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Artificial Intelligence, Jobs and the Future of Work: Racing with the Machines

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Abstract:
Artificial intelligence is rapidly entering our daily lives in the form of driverless cars, automated online assistants and virtual reality experiences. In so doing, AI has already substituted human employment in areas that were previously thought to be uncomputerizable. Based on current trends, the technological displacement of labor is predicted to be significant in the future – if left unchecked this will lead to catastrophic societal unemployment levels. This paper presents a means to mitigate future technological unemployment through the introduction of a Basic Income scheme, accompanied by reforms in school curricula and retraining programs. Our proposal argues that such a scheme can be funded by a special tax on those industries that make use of robotic labour; it includes a practical roadmap that would see a government take this proposal from the conceptual phase and implement it nationwide in the span of one decade.

Keywords: artificial intelligence, technological unemployment, unconditional universal basic income, retraining programs

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1 Introduction

Public discussions around unemployment typically focus on weak demand and outsourcing to developing countries, with limited attention given to structural changes in the economy that result from technological development (Brynjolfsson & McAfee, 2011). In this context, we believe that the future employment landscape will be dramatically transformed by the exponential growth in computer processing power and the spread of "Artificial Intelligence" (AI) – a term that was first used in 1956 by computer scientist John McCarthy during a conference to discuss if machines could be made intelligent (Rossi, 2016). Since then, the term AI in the context of technology is typically used to describe a computer program that can perform tasks or reasoning processes typically associated with intelligence in human beings.

The tremendous advances in AI and computer technology seen over the last several decades are often attributed to Moore's Law. Gordon Moore – co-founder of Intel – observed in 1965 that the number of transistors on an integrated circuit usually doubles every 18 months (Moore). As the ability of processors to complete larger numbers of simultaneous computations grows exponentially, so too does the scope and depth of the tasks that can be efficiently computed. It is important to note that while the hardware component is considered a crucial factor in the advent of the computer age, this trend is expected to slow down as certain physical limits are reached (i. e. circuits the size of individual atoms). Yet hardware is only part of the picture, as simultaneous algorithmic advances have played a significant role in modern computing. For example, in the period 1988–2003 a standard optimization problem saw a 30 millionfold improvement, where the 1,000x factor that is credited to processor speeds is relatively insignificant when compared to the 30,000x credited to algorithmic improvements over the same period (Fallows, 2011). The coming of AI technology mirrors this development - computers are not just getting faster at doing routine calculations, they are able to handle increasingly more variable and complex data that allows them to adapt to tasks that have traditionally been considered uncomputerizable.

Fast forward 20–30 years in the future and, based on current estimates and research, we believe that robotic labor will have started to substitute human labor *en masse* across most sectors of the economy. As this unfolds, governments will fall in the vicious circle of funding expanding social welfare programs (think here of unemployment benefits) with less tax revenue (consider here losses from income tax revenue).

To counter these developments, we propose an integrated two-pronged solution that, in our view, will help a government successfully navigate the changing landscape in the labor market. More concretely, we propose the introduction of an Unconditional Universal Basic Income – an unconditional, periodic transfer of money from the government to every citizen in the society. Under such an income security cushion, an individual

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would be shielded from the negative aspects of technological advancement while being given the opportunity to adapt to a changing economy. We argue that different aspects of this redistribution scheme appeal to both left- and right-wing parties, while the money for the initiative can be raised in part by taxing "smart" machines and, more generally, fully automated firms.

Whereas our basic income proposal separates human basic needs from the need to find employment, it would still not allow an individual to consume goods and services beyond their most immediate needs, such as food and housing. In other words, they would still have an incentive to find employment. Enter the second prong of our proposal, which is meant to ensure that humans can still race with the machines and remain relevant in the labor market. Specifically, we argue in favor of retraining programs for those pushed out of employment, and a reorientation of the entire education system towards life-long, skill-based training relevant to the age of artificial intelligence.

Our multi-layered analysis commences in Chapter 2 with a discussion on the future of employment and the reasons we believe that artificial intelligence is a much bigger threat to jobs than the previously experienced waves of automation. In this chapter we also review some of the existing literature while discussing our assumptions and the inherent difficulty in predicting future technological trends. Chapter 3 builds upon these observations and offers a multidisciplinary, holistic and scalable solution to these developments centered around basic income and skill development. Chapter 4 puts forward a multi-stage framework that would see our proposal implemented nationwide in any given country in the span of ten years. Finally, Chapter 5 summarizes these ideas and presents our final conclusions.

2 Jobs and employment in the age of artificial intelligence

2.1 The fable of the wise man

Humans have a penchant for linear thinking – we imagine future developments to follow trends based on our past experiences. Exponential growth, on the other hand, perplexes our intuition and distorts our expectations of the future. This is so because, initially, exponential growth increases seemingly linearly (think here of 2 + 2 = 2*2), but then it accelerates so rapidly that any model based on a linear trend is doomed to tragically underpredict the magnitude of change. This tendency for extrapolation based on previous events, and the associated challenges that come from this reasoning, has been further documented in the context of financial markets (Taleb, 2005) and in estimating population growth (Rosling, Rosling, & Rosling, 2018).

A particularly relevant fable is that of the Wise Man who invented the game of chess, and so pleasing the Emperor of his kingdom that he was offered any reward he wished (Tahan, 1993). Understanding the power of exponential growth, the Wise Man asked for a seemingly modest gift: a grain of rice on the first square of the chessboard on the first day, two on the second, four on the third ... with the doubling continuing every subsequent day until the final 64th tile on the chessboard was reached. Halfway through this process, on the 32nd tile, the number of rice grains required was on the order of a large rice field – a significant gift, but still manageable by the standards of the wealthy Emperor. Yet the upcoming doublings would yield results that were almost unfathomable when considering the modest starting point; by the 64th tile the number of rice grains owed would be roughly equal to the number of grains of sand found on Earth.

Now using the chessboard and rice concept as an analogy for the doubling of processing power – if we set the starting point as the 1960s, 32 doublings each at an interval of 18 months, brings us to the start of the twenty-first century. As inventor and futurist Ray Kurzweil notes, we have now entered the "second half of the chessboard" with respect to the development of computers and Information Technology, after which point exponential growth yields explosive results (Kurzweil, 2000). What comes next will completely dwarf the past, and as these "changes happen faster than expectations and/or institutions can adjust, the transition can be cataclysmic" (Brynjolfsson & McAfee, 2011).

2.2 The future of employment: A scenario analysis

Following up on the observations of Kurzweil, we start our formal analysis by conducting a simple scenario planning exercise that helps us identify the challenges to employment in the future brought upon by the maturing AI technologies. Scenario planning helps organizations to prepare for an uncertain future by envisioning situations that may occur (Schoemaker, 1995). The creation of scenarios aids in the recognition of, and adaptation to, changing environments, while eliminating blind-spots and biases by transforming perspectives on what the future might hold.

Our focus for this exercise was answering the following question: how will developments in AI affect employment by 2038? We considered two interconnected variables: the level of automation that AI will bring to the labor market, and how well the economy adjusts to this change. Keeping with the chessboard analogy, the resulting analysis identified three plausible scenarios[1] (see Figure 1):

- *Stalemate*: the AI revolution is much smaller than expected and does not change the nature of work. The economy does not need to adapt and employment in 2038 looks like what it does today. In this scenario, there is little reason for concern and governments can continue operating as usual.
- *Check*: despite the wave of automation that AI brings about, the economy is able to shift and adapt, allowing for the creation of new jobs to replace the lost ones. The transition may cause some initial havoc in the labor market, but after a period of unease, stability will ensue.
- *Checkmate*: the AI revolution results in rapid job loss as the economy, governments and individuals are unable to keep up. With the economy unable to adjust, there is a hollowing out of jobs resulting in mass technological unemployment and social instability.

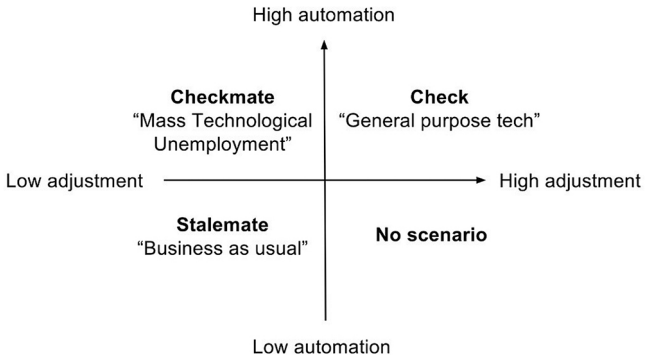

Figure 1: A Scenario Planning Exercise: How will developments in AI affect employment by 2038?

A Pew Research Center Report (Anderson & Smith, 2014) finds that experts are highly divided when asked a similar question. Roughly half of them, which we refer to as the linear thinkers, believe that artificial intelligence will be no different to previous wave of automations, such as the introduction of the steam engine in the nineteenth century. The introduction of AI will lead to the creation of enough jobs in new industries to match the lost ones in fully automated sectors. Hence in their eyes the *Check* scenario is the one to materialize in the future.

The other half (the exponential thinkers), however, strongly believe that from a historical perspective what we are experiencing is different. AI has the potential to substitute human labor across the whole job spectrum, to the point where no person should believe in the unassailability of their profession. Hence their verdict: *Checkmate*.

We acknowledge that our forecasting ability is far from perfect; the *Checkmate* scenario that is explored further in this paper is based on a plausible, but not certain, extreme version of the future. But the ambiguity surrounding the probability of this prediction should not disqualify a discussion on the effects that AI would have on the workforce. Even if the chances of a *Checkmate* scenario occurring were only 5 % in the next 20 years, we believe the risk itself to be a compelling enough reason to plan for this outcome. In fact, the simplest way of thinking about risk is a product of probability and impact (i. e. R = P x I). The impact, along with the probability of occurrence, are the real factors to consider in this analysis. The impact of the *Checkmate* scenario, as we've described it, are so widespread that it should eclipse the variability surrounding the probability when planning for the future – the possibility of this scenario occurring should be taken seriously.

2.3 The AI revolution: Why it's different this time

In our opinion, the real debate behind the *Check* and *Checkmate* scenarios is centered around whether AI is just another general-purpose technology (GPT), which like steam power, electricity, and the combustion engine before it will alter societal progress but collectively raise the standard of living. In the case of previous GPTs, economies have historically been able to adjust to these technological disruptions, and the standards of living have steadily improved as a result. For example, about 90 % of Americans worked in agriculture in 1800, but with the industrial revolution and mechanization this number dropped to 41 % by 1900 (Lebergott, 1966), and 2 % by 2000. While industrialization has clearly eviscerated the demand for agricultural labour, nobody can

deny that on aggregate (i) society has benefited from the previous centuries' technological developments – it takes little to see that the median lifestyle is now significantly improved over what it was in 1800, and (ii) technological disruptions in different eras have presented employment opportunities to the whole societal spectrum with unique low and high skill job distribution: agriculture and the artisan shop in pre-industrial times; manufacturing and clerking in the industrial phase; and service and management in the latter half of the twentieth century.

But AI challenges this model, as jobs across the whole employment spectrum are simultaneously challenged by a technology that combines the speed and efficiency of a machine with the creativity and agency of a human. The previous GPTs were not subject to the same level of continuous improvement, and at the pace currently being experienced in digital technologies (Frey & Osbourne, 2017). Computers in the context of AI are the first truly "universal machines", which can find applications in all industries, across all types of work, and are designed to continue learning and improving as more data becomes available.

Humans have always been relatively protected from this occurrence from an economic perspective precisely for the reasons stated in NASA's "The Case for Man in Space" report from 1965: "Man is the lowest-cost, 150-pound, nonlinear,[2] all-purpose computer system which can be mass-produced by unskilled labour" (Singer, 1965). But the advent of AI means that economists will have to rethink the traditional relationship between output and employment (Okun's Law), which states that increased output means increased employment. While an invention that replaces workers with machines in a specific field could have a positive effect on society (Autor, 2015) – reducing the price of goods, increasing real income – the same benefits will not exist if deskilling and shrinking employment occurs across all fields simultaneously.

Humans still hold a comparative advantage over computers and AI across a significant segment of employment. But given the categorization of labor and the coming technological changes, this is a precarious situation. Based on the study by Autor, Levy, and Murnane (2003), types of labor can be categorized in a 2 × 2 matrix (Figure 2) where the "Degree of Cognition" and the "Degree of Repetition" for a job are plotted on the X and Y axis respectively.

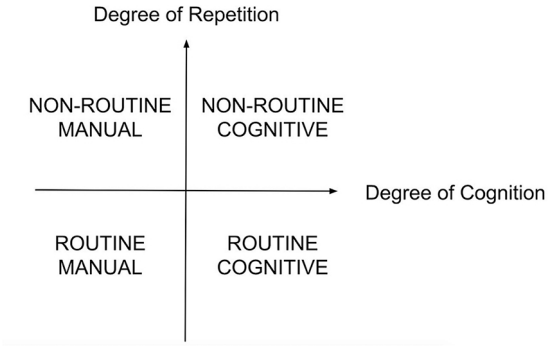

Figure 2: Labor categories according to Autor, Levy, and Murnane (2003).

The routine/non-routine category refers to what degree a job follows explicit rules, while the manual/cognitive division refers to the degree of physical or knowledge work required. The bottom row represents the jobs that are already under critical pressure from modern computing, since a computer does much better than a human at performing tasks that follow a predefined set of rules. Basic manufacturing is an example of routine manual labor, while word processing and computation are examples of routine cognitive labor. This still leaves the upper row, where a high level of intuition and problem solving are required, which is exactly where recent employment growth has been concentrated in developed countries (e. g. services and high-skill positions). But this advantage is temporary, as Ford (2015) describes AI and automation as technologies that will simultaneously move into jobs that have been in the domain of human labor, while continuing to consolidate its dominance in routine jobs. This represents a situation that has never been witnessed in the history of economic development – a technology that simultaneously threatens jobs across the whole employment spectrum. When coupled with the rising costs of education and health care, this puts further pressure on working and middle-class families (Ford, 2015).

Non-routine cognitive tasks across all industries are currently in the early stages of being automated with the help of AI technology. The following are some notable examples:

- Deciphering handwriting (Plötz & Fink, 2009).
- Impartial decision-making in fraud detection (Phua, Lee, Smith, & Gayler, 2012).
- Paralegal, contract/patent law research – Symantec's Clearwell System (Markoff, 2011).

- Diagnostic tasks in health-care – IBM's Watson (Cohn, 2013).

Meanwhile, better sensing and data processing capabilities are leading to the development of mobile robotics that allow for the automation of non-routine manual tasks. Industrial robots have already taken over most operations in advanced manufacturing, while jobs in agriculture and cargo handling are imminently automatable. A non-routine manual job that has been a bastion of human employment until recently, is the operation of a vehicle, which as we have stated is already in the process of being computerized with the development of self-driving technology. This means that many occupations pertaining to the transportation and mining sectors are on their way to being automated (Frey & Osbourne, 2017).

Human employment projections will look bleak as these advancements in AI continue to permeate the economy. With the price of robots expected to fall by 10 % per year on average, the pressure on low-wage services occupations will continue to increase (Manyika et al., 2013) as the current trend of replacing manufacturing labor with robots becomes commonplace. For example, Chinese contract manufacturer Foxconn, which employs 1.2 million people, has already replaced 60,000 human employees with robots (Wakefield, 2016). Also, the introduction of driverless capabilities by 2030 will imply that truck- and cab-driving will be less relevant as job occupations in most developed countries. According to Solon (2016), trucking employs 3.5 million people in the U.S., and is the single biggest source of jobs in 29 states.

The effect of artificial intelligence on the level of human employment will be severe; Frey and Osbourne (2017) calculate that 47%[3] of all jobs offered in the US economy fall in the high-risk category (i.e. jobs that are easily automatable in the next two decades). Another 33 % of total jobs (e. g. doctors, lawyers, engineers, teachers etc.) fall under the low-risk of automation category, which is simply a relative classification as these professional jobs are also expected to come under pressure from automation (Susskind & Susskind, 2015). Moreover, the Frey and Osbourne study shows that the likelihood of employment loss in this first wave of computerization exhibits a strong negative correlation with average median wage and level of education. In other words, the polarization and inequality between low- and high-skilled workers will further intensify as certain classes of workers in the population are disproportionately affected by AI and automation.

2.4 Challenges in predicting future employment

It is important to acknowledge the inherent challenges that exist when trying to predict future technological trends and their widespread impact on society. The *Checkmate* scenario described in this section (i. e. mass technological unemployment at the hands of artificial intelligence and automation) is far from certain – it merely represents a plausible scenario, one that is used by the authors to establish the framework around which potential future plans should be constructed.

While reviewing the literature, there were two important points used to oppose the *Checkmate* scenario as envisioned:

- Technological unemployment will not occur as soon as predicted since artificial intelligence is still far from being able to substitute all the carefully bundled actions required to truly replicate human behaviour (Autor, 2015).

- These new technologies will lead to a beneficial "innovation effect" – sparking new industries or decreasing the cost of existing processes. This will stimulate the economy by both increasing overall output and unlocking latent demand for professional services as they become cheaper (Susskind & Susskind, 2015).

Although there is variability surrounding which types of jobs will be affected, how soon these changes will occur, and the overall magnitude of the change, there is consensus that artificial intelligence as described in this article would represent a new employment paradigm. The high-risk jobs described by Frey and Osbourne (2017) are only a snapshot of the current employment landscape, but still represent a large enough cross-section of available jobs under risk to cause alarm and merit discussion. We acknowledge that a technology as profound as AI is bound to create jobs, just as previously revolutionary technologies (steam, electricity, computing etc.) have done, but there are other important questions surrounding this technological transformation that should still be examined regardless of the eventual outcome. For example, will our society be able to accommodate the displacement of a large percentage of its workforce within a generation or two? Will the lower-risk professional jobs be able to accommodate the massive shifts in our labour markets as they also come under pressure from automation?

The answers to these is questions is fundamentally unknowable since the future is impossible to predict with certainty. But planning for the worst-case scenario is a prudent exercise – one that will lead to a more informed decision-making process. The proposal and implementation strategy in the following chapters is our attempt to start a discussion on how to plan for the *Checkmate* scenario.

3 Our proposal

3.1 Rethinking our economic system in the age of AI

The *Checkmate* scenario, as applied to the arrival of artificial intelligence and further automation in many job occupations, would seriously strain today's economic systems. In our view, the current capitalist economic system is built upon, and revolves around, the concept of *earning a living*. Simply put, individuals enter the labor market to obtain a stream of income. This income, in turn, allows one to engage in a range of economic activities including spending on goods, services and leisure, financial investments and saving.

On the other hand, at a macro level, the elected government maintains societal stability by regulating the conflicting relationship of the profit-maximizing firms and utility-maximizing consumers. In practice, this is achieved usually by taxing corporate profits, capital and labor and provide some of this revenue in the form of social protection programs (e.g. unemployment and poverty allowances). When unemployment hovers at around 5 % to 15 % and 10 %-20 % of the population lives under the poverty line, which is currently the case in many countries, government budgets are stretched to the limit to fund social welfare programs for those in need. A massive technological displacement of labor would simply explode national budgets and make the existing relationship between economic agents in the society untenable. The current economic system would certainly require significant modifications to survive the impact of widespread automation at the hands of artificial intelligence.

Economic opportunity reflects the balance of power in a society since "money begets you [political] power", which is a statement paraphrased from Mark Hanna, William McKinley's campaign manager (as cited in Acemoglu, 2011). As inequality grows with mass unemployment, this will have a distortionary impact on the stability of many developed countries as a belief in fairness and equal opportunity are integral to the functioning of a democracy. As a feeling of desperation sets in, and when even hard work and proper education are not enough to guarantee economic prosperity, it does not bode well for the future. Clearly, well-developed and targeted policy interventions are required to address the impact of AI on the society – such a solution will be discussed in this chapter.

3.2 Enter the unconditional universal basic income

At the heart of our proposal lies the Unconditional Universal Basic Income (UUBI). As the name suggests (Table 1), it consists of an unconditional, periodic transfer of money from the government to every individual in the society.

Table 1: The Name Says It All: Depicting the Etymology of UUBI.

Unconditional	The stream of income provided is not conditioned by some performance measure, willingness to work, or other related factors on behalf of the individual.
Universal	It is paid to every individual in the society, irrespective of his/her position in the society, current job, or financial means.
Basic	The stream of income provided seeks to meet all the basic living needs of an individual.
Income	It consists of periodic cash payments to individuals.

The concept of UUBI – or at least variations of it – is certainly not new in philosophy and political economy. As far back as 1795, the famous English-American political activist and philosopher Thomas Paine (1795) suggested the creation of a special fund,

> out of which shall be paid to every person, when arrived at the age of twenty-one years, the sum of fifteen pounds sterling, as a compensation in part, for the loss of his or her natural inheritance, by the introduction of the system of landed property. And also, the sum of ten pounds per annum, during life, to every person now living, of the age of fifty years, and to all others as they shall arrive at that age.

Paine's suggestion of a minimum guaranteed income and means of funding it – via an extra tax on landowners – were followed up and expanded theoretically by famous philosophers such as Charles Fourier, Joseph Charlier, John Stuart Mill and Bertrand Russell. Birnbaum and Widerquist (2017) provide a synthesized exposé of these authors´ ideas on basic income. However, it was in the twentieth century that mainstream economists began considering forms of universal basic income as genuine and effective economic tools to combat poverty and unemployment. For example, nobel laureate Milton Friedman, proposed the introduction of a negative income tax

(Friedman, 1962). This would be a progressive income taxation system, that instead of having individuals with low income pay taxes, awarded them with a supplemental government-sanctioned grant. Such a scheme would essentially lead to the same redistribution outcome as the UUBI we propose. Other prominent economists such as James Tobin and John Kenneth Galbraith have also defended in public the idea of introducing some form of basic guaranteed income.

This rich plethora of essays and proposals in favor of basic income hides the fact that little to no research has been devoted towards proposing and evaluating a concrete UUBI structure: a clear economic justification behind the exact amount of UUBI offered to every individual; means of funding the UUBI scheme; political considerations; and a feasible plan of implementation. Our proposal endeavors to provide a framework that would rectify these limitations.

We propose that the amount of UUBI provided to every individual in the society be closely linked to the consumer price index (CPI) and historical data on national household expenditure. CPI is one of the best statistical measures economists possess to track the cost of the same basket of goods and services over time and the general level of prices. Making use of this enables the amount of UUBI to be adjusted after an upward or downward movement in inflation. Furthermore, employing historical data on household consumption habits would allow policy makers to construct a solid economic assessment of the exact amount of income an individual requires to meet his basic needs.

Table 2 provides an outline of how to calculate the basic needs of an individual using official German household expenditure data. After identifying and itemizing all the components of household expenditure in the first panel, Panel 2 estimates that a household would require on average approx. EUR 2,500 to meet its most basic needs (including here basic health insurance that is not reflected in Panel 1 under the *Health* item). Building upon this simple but intuitive analysis, we conclude that in Germany every adult in excess of 20 years old must receive EUR 800–1,200 of UUBI and non-adults half of that amount. Until children reach the mature age of 20 years old, the UUBI money they are entitled to must be transferred to and administered by their biological mothers (not much different from the current *Kindergeld* system in Germany). A similar expenditure analysis can easily be conducted for any other country.

Table 2: Micro Level: Calculation of the Basic Income Needs in Germany.

Panel 1: Private Household Consumption Expenditure in Germany				
Items of Private Consumption Expenditure	**2014 EUR**	**%**	**2015 EUR**	**%**
(1) *Food and Beverages*	326	13.7	332	13.9
(2) *Clothing and Footwear*	107	4.5	105	4.4
(3) *Housing, Energy, Maintenance of the Dwelling*	856	36	859	35.9
(4) *Furnishings, Equipment, Household Maintenance*	132	5.6	127	5.3
(5) *Health*	92	3.9	100	4.2
(6) *Transport*	325	13.7	314	13.1
(7) *Postal Communication and Telecommunication*	61	2.6	61	2.6
(8) *Recreation and Culture*	248	10.4	252	10.5
(9) *Education*	17	0.7	16	0.7
(10) *Restaurants and Hotels*	129	5.5	135	5.7
(11) *Miscellaneous Goods and Services*	82	3.5	89	3.7
Total	2,375	100	2,391	100
Panel 2: Basic Calculations of Household and Individual UUBI Amount				
Basic Needs in EUR: (1) + (2) + (3) + (4) + (5) + (6) + (9)	1,855		1,853	
Basic Health Insurance in EUR	700		700	
Total Household UUBI in EUR	2,555		2,553	
UUBI per Person in EUR (Assuming 3 Household Members)	852		851	
Panel 3: Proposed UUBI Range per Person in EUR				
Adults (20+ years)	800	1,000	1,200	
Non-Adults (0–20 years)	400	500	600	

Sources: The data to construct Panel 1 was retrieved from Statistisches Bundesamt, the German Statistical Office (Statistisches Bundesamt, 2017). Calculations and estimates in Panels 2 and 3 are our own.

At a more practical level, the introduction of UUBI raises a multiplicity of issues: Should UUBI be only extended to the nationals of a given country? Can UUBI be offered in practice with "no strings attached"? Firstly, we believe that legal permanent aliens residing in the country who have paid taxes to their current country of residence for a specified number of years should also be eligible for UUBI. Secondly, a "no strings attached" approach towards offering UUBI in the society cannot be realistically implemented. For the sake of

argument, consider a citizen who receives a monthly amount of basic income of EUR 1,000 in Country X from the government. They could well apply an arbitrage strategy by taking this money and moving to another Country Y with a much lower standard of living. In such a scenario, the citizen would simply acquire the EUR 1,000 and consume, invest, and live in Country Y. To inhibit such behavior, a residency criterion, consisting of the number of days one needs to remain in Country X, would need to be instituted. If this criterion is not met, the citizen is obviously free to move to another country, but in so doing, will forego their basic income entitlement from Country X.

Regarding the issue of people that have already made contributions towards their pensions or other forms of social security, we categorize the individuals in a society in four general categories: (i) those under the age of 20, (ii) those above the legal working age that are either in voluntary unemployment, or in the process of finding a job and currently earning unemployment benefits, (iii) those above the legal working age that have already contributed for a number of months/years towards their pensions, (iv) those that have already retired and collect their monthly pension income. For categories (i) and (ii) the transition to a UUBI scheme will be rather straightforward as they will start receiving their monthly UUBI as soon as the scheme is approved by the government. Category (iv) individuals (usually people above 65 years old) will simply continue to receive their monthly pension under the old pension scheme and will not receive any UUBI income at all. For category (iii) individuals several solutions may apply. One would be to calculate their total contributions to date and give it back to them as a lump sum payment. Another solution might be to spread the total contributions paid to date over the expected lifetime of the individual. Under this second scheme, category (iii) individuals would receive their monthly UUBI payment from the government, plus a "contributions premium".

A main critique of basic income is that unconditional cash transfers would induce idleness in the society (Rycroft, 2017). Individuals that would otherwise have to find a job to secure income, would simply rely on UUBI rather than enter the labor market. Albeit a valid concern, we believe that incentives at the individual level are determined by the amount of basic income that everyone would receive. A lower-than-optimal amount of UUBI would fail to achieve the basic objectives of the program – alleviating poverty and combating unemployment. On the other hand, a higher-than-optimal amount would indeed lead to the outcome envisioned by UUBI's critics. However, through large-scale randomized controlled trials (see the implementation section in Chapter 4), researchers would be able to ascertain an optimal UUBI value that best aligns individual incentives. Aligning incentives in this manner means that the income provided to the individual is enough to cover their most pressing needs (e.g. food, clothing, housing, etc.), while still incentivizing the individual to enter the job market and secure income for items such as temptation goods and vacations.

Recent evidence from experiments in Kenya, Namibia and India (see the Appendix) have shown that unconditional cash transfer schemes bring about positive economic, psychological and societal outcomes. In all these cases, both consumption and overall economic activity have markedly increased, these being good harbingers of economic growth. In the Kenyan and Namibian projects, the cash transfer has induced a significant minority of households to not only improve their standard of living, but also to invest part of the basic income to start up new businesses or improve existing ones. This observation counters the idleness critique mentioned earlier. Moreover, among children, school attendance rates have risen and drop-out rates have fallen during the period of the experiments.

Quite surprisingly, the Kenyan experiment reports a marked increase in the psychological well-being of individuals that obtained the cash transfer, as measured by a reduction of the stress hormone, cortisol. In addition, customized questionnaires before and after the experiments show that social relations among neighbors in communities that received the transfer improved. In our view, the qualitative improvement of social cohesion could be a direct result of UUBI, as this approach bridges the current gap between the so-called "givers" and "takers" in a society. Also, UUBI, as here proposed, is equivalent to making income security a basic human right by essentially decoupling basic needs from the need to work.

3.3 Funding the UUBI initiative

At a first glance, funding a UUBI program seems an impossible task as it would devour a massive share of the state budget. Table 3 reports the cost of such a program in the German case for all three outlined scenarios. The cheapest scenario would require a guaranteed funding of roughly EUR 780 billion, whereas the most expensive would consume more than a third of Germany's GDP. This compares to current German expenditure on social protection of 19 % of GDP as of 2015.

Table 3: Macro Level: Total Cost of UUBI.

Panel 1: German Macroeconomic Data and Demographics as of 2015

Adult Population (20+)		67,137,534	
Non-Adult Population		15,038,150	
Nominal GDP in EUR		3,032.82 billion	
Current Social Protection Cost (as % of GDP)		19.0 %	
Panel 2: The Cost of UUBI Initiative in Germany as of 2015			
	Scenario 1	**Scenario 2**	**Scenario 3**
Adult UUBI (EUR)	800	1,000	1,200
Non-Adult UUBI (EUR)	400	500	600
Total Cost of UUBI (EUR)	716.76 billion	895.92 billion	1,075.08 billion
Total Cost of UUBI (as % of GDP)	23.6 %	29.5 %	35.4%

Sources: All demographic data are obtained from Statistisches Bundesamt (Statistisches Bundesamt, 2017). The rest of the macroeconomic data in Panel 1 are retrieved from the OECD (Organization Economic Cooperation and Development, 2017). Panel 2 consists of our own calculations.

However, the numbers in Table 3 have the potential to misguide the reader in thinking that UUBI is simply too expensive to provide, which is not necessarily the case. First, under our proposal, the UUBI program is intended to substitute 90 %-95 % of all social welfare programs, universal pension plans and universal health insurance (note: mental disability allowances and counseling related services would not be discontinued). Combine this with the savings coming from greatly reducing, or completely closing, the government agencies that are currently responsible for these various social welfare schemes, and many developed countries could end up offering a UUBI scheme without resorting to extra taxation. For example, the Economist's Data Team (2016) indicates that eliminating all non-health related welfare spending would allow Germany to offer a yearly UUBI of USD 8,400 to every citizen, this being enough to satisfy the funding needs of our first scenario. Similar calculations for Denmark show that it can offer even more – a yearly USD 10,500 per person.

Many countries, however, would need to find extra budgetary means to fund the basic income initiative. We believe that the introduction of an income tax on intelligent machines in the economy would constitute the best solution available. In our opinion, this can be done by first classifying robots under law as "technological life forms" subject to income tax. This legal recognition would then allow a government to devise a way to extract this tax in practice. A tax on robots would not only provide the means to fund UUBI; it would indirectly decrease the labor productivity of machines and, by association, increase the chances for humans to secure employment. As a result, the amount of the tax would determine the productivity gap between humans and robots in the economy and, in turn, regulate the robot-human proportions in the labor market.

3.4 UUBI meets politics

The successful introduction of UUBI in a society can only be achieved if a broad consensus across the political spectrum is reached. Why? The dramatic changes to government brought about by the UUBI scheme (i.e. reducing or replacing existing agencies responsible for all government-sanctioned social welfare programs) will render it unfeasible to return to the old social welfare systems. This will provide a buffer against short-term governmental changes and populist proposals.

With that said, we believe that there is substantial room for consensus in the middle of the political spectrum as certain elements of UUBI appeal to both a center-right and a center-left government. The left would appreciate the fact that the scheme is intended to pull a significant portion of the population out of poverty and combat the most undesirable effects resulting from unemployment. The right, on the other hand, would welcome the efficiency that such a measure would bring in running the government. Replacing all social security programs with a centralized approach, in which everybody gets paid the same amount with no eligibility criteria, would be an efficiency improvement, the magnitude of which is unseen in the history of governance post WW2. The public's backing of UUBI would be critical in reaching a political consensus.

The danger of populist movements would also be lower because i) extreme left and right parties would not be able to galvanize many voters based on economic reasons, and ii) even if a populist party wins the election on the promise of drastically altering UUBI, market forces would intervene and make such a move difficult. A country relying on taxation of AI to support UUBI initiatives would quickly feel, and protest the effects of such changes.

3.5 Skills development

If one thinks of UUBI as a "shield" that would protect an individual from the negative aspects of technological development, the following part of our proposal would resemble more to a "sword" that would allow countries

to effectively compete and race with robotic labor. While the UUBI and AI taxation approach deals with many of the direct economic challenges that result from technological unemployment, a truly holistic solution must also take into consideration the externalities surrounding unemployment. Humans are social beings, and thus have a need to feel useful and contribute to the society. Substituting the societal engagement that comes from employment with a monetary allowance does not fill this void. Furthermore, UUBI, by itself, cannot make a worker more productive. Hence there is a need for extensive retraining and skills development programs designed to keep people competitive as AI disrupts the labor market.

Firstly, we propose the set-up of a public online portal that offers courses designed to equip the public with the relevant skills needed in job occupations not immediately at risk of being computerized. A quota system based on the principle of first-come first-served mitigates herding behaviour which would occur when a minority of preferred courses are attended by the majority of participants. Moreover, the courses would be offered only to adults (20+ years old), to prevent clashes with the public education system. The portal would help the current working-age generation, which would be the most affected by the AI revolution, acquire new skills and confidently re-enter the labor market. As the existing workforce might need reskilling several times in their professional lives to catch up with technological advancements, learning would be transformed into a continuous process that does not end when one finishes tertiary education.

Individuals would have to pay a fee to participate in any of the courses, but funding schemes can be put into place to lighten the financial burden of the individual. For example, West (2015) proposes the introduction of activity accounts, which similarly to retirement accounts, would be part-funded by a person's current employer with the intention of being used for learning or job retraining should the need arise. Such a fund would carry between employers, meanwhile other incentives such as tax credits could be adopted to encourage its use.

Secondly, a structural reform of the current educational system, led by a total revamp of school curricula, would be required. The current schooling system caters to the twentieth century employment paradigm: teaching silos of knowledge intended to produce a workforce capable of amassing information and executing repeatable instructions. In the age of AI, computers will be able to do this more quickly and accurately than humans. It is therefore essential that our schools begin to better equip students with the necessary tools to handle work in the twenty-first century. There are a number of ways that this can be done. One is to begin removing the silos between skill sets, for example by breaking the dichotomy between the humanities and the sciences (see the report by the World Economic Forum, 2016). Having individuals skilled in multiple disciplines will allow for greater levels of recombinant innovation which, according to Weitzman (1998), is the best way for human ingenuity to stay ahead of technological developments. Moreover, children should be acquainted with the basics of programming and algorithms at an early age, preferably in elementary school. The programming curricula should build up gradually both in depth and breadth with subsequent years of study.

4 Implementation

Haushofer and Shapiro (2016) conclude that specific design features of cash transfer programs will imply policy trade-offs. Hence, due to the over-arching changes associated with UUBI, and its potential to realign incentives in society, its introduction must be the result of a government-backed, carefully thought-out process. We propose a multi-stage process for the implementation of the proposals discussed in Chapter 3.

The *Initialization Stage* consists in setting up basic income think tanks that will lay the foundation for *Stage 2*. These think tanks, and the researchers they employ, will focus mainly on the core issues of the proposal, namely the effects of basic income on individual incentives and the repercussions that a tax on robots and automation will have on production, business innovation, etc. These thinks tanks will also devise the methodology of potential experiments that will be run in Stage 2. The government officials that will oversee the process must also consult and hear from all relevant interest groups in a country. We estimate this stage would take anywhere between 1.5 to 2.5 years.

The *Testing Stage* makes use of the methodology outlined in *Stage 1*, and implements a massive randomized and controlled basic income experiment, funded by the government but run by a preselected multidisciplinary team of sociologists, economists, anthropologists and psychologists. This stage is crucial because previously run experiments (refer to the Appendix) have failed so far to capture the many facets of conditional cash transfers, since they:

i. focus their testing and analysis only on the poorest segments of the population and do not consider how basic income might affect the incentives of the middle class, or the wealthy,

ii. are biased towards reporting only favorable results in some cases,

iii. fail to argue convincingly why they have offered a specific amount of basic income during the length of the experiment, and

iv. offer only evidence about short-term effects, since most of these experiments run for at most three years.

To counter all these shortcomings, the experiment we propose should start off by identifying control and treatment groups among the general population. These groups should be as similar as possible (incl. here similar demographics, levels of economic wellbeing, etc.). The only difference is that the treatment group receives the periodic basic income, whereas the control group does not. The sample of the population that participates in the experiment should be big enough as to produce consistent results. Both treatment and control groups should be followed closely by the researchers during the entire length of the experiment. This might involve, but is not limited to, baseline surveys pre-, during and post-experiment and one-on-one interviews. Also, different amounts of basic income need to be offered during the length of the experiment in order to observe the response of the individuals to different levels of income. To obtain results that are indicative for the medium term as well, we propose that experimental phase last for 5–6 years.

At the conclusion of the experimental period, the qualitative and quantitative result should be thoroughly analyzed by the multidisciplinary team and the output should be published. One of the most important aspects of this research would be the calculation and justification of the optimal basic income. This process might take 6 months to 1 year. Add to this the time needed to run the experiment, and Stage 2 would require 5.5 to 7 years for completion.

The results obtained from *Stage 2* would allow the government to enter into negotiations with political parties that represent the majority of the population in a particular country, and to reach a consensus on the introduction of UUBI nationwide. In what we refer to as the *Transition Stage*, practicalities, such as the residency criterion we discussed in the previous chapter, would be further analyzed. Once a compromise is reached, the current government at the time of negotiations would proceed with creating a new government agency that would manage the entire UUBI program. This would be accompanied by a revision of school curricula and the institution of the online portal, which would help individuals up-skill and adapt faster to the changing nature of employment. We estimate this stage would last between 1 and 2 years.

Finally, in the *Implementation Stage*, UUBI is signed into law and all governmental bodies responsible for the discontinued social welfare programs are replaced. For illustrative purposes, Figure 3 maps all the stages and the subsequent steps involved. In total, the introduction of UUBI in a country would take anywhere between 8 and 11.5 years from initialization to full implementation.

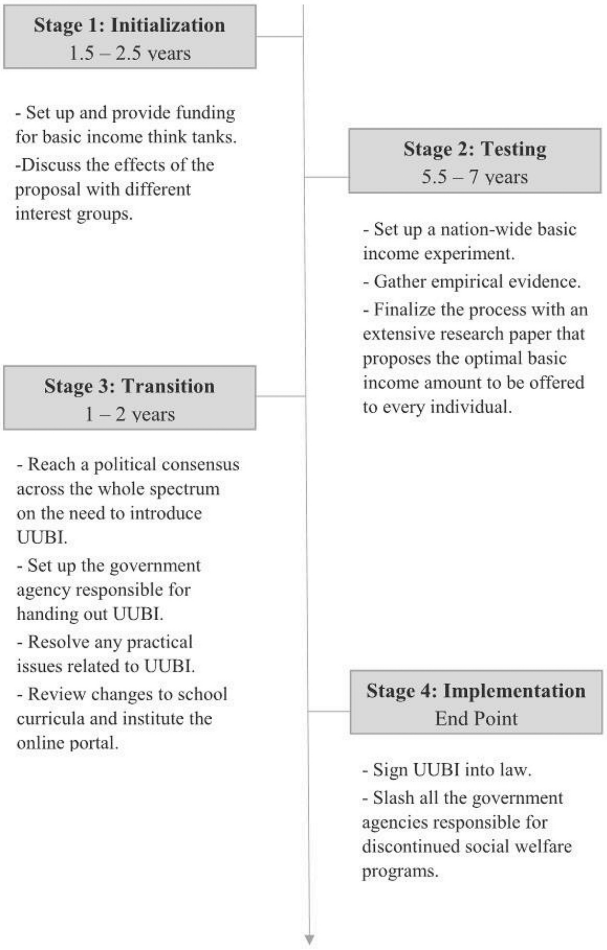

Figure 3: Stages involved in setting up a fully-fledged nationwide UUBI from initialization to implementation.

In our view, this multi-stage approach, if applied now or in the next few years, would allow a country to stay ahead of the expected developments in artificial intelligence and the automation of labour. The authors would like to underscore the importance of proper planning; a rushed and poorly planned introduction of UUBI in response to societal challenges is a recipe for disaster given the widespread effect that unconditional basic income has on human incentives.

5 Conclusion

The reality is that a broad range of contingencies must be planned for, regardless of personal or political persuasions and differing initial assumptions, to ensure that we are better equipped to deal with future developments. UUBI as we propose, is simply our response to a potential technological outcome, in which society's problems become more about the distribution of wealth rather than scarcity. This paper is based on the hypothesis that a rapid and sweeping challenge to existing jobs will likely occur in the future, the magnitude of which is underappreciated. Realistically, some intermediate outcome between the *Check* and *Checkmate* scenario described is most likely to occur. Where on this spectrum the future of employment lies is a difficult question to answer, but the potential societal impact of the *Checkmate* scenario underscores the importance of developing a strategy – UUBI would be a means to address the potential challenges to human employment in the context AI technology and automation.

This paper proposes several measures to alleviate the pressures of massive technological unemployment. At the core of our proposal stands the concept of Unconditional Universal Basic Income, a periodic and unconditional transfer of income from the government to every individual in society. The suggested UUBI scheme can be funded by a tax on AI machines and savings from centralizing existing social benefits programs, and is political tenable as it appeals to parties along the entire political spectrum. If complemented by a reform in school curricula and the introduction of an efficient labor market-oriented retraining program, UUBI has the potential to lead to a systemic shift in the current economic paradigm and mitigate some of the most undesirable effects associated with technological unemployment.

In addition, we supplement our historical analysis by recommending a multi-stage decade-long implementation plan that would see our proposal materialize in any given country. It is our belief that this phased approach would guarantee the correct alignment of economic incentives, at the individual and collective levels, upon the introduction of a UUBI system. Our proposal reiterates the need for political leaders that now, more than ever, think beyond their standard 4-year political terms to lead their countries effectively into the future. Artificial intelligence and automation represent a tremendous opportunity for our society, but without a strong transitionary plan in place we are destined to lose our race with the machines.

Notes

1 No plausible scenario could be discerned in which the economy adjusts to AI, but AI has no impact on the economy.
2 The use of the term "nonlinear" is not to be confused with our tendency for linear extrapolation mentioned in Section 2.1. The term in this quote refers to the creative decision-making ability that humans possess, and how we synthesize and react to immediate sensory information rather than how we predict future outcomes based on data.
3 The number is limited to only the substitution effect of future computerization, based on technology that is in the early stages of development.

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Appendix

Table 4: Worldwide unconditional transfer scheme experiments.

NAMIBIA	
Period	January 2008 – January 2010
Name of the Project	The Basic Income Grant Experiment
Project Manager	A coalition of: 1) Council of Churches (CCN) 2) National Union of Namibian Workers (NUNW) 3) Namibian NGO Forum (Nangof) 4) National Youth Council (NYC) 5) Namibian Network of AIDS Service Organizations (Nananso)
Location inside Country	Otjivero-Omitara Village
Population Sample	930 inhabitants
Cash Transfer	100 Namibian Dollars (roughly 12.40 US dollars at the time)
Findings	1) The percentage of households living under the food poverty line fell from 76 % to 37 %. 2) Great reduction of child malnutrition. 3) School attendance dropped by 42 %, while drop-out rates dropped from 40 % to 5 %. 4) A sizable portion of participants used the income to start or improve their own small businesses, such as brick-making and baking bread. 5) Overall increase in economic activity and savings accompanied by an overall decrease in household debt.
Main Limitations	1) One or more of the participating project managers may be characterized by potential bias or hidden agendas. 2) Small sample size and the selection of only one village for the experiment. 3) Findings may not be indicative for developed countries as well.
KENYA	
Period	April 2011 – January 2013

Name of the Project	GD Project
Project Manager	*GiveDirectly Inc*. NGO
Location inside Country	120 villages in the Rarieda District
Population Sample	1372 households
Cash Transfer	1) Three quarters of the sample received KES 25,200 (USD 300 at the time). 2) One quarter of the sample received KES 95,200 (USD 1,000 at the time). 3) Half of the sample received the transfer in equal monthly instalments across nine months, whereas the other half received the transfer as a one-time lump sum payment.
Findings	1) On the economic side, these transfers led to an increase in overall consumption, reduction of hunger, increase in investments on livestock and small business, and allowed poor households to build assets. 2) At the psychological level, these transfers led to a 0.18 standard deviation increase in happiness and a 0.15 standard deviation increase in life satisfaction, all these measured by customized questionnaires. 3) In addition, stress levels among the individuals in the sample fell sharply as evidenced by a reduction in the levels of the stress hormone, cortisol.
Main Limitations	1) Results are still preliminary as the study is in progress. 2) Findings may not be indicative for developed countries as well.
INDIA	
Period	2010–2013
Name of the Project	3 different projects
Project Manager	Self-Employed Women´s Association (SEWA) with financing from United Nations Development Program and UNICEF.
Location inside Country	Delhi and Madhya Pradesh
Population Sample	15,000 individuals in 20 villages
Cash Transfer	1) First year: 200 Rupees (about USD 3.75 at the time) to every adult man and woman. Children under the age of 14 were granted 100 Rupees. 2) Second and third year: 300 Rupees for adults and 150 Rupees for children
Findings	1) Reduction in hunger and malnutrition. 2) Increase in the household budget dedicated to healthcare. 3) School attendance and drop-out rates improved by a factor of three. 4) Increase in overall economic activity. 5) Improvement in societal relations.
Main Limitations	1) Monthly monetary amounts offered to the citizens may be too small to affect individual incentives. 2) The differences in findings between the first year (lower amounts of UUBI) and the other two years are not clear. 3) Findings may not be indicative for developed countries as well.
FINLAND	
Period	January 2017 – January 2019
Name of the Project	Basic Income Experiment
Project Manager	Finnish Social Security Government Agency (KELA)
Location inside Country	Nationwide
Population Sample	2000 unemployed citizens between the ages of 25 and 58.
Cash Transfer	EUR 560
Findings	1) Significant cut in governmental red tape and bureaucracy. 2) Alleviation of poverty.
Main Limitations	1) Results are still preliminary as the study is in progress. 2) Small sample size. 3) The experiment does not cover the effect that UUBI would have on those citizens that are employed.

Sources: For the Namibian experiment and its lessons see Haarman and Haarman (2012). Results on the Kenyan experiment are detailed in Haushofer and Shapiro (2016). The results of the Indian pilot projects are presented in Fernandez (2013). Finally, details on the basic income experiment in Finland can be accessed from Kela's official website.