pointed to a need for better safety nets for people during retraining: expecting HGV drivers to reskill immediately to become teachers, caregivers or social workers, for instance, is unrealistic. Lund said that companies with the right motivation can steer people through different types of educational programmes and quickly teach them how to do new tasks – in low-level nursing, for example, or in IT system support. The question is: will we give them the opportunity, the knowledge and the wraparound services when these are needed? The experts emphasized that some sort of income provision and childcare will also be essential as these people complete training programmes, alongside a wide range of other social services to allow people to effectively participate in retraining opportunities.

2.3 Positive visions in response to AI and loss of well-being

Introduction

The importance of work

Work sits at the very centre of many people's lives. In France, Italy and many other European countries, more than 90% rank work as "quite important" or "very important". And in almost all of Europe, fewer than 20% say it holds little or no importance.⁷¹ Conducted by Pew Research Center, a 2018 survey of US teens aged 13 to 17 found that 95% see an enjoyable job or career as extremely or very important to them in adulthood – a larger proportion than said the same for helping people in need (81%), having a lot of money (51%), getting married (47%) or having children (39%).⁷²

These responses are to be expected: work is the main way in which people generate income to meet their needs and flourish in life. And depending on the work relationship, it can contribute to a range of benefits such as healthcare, childcare and housing support. But work can offer non-economic benefits as well, such as a sense of purpose, social relationships, self-development, status and autonomy.⁷³ Often a source of personal identity, work develops character and habits and affects physical and psychological health.⁷⁴ One study found that the majority of people, if they won the lottery, would still prefer to continue to work – a clear sign that work is not just about economic benefits.⁷⁵

The effects of unemployment

Given these findings, it is no surprise that unemployment is widely perceived as a major cause of diminished well-being. Six studies that use a life satisfaction measure to estimate the effect of unemployment on people's well-being find that it can cause a significant loss of "life satisfaction" (a drop of between 0.3 and 1.55 "life satisfaction points" on a 10-point scale).⁷⁶ For some comparison, widowhood has been found to cause a loss of up to 1.3 life satisfaction points and anticipation of a divorce a loss of up to 0.7 life satisfaction points, but long-term unemployment tends to cause a larger drop in life satisfaction overall. The biggest hit to well-being comes at the moment of becoming unemployed, despite an expectation of some adaptation to the circumstance (though this adaptation to unemployment does not occur fully even after several years).⁷⁷ In turn, several studies show that the fear of job automation alone can cause some loss of life satisfaction even before actual unemployment occurs.⁷⁸ This implies that the actual loss of well-being due to unemployment caused by automation could be larger than is captured by these estimates. In addition, there are concerns that unemployment could have a

persistent "scarring effect" even after new jobs are found. Considering all of these effects, it has been suggested that unemployment could result in the loss of 2.1 life satisfaction points a year.⁷⁹

Why does unemployment cause such a dramatic loss of happiness? The short answer is that it deprives an individual of the economic and non-economic benefits of work described above. Empirical evidence supports this contention: unemployment can "damage individuals' perception of self-worth and lead to high levels of mental distress".⁸⁰ It can also create a sense of helplessness in which the future seems to spiral out of control.⁸¹ Importantly, the drop in happiness cannot be explained by loss of income alone: the psychological and social context matters, as well.⁸²

Employed versus out-of-labour force

Some people – housewives/husbands, students, retirees and others – choose not to participate in the labour market at all. Another way to see the importance of employment is therefore to compare those in work with those outside the work environment. Evidence suggests that being in work is preferable to being out of the labour force altogether, even when those outside the labour force do not suffer financial distress as a result. Paul and Batinic (2010) found that even without significant differences in terms of the perceived financial situation between the employed and the out-of-labour force, the former had significantly better access to time structures, a collective sense of purpose and activity, though not necessarily more access to social contacts and status when controlled for age.⁸³ Similarly, Clark and others (2018) found that in the UK, Germany, Australia and the US, those outside the labour force had a lower level of life satisfaction than those in full-time work (-0.04 to -0.29 life satisfaction points on a 10-point scale).⁸⁴

A meta-analysis by Biskup and others (2019) reported that the positive emotional effects are slightly higher for work-related activities than for non-work activities.⁸⁵ People report being more engaged, alert and interested in their work, while experiencing greater enjoyment and happiness in non-work activities. Csikszentmihalyi and LeFevre (1989) found that the majority of "flow experiences" (being fully focused and involved in an activity) are linked to work, not to leisure pursuits.⁸⁶ That said, Biskup and others (2019) also found a more pronounced negative effect for work than for non-work activities, suggesting that work generates both positive and negative experiences.⁸⁷ Clark and others (2018)

acknowledge that, of all activities, work always figures very near the bottom of the list in terms of average happiness across different activities.⁸⁸

A literature review by Muller and Waters (2012) concluded that people enjoy less well-being if they do not have access to the various benefits that employment often provides. The same observation has been made among people outside the labour force.⁸⁹ This could be because employment naturally makes days more structured, enforces activity and generates collective goals and purposes – all factors that are associated with greater well-being.⁹⁰ Unemployed people who perceive themselves as more structured, purposeful and active also report greater well-being than unemployed individuals with a less structured and active lifestyle.⁹¹

However, it is not always clear from studies how much of the loss in well-being can be explained by reduced income and by other factors. Selenko and others (2011) found that employed people engaged in more activity and had a better time structure but also enjoyed superior financial benefits compared to those outside the labour force.⁹² On the other hand, not all out-of-labour-force activities are equal: by their very nature, some such pursuits may enforce less activity, detract from the time structure and/or provide less access to other people. Indeed, other activities may in fact prove better than certain forms of full-time employment.⁹³ Someone retired on a good pension who volunteers likely has greater well-being than someone in full-time employment but with bad working conditions

Is universal basic income enough?

One increasingly popular policy response to automation is a universal basic income (UBI). Most commonly, it is thought to have five defining features: it is “distributed in cash, regularly, individually, unconditionally and universally”.⁹⁴ To

expand: it is distributed in cash rather than as food stamps or the like; it is provided regularly instead of as a one-off payment; it is provided to individuals not households; it is unconditional, as the beneficiaries do not have to meet certain requirements to qualify for benefits; and it is universal, as everyone receives it, with no strings attached.⁹⁵ These details do vary, though, depending on the exact proposal.⁹⁶

Recent UBI studies – more than 20 so far – have been encouraging, but it is still too early to be very confident.⁹⁷ Only two appear to have looked closely at the relationship between UBI and life satisfaction. One of these was conducted in Kenya by Haushofer and Shapiro (2016),⁹⁸ the other in Finland by Kangas and colleagues (2019).⁹⁹ The latter, for instance, reported that the average value for life satisfaction in the intervention group was 7.32 on a 10-point scale, whereas the average life satisfaction value in the control group was 6.76. The UBI is probably not responsible for the entire effect: response rates among those invited to take part in the study were very low, and likely indicate some selection effect that may have affected who responded to the survey.¹⁰⁰

In turn, given that the empirical evidence suggests that the strong relationship between work and well-being is not simply attributable to a worker's income, one might question the likely effectiveness of a UBI in the future. Merely providing unemployed people with income but doing nothing else may not restore well-being to previous levels. Policy responses to unemployment caused by automation must therefore take full account of all of the factors responsible for any decline in well-being. One of the most effective solutions may simply be to help as many unemployed people as possible find a new job or to create work for them to do.

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The first positive vision relating to the challenge of well-being and meaning advocated a human-centric approach to AI. Several experts hoped that excessive automation would be avoided and the “sweet spot” in which humans and machines work together could be found. They said machines should be built that complement humans rather than substitute for them, the idea being that the latter type of technologies reduce demand for labour whereas the former technologies increase it.

Klinova and Korinek (2021), though, noted that even human-augmenting AI can still be labour-saving, displacing workers and reducing wages, as it depends on whether the firm cuts its prices and how demand responds to such a move.¹⁰¹ Furthermore, Klinova, when interviewed, emphasized that the dominant orientation of AI today is towards learning how to substitute for humans: most benchmarks are set around achieving parity with or surpassing human performance in basic tasks at which humans are already quite good. The hope is nevertheless that we will invest more in designing benchmarks for human-complementing AI, such as benchmarks around the collaborative performance of human-plus-AI teams and the incremental productivity gains humans can achieve when equipped with AI tools.

In this spirit, Sherryl Vint, Professor of Media and Cultural Studies and of English at the University of California, Riverside, noted that software engineers could be recruited to join AI projects based on a desire to contribute their skills to a collective notion of public works, rather than with a view to the next product to be brought to market.

Restrepo said that, for everyone to take part in the process of creating economic value, there will also need to be a diversity of tasks and activities to be done by humans. The more tasks there are, the less inequality there will be, because people can then try out more alternatives until they find something they are very good at. Along these lines, Weyl emphasized how the personal computer, for instance, is the opposite of a substituting technology: it is a tool that enables individuals to develop their own career and talents. And he suggested that virtual reality technologies are almost entirely about complementing humans, as are social technologies (such as video conferencing), cyborg-related technologies (technologies intended to replace and/or enhance a human body part) and open-web applications.

In this positive vision, we would choose a path where humans and machines work together, rather than having machines do everything. And some experts anticipate that, as a result, there will still be many productive activities for human beings to do, ranging from health services to physical therapy to coaching new mothers to early childhood education.

Key challenges to positive vision 4

One challenge to positive vision 4 noted by many experts is that the incentives to automate are currently misaligned. Above all, experts are worried that the current tax structure is far too favourable to automation, encouraging companies to substitute workers rather than complement them. Furthermore, automation also discourages warehouse structures; instead, it promotes concepts such as “just-in-time” manufacturing that reduce the resilience of manufacturing companies. Many developed economies thus suffer from a taxation imbalance between investments in labour and investments in capital: the latter generally enjoy tax advantages, but the former are often seen as a tax burden. Olaf Groth, Professor of Global Strategy, Innovation and Economics at HULT International Business School, added that upgrades in technology can be capitalized, whereas the upskilling and training of workers cannot. Erik Brynjolfsson, Director of the Stanford Digital Economy Lab, painted a clear picture of the challenge: currently, if an entrepreneur has two \$1 billion ideas, one of which involves employing thousands of people and the other no people at all, the government is likely to collect far more tax revenue from the former. Put another way, governments impose a heavier financial penalty on ideas that employ more people.

Experts recognize that this imbalance must be corrected if we are serious about transitioning to a more automated world in which human labour “has a chance”. Incentives for companies to automate jobs in order to generate paper profits rather than contribute to improvements in overall productivity must be removed. Some experts said there must be a choice of whether to provide incentives to automate out of existence opportunities for workers, or whether to take a different path – for example, by redistributing tax revenue to encourage companies to build up their workforce alongside automation. Right now, the wrong trajectory has been taken.

Policies to achieve positive vision 4

The set of policies that experts proposed to achieve positive vision 4 involved making tax structures more conducive to developing and using technologies that complement human beings rather than substitute for them. The aim would be to reward those who create technologies that complement work. Brynjolfsson and McAfee (2014) suggested considering various ideas: “Use taxes, regulation, contests, grand challenges or other incentives to try to direct technical change toward machines that augment human ability rather than substitute for it, toward new goods and services and away from labour savings.”¹⁰² More specifically, Acemoglu and others (2020) propose that it may be beneficial to increase taxes on capital, including raising corporate income taxes and reducing depreciation allowances.¹⁰³ It could also be useful to consider taxing automation in cases where humans still have a significant competitive advantage, while subsidizing capital where machines have that advantage.¹⁰⁴

Most of the experts agreed that, in a world where most tasks could be automated, a new definition of work would be needed. The hope was also expressed that machines could be used to replace workers in dangerous, mundane or boring tasks, leaving them free to perform safer, more fulfilling and more enjoyable work. For instance, several experts explained that if there was a way to eliminate “routine” manual activities and instead focus on creating more “non-routine” work, more meaningful activities for human beings could be created. The result would surely be greater job satisfaction and better health. Work would be more flexible, as workers could decide how many hours they want to work. It could also encompass not simply the activities required to earn an income, but also leisure and learning activities. Fregin, for example, mentioned that employers are currently reluctant to support their employees’ hobbies such as playing an instrument or joining a football team. However, some aspects of the specific skill sets developed in such contexts could become very useful to the employers, such as increasing team spirit or improving focus and drive. As a general rule, the boundary between work and leisure – and with it the definition of a meaningful life – may need to be revisited.

What might the “non-routine” work discussed above look like in practice? Salomons mentioned analytical and social skills as an important combination. Some experts argued that faculties such as social intelligence, emotional intelligence, compassion, empathy, creativity and trust would be needed in conjunction with critical thinking, complex reasoning, sound judgement and common sense. These would focus on the so-called “comparative advantage” of human beings over machines. Experts noted that, somewhat ironically, many of these activities are already found in traditionally neglected sectors – such as early childhood education and care for senior citizens – and that there is now an opportunity to focus on and prioritize these important areas of work. One lesson from the COVID-19 pandemic, some noted, is the importance of interpersonal interaction: people need meaningful connections with other people, and machines cannot provide that. As we have seen time and again, human beings may want to talk to friends or relatives in a situation of sickness, loss or inability to work. Some experts also spoke of the importance of humans rather than machines continuing to make life-or-death decisions.

There was also a view that, even if machines could do everything, this is not to say they should: there will inevitably still be some tasks that humans will prefer to do themselves. For instance, human beings might still be called on to make important strategic decisions – setting collective goals such as how best to share material prosperity, treat others in society and steward the planet, for example.

Key challenges to positive vision 5

Some experts feared that, in practice, AI could make jobs worse. New tasks might not necessarily be more fulfilling than current work; just because something cannot be automated does not mean it is necessarily meaningful or fulfilling. Another concern, raised in the interview with Stephanie Bell, Research Fellow at Partnership on AI, was that new technologies might lead to a new “digital Taylorism” in which work is subject to increased surveillance and regulation. She pointed to AI products coming on to the market right now that introduce extensive surveillance and set increasingly aggressive production targets. One example is software that helps employers identify a worker’s most productive tasks by monitoring their desktop, calendar and even webcam (to ensure they are “sitting where they should be”). While such tools might be called “productivity software”, they could easily become tools of exploitation. Bell also raised the problem that, at the moment, regulatory guard rails protecting workers are not in place, and that rates of worker injury are much higher in automated warehouses because the rate of work accelerates to a speed that human bodies cannot handle. More generally, some worried that integrating AI products in business could simply destroy far more jobs than are created.

Policies to achieve positive vision 5

Experts identified several policies that would be useful to achieve positive vision 5. To increase well-being at work, it was thought essential to establish robust guard rails to protect people from being exploited by AI systems, and also to safeguard their working conditions. Experts cited the “platform economy” as a specific area of concern. In addition, Salomons referred to suggestive evidence that having workers represented on corporate boards of directors could improve worker outcomes and help shape a firm’s long-term investment strategies. Further study of this proposal is needed.

Another solution mentioned by some is to push governments to invest in beneficial AI research and applications. Acemoglu, for instance, said the public sector needs more human capital, as the best talent currently works in the private sector. Furthermore, it was noted that policies should encourage research communities and start-ups to think about the type of AI applications they are developing: do they complement or substitute for humans? For example, it would be useful to invest in AI technologies that help teachers to achieve their goals (rather than replacing them); since teachers are often overworked, new technologies could save time to help them focus on student interaction. These policies, it was suggested, should likewise take into account the societal consequences of replacing workers – such as truck drivers – who might not currently have many other feasible options for work. Restrepo stressed that replacing those aspects of a job that contribute least to well-being is a welcome development,

although great care should be taken before replacing a job in its entirety. Acemoglu further advocated reinforcing civil society so that citizens could put pressure on companies and elected representatives to take precautions and steer

technological change away from a jobless future. Fregin noted that strengthening labour unions and lowering the barriers to organized labour could also enable workers to negotiate better conditions for themselves and enhance their well-being.

PV6

Positive vision 6: Civic empowerment and human flourishing

In this scenario, humans would be free of unpleasant labour, contributing to society instead through valuable unpaid activities. It is hard to imagine what this world of remarkable abundance might look like: in one of the workshops, Manu Saadia, author of *Treconomics: The Economics of Star Trek*, prompted this report's authors to use *Star Trek* as an inspiration. Characters in the series use a replicator, a machine that produces anything; in this extraordinary world, there would be no need for price-setting or markets – and no need for money at all – as the price of everything would be zero. Work would no longer be something people

traditionally do to earn a living, attain status or fill life with meaning. Instead, it would serve the purposes of exploration, self-improvement, philosophy and meditation. AI, it is said, would be the ultimate “public good” – a non-rivalrous and non-exclusive good whose use by one person does not prevent anybody else from using it. And if people's basic needs are covered, they can devote time to other things they find enjoyable.

Some argued that humans would be entirely fulfilled by the ability to simply enjoy life and play. Others said, jokingly, that they would feel very

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good about a future in which machines did all their work while they themselves got a wage from the government every month. Other activities could be just as fulfilling, such as playing music or building things – provided that everyone receives sufficient income. Again, some experts argued that, while some people experience a high level of well-being at work, many others do not. People would thus be free to pursue the things they care most about, whether that means spending time with their family, contributing to a community or engaging in religious practices.

David Brin, science fiction author, added that adults with more free time and no urgent needs to satisfy would focus on activities they wish to master, calling it the “Age of Amateurs”. Ken Liu, science fiction writer, also emphasized the importance of thinking about how we would play with AI, guided by what satisfies our curiosity, helps us grow and gives us pleasure. He added that, since friends and connections are very important for humans, we also need to reflect more on how AI can mediate social relationships and how we would socialize with AI. Calum Chace, author of *Surviving AI*, proposed that the answer lies in “fully automated luxury capitalism” – an economy of abundance. For as long as they exist, humans will always face perceived shortages such as attention from other people, artisanal goods and art.¹⁰⁵

Other workshop participants mentioned that people in such a world might live longer due to less physical and mental stress. Artistic output, some hoped, would flourish in an era of creative abundance. People would have time to engage in democracy and explain what they want, to volunteer to help animals, elderly people and future generations. Pointing to climate change as one of the foremost global problems, Saunders, for example, talked about how people with extra time and advanced AI capabilities could become involved as citizen scientists – monitoring changes, collecting data and doing useful environmental work.

Key challenges to positive vision 6

Experts understandably anticipated several challenges to achieving this vision. To begin with, a workless future might be felt to be meaningless – particularly given the strong empirical evidence we saw earlier that work is a critical source of meaning and purpose. Brynjolfsson quoted Voltaire’s maxim that work keeps three great evils at bay: boredom, vice and need. Need is the easiest to fix, but ways for people to find meaning in life are also required. Even more so, Weyl added the notion, which he attributed to the philosopher Michael Sandel, that by being part of a working society people are given the chance to influence and contribute to the social system in which they live. While there may be a lot of short-term rewards in eating crisps, watching TV and playing video games, this may not add up to an existence as meaningful as work has done in the past. Groth, nevertheless, warned against assuming that people will be unable to

adapt by engaging in other meaningful activities such as travelling, organizing common-interest groups and curating gardens.

Worries about inequality in the allocation of meaningful activities were also expressed. Even if some activities are not automated – setting collective goals, engaging in moral decision-making and taking part in activities that require some kind of empathetic interaction, for example – it is not clear whether there will be enough demand for such tasks to keep everyone in work. These inequalities are challenging not only for individuals but also for society as a whole. Some, for instance, touched on the difficulty of maintaining social solidarity if opportunities for making a meaningful contribution to society are not open to all. Indeed, even in the *Star Trek* world, there are harsh inequalities between the very few who can explore the wider universe and the vast majority of others who don’t have these opportunities.

Moreover, it was said that, if not everyone participates in creating value, this could fuel a new imbalance of power, with a limited set of non-automated tasks reserved only for a minority. Kanta Dihal, Senior Research Fellow at the Leverhulme Centre for the Future of Intelligence, University of Cambridge, addressed additional uncertainties about what role a person ought to play in a society where AI can do everything better. If work is no longer there to give purpose and direction to a person’s life, if it is no longer a source of pride and identity, what should take its place?

Some workshop participants also pointed out the possible problem of there not being strong incentives for people to be educated and contribute to a flourishing society, which would lead to a stagnating future exemplified in the apathy of people in the animated movie *WALL-E*.

Policies to achieve positive vision 6

Some experts said that, to overcome these challenges unpaid activities need to be created that allow people to contribute to their communities. To do so, Susskind (2020) has suggested that governments set up a programme to create jobs for people who want them.¹⁰⁶ Given the many parts of life that have not yet been automated, such as education and healthcare – even with all the coming technological advances – there could be many opportunities to do this.

UBI, as noted before, was also discussed as a policy solution. According to Bell, most UBI experiments show that people take the money and devote their time to doing something that is worthwhile not just in their own eyes, but also from the perspective of outsiders. However, the idea of a UBI was controversial among the economists interviewed, as some worried that it could lead people away from the value production system. Salomons, for instance, said that UBI is quite extreme because it is very diffuse: it could end

up helping those who do not need help while not providing sufficient assistance to those who really need it. One possible solution would be to try limited versions of a basic income – on a part-time basis, for example, or subject to certain conditions such as learning and education. Acemoglu said

he would consider radical options such as very significantly slowing down technological progress if other solutions did not succeed. He saw this as a way to avoid a future in which most of the population received a basic income and spent its time playing video games rather than creating value.

2.4 How will we measure success?

We also asked experts what they think about the measures currently used to evaluate the success and well-being of societies – and if they could be improved in the future. While the general consensus was that GDP is becoming a less useful tool for measurement, it was also acknowledged how hard it is to come up with better alternatives. GDP is one of the main metrics used to measure economic growth: its purpose is not to directly measure well-being, but to act as a proxy for it. Yet, even for measuring economic growth, it has limitations. James Bessen, for instance, Executive Director of the Technology and Policy Research Initiative at Boston University School of Law, said that new technologies often change the quality of products more than their cost. Brynjolfsson added that more and more investment in intangibles cannot be measured by GDP, which, as a consequence, cannot properly measure the benefits of the digital revolution. Brynjolfsson and his colleagues have developed a new measure in response: GDP-B, where B stands for benefits.¹⁰⁷ This is a metric that quantifies contributions to consumer well-being from free goods, often neglected in traditional GDP measures, while retaining much of the precision of traditional GDP.

Given the difficulty of devising a new, general measure of well-being to replace GDP, one argument was that we should instead adopt a case-by-case approach. Brynjolfsson, for instance, said we can add complements to GDP and introduce a dashboard of many different metrics.

He illustrated this with an analogy about cars: “If you are driving a car, you do not just have one number on the front that says this is your ‘carness’. Right now, you have a separate measure for speed and for fuel and for air temperature, oil pressure, whatever. By analogy, we need a suite of metrics that measure different things.” Lund added that, as machines do more and more work, we will have to look at health outcomes, life expectancy, education and happiness measures more than GDP.

Another concern was how to make societies more equitable, and workshop participants explored various metrics that could be considered for this purpose. The Gini coefficient was discussed alongside other metrics that assess equality of opportunities and outcomes. A measure for assessing the level of wealth equality in particular was thought to be important: if labour income becomes less significant, for instance, then measuring other forms of wealth that do not come from working may be helpful. Some experts mentioned that interesting experiments are being conducted using survey-based approaches to happiness and other ways of measuring well-being. Alternatives include gross national happiness indices, incidences of suicides and substance abuse, loneliness measures and the OECD’s well-being index. Not all economists were convinced of the benefits of these experiments, though, as the measures can appear somewhat subjective and imprecise.

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Conclusion

Many different voices are needed – from policy-makers to the wider public – to reflect upon the futures we want.

This report brings together leading authorities on the future of work from different fields and backgrounds. It summarizes their thinking on the positive AI economic futures that we should want to build in a world of increasingly capable technologies – and how to achieve them.

Yet this is just the beginning of the conversation. The hope is that everyone who reads this report – from policy-makers to business leaders, expert commentators to the wider public – will continue to engage with these issues. Inevitably, the visions in

this report are only some of the many possibilities that need to be considered and reflected upon.

The intention is that these ideas start a broader discussion – about what sort of future we want and the challenges that will have to be confronted to achieve it. If technological progress continues its relentless advance, the world will look very different for our children and grandchildren. Far more debate, research and policy engagement is needed on these questions – they are now too important for us to ignore.

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Appendix

Interview questions

1. What are the most significant positive scenarios that could arise with the automation of all or most “routine” manual and cognitive work?
2. In a recent survey, leading computer scientists made the claim that there is a 50% chance that machines will outperform human beings at “every task” (including intellectual ones) within 45 years. How does that sit with your own views about technological progress?
3. Imagine these computer scientists are right, and that machines will outperform human beings at “every task”. Would you feel positively or negatively about this future? Why?
4. Leaving aside the claims of these computer scientists, do you think “this time is different” and that AI and related technologies might decrease the demand for labour in the 21st century? Whether yes or no, why is that?
5. What kind of tasks should society not delegate to machines, even if it could?
6. What, if anything, would that mean for the future of work?
7. Do human beings have needs and desires that no technology could satisfy? What would that mean for the future of work, if anything?
8. Considering the challenge of large-scale automation, how could humans still maintain a valuable role in society?
9. If technological progress leads to growing inequality – among workers – what would the most effective response to that challenge be?
10. If technological progress leads to growing inequality – between workers and those who own these new technologies – what would the most effective response to that challenge be?
11. What is the most effective response to the loss of meaningful work?
12. In a future with machines that are far more capable than today, would we have to revisit our metrics for human well-being? Would GDP, for instance, still be fit for purpose? What metrics would you use regarding the challenges of inequality and meaning?

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