The Future of Society

Humanising the Robot Revolution | April 2018

Pottinger

Cover image: Starman and Tesla Roadster en route to Mars
Credit: Spacex image edited by AB-nebula via Reddit

Contents

1. Introduction and Context 3

1.1 The Dawn of the Robot Revolution 3
1.2 Beyond the Future of Work: Defining *The Future of Society* 4
1.3 Quantifying the Impact of Artificial Intelligence and Robotisation 8

2. Phase 1 Findings and Recommendations 9

2.1 Framing the Problem 9
2.2 Identifying a Complete Set of Policy Measures 11
2.3 A Short-list of Recommended Policy Priorities 15
2.4 Key Recommendation: Implement "Robot Value-added Taxes" 17
2.5 The Importance of Incentivising Job Creation 20
2.6 Sharing Economic Benefits Via Alternative Ownership Structures 23

3. Key Focus Areas for Phase 2 26

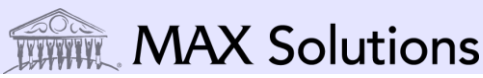
4. Where Does This Leave Us? 27

5. List of figures 28

Pottinger wishes to acknowledge MAX Solutions, our official partner for Phase 1 of this project.

MAX Solutions is an Australian national organisation that delivers employment, health and training services, best known for its work as the employment service provider, MAX Employment.

Since opening in 2002, MAX Solutions has offered proven solutions to support individuals, business and the Australian Government achieve outcomes that benefit the community. Operating from more than 250 locations, MAX Solutions is an industry leader focused on innovation for improved performance and results – *giving every person every chance*.

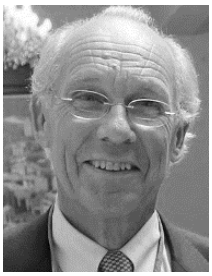


About the Authors

Nigel Lake, Executive Chair and Co-founder, Pottinger and co-founder and CEO of programmatic analytics business Atomli.

Nigel has wide-ranging experience advising leading companies on strategy, M&A, innovation and organisational change, and governments on policy development and large-scale infrastructure projects. He is recognised for his expertise in innovative approaches to valuation and risk analysis, and their application to long term investment decisions, including large scale infrastructure projects. For the last five years, he has been a participant in the B20 Initiative, with a particular focus on infrastructure.

Nigel lead's Pottinger's involvement in China's One Belt One Road Initiative and is also a participant in the Australia-Canada Leadership Forum. He is author of *The Long Term Starts Tomorrow* and various papers, including *Ending Accidental Time Bias.* He is a graduate of Queens' College Cambridge and a Fellow of the ICAEW.



Professor Jorgen Randers, Professor of Climate Strategy, BI Norwegian Business School, where he works on climate and energy issues, scenario analysis and system dynamics. He was President of the BI Norwegian Business School between 1981 and 1989.

Jorgen is one of the world's leading systems thinkers and futurists and has spent one third of his life in academia, one third in business and one third in the NGO world. He is non-executive member of several corporate boards in Norway, including the state owned Postal Service and sits on the sustainability council of The Dow Chemical Company in the US and Astra Zeneca in the UK. He is also an advisor to the Government of China on sustainability, environment and the future of work. Other roles include Deputy Director General of the World Wide Fund for Nature (1994 to 1999).

Jorgen is a full member of the Club of Rome, and is co-author of The Limits to Growth in 1972 and its sequels in 1992 and 2004. In 2012 he published 2052 – A Global Forecast for the Next Forty Years, which is now available in 8 languages and has sold more than 100,000 copies. He has received many prizes and awards, including an honorary doctorate from the Anglia Ruskin University in Cambridge UK. He is a full member of the Club of Rome.

Pottinger

111 Elizabeth Street
Sydney, NSW 2000 Australia

25 West 39th St
New York NY 10018 USA

Fellow Humans,

The Robot Revolution, in which the role of machines progresses from the automation of tasks to the automation of decision-making, is upon us. Whilst the impact of robotisation on society is often discussed under the topic heading *The Future of Work*, in reality the effects will impact almost every part of our lives, defining *The Future of Society*.

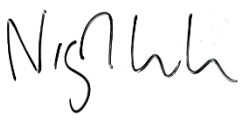
During 2017, Pottinger and Professor Jorgen Randers of the BI Norwegian Business School collaborated to develop a comprehensive analysis of potential policy and strategy responses to these critical challenges. Our work thus far has indicated the following.

- **Automation will increase productivity significantly, but will also displace humans from a substantial proportion of existing administrative and management roles. Indeed, the majority of all existing jobs can already be automated using current technology.** Previous revolutions suggest that new jobs will not emerge rapidly enough to make up for those lost to machines. Thus, without policy intervention, the effects of robotisation are very likely to consume existing jobs more rapidly than new ones can be created, at least in the developed world.
- Importantly, increasing automation will increase the polarisation of wealth, both within countries and between nations, which will in turn constrain overall economic growth. This will add to societal and fiscal pressures for change. The social effects will be profound, and governments will be severely challenged as they seek to balance fiscal responsibility with society's expectations.
- Recent experience in the USA and UK suggests that this is already happening – ie job creation has been insufficient to offset job attrition fully, and increasing polarisation of wealth (ie a reduced worker share of overall income) has also restricted economic growth. Real growth in median wages has stagnated in the US for nearly fifty years. Unemployment is approaching a low point, and yet median real incomes remain under significant pressure or are declining, a significant red flag for any government.
- As societal tension grows, voters will blame the corporate, economic and political elite, though not necessarily in that order. Governments will in turn seek convenient scapegoats who are easily taxed to meet short term funding challenges. Without intervention, there is a very real and growing risk of disruptive societal revolution, which would be very damaging to the interests of the richest and most powerful members of society.

- Each country or region will need to identify policy responses that can be afforded within current budgets, or face a downward economic spiral exacerbated by crumbling physical and social infrastructure. These problems are already clearly evident in countries such as the USA.
- Great care is required in designing and implementing these measures, to ensure that economic incentives do not promote unintended, adverse consequences, and that the right outcomes are achieved over the longer term. This will require fresh thinking and a longer-term mind-set.
- We have identified a complete set of policy options, and recommend eight policy priorities. These are designed to raise revenues, enhance societal welfare, and slow or halt the concentration of wealth. We note that most of the proposed measures are well understood, and there is considerable flexibility in how they are applied.
- **The most important step is the introduction of a new element of taxation linked to the increased use of artificial intelligence and robots.** Specifically, we envisage a progressive tax on the value added per employee, intended to withdraw some of the excess profits arising from robotisation at the company level. This would create a feedback loop to reward companies that provide higher levels of employment and thus reduce the burden on the welfare state, and to deliver part of the benefits of robotisation to remaining employees as higher wages. To ensure that companies cannot defer or avoid payment of these taxes, these measures should be implemented through some form of addition to existing sales or value-added taxes. Ultimately the objective is to ensure that both governments and companies increase their focus on the preservation and creation of jobs, including high value roles in industries where demand for skilled personnel is likely to increase as a result of robotisation.
- New measures of economic and social progress will be essential to track whether or not policy responses are achieving their desired goals. Continued reliance on historic metrics, including the 20th century obsession with headline economic growth, is likely to result in short term choices being made that drive bad results over the medium to long term, increasing the risk of disruptive, revolutionary change.
- The implications for education and development are also profound. Though we remain strong advocates of the importance of STEM subjects, many related jobs can and will be automated. As a result, the large majority of employment opportunities in the future will depend primarily on soft skills related to creative, cultural, caring and communication roles. Our children must make educational choices that are right for the world twenty years hence, not twenty years ago.
- **The longer the requisite policy measures are deferred, the more income inequality and wealth inequality will increase, making significant societal disruption more likely. In this context, we note that the economic and political elite have the most to lose from these changes.** Meanwhile, radical political leaders have emerged in numerous countries, and their chances of election are increasing. Unsurprising, forward-thinking companies and investors are already beginning to act to mitigate these risks.

This paper provides a summary of our current thinking and an overview of planned activity in 2018. Our ongoing work focuses on providing a robust quantification of the timing and extent of the impact of robotisation on society, working with external collaborators and supporters. We welcome participation by leading companies and governments, with a particular focus on localising our recommendations for specific countries and regions, and drawing out the implications for individual industry segments.

For further information, please contact Pottinger at +61 2 9225 8000 or Info@futureofsociety.org.



Nigel Lake
Executive Chair, Pottinger

1. Introduction and Context

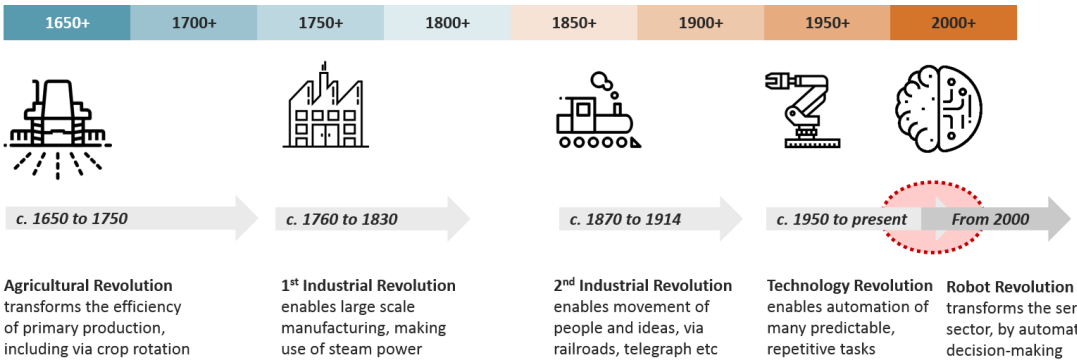
1.1 The Dawn of the Robot Revolution

Dramatic advances in science and technology have impacted almost every aspect of modern-day life in the developed world over the last fifty years. Extraordinary improvements in medicine and healthcare have increased life expectancy by roughly a decade in the USA, more than doubling the length of retirement. In countries like China and India, life expectancy has increased by nearly half. The interconnected forces of innovation, industrialisation, automated manufacturing and scale efficiency have driven productivity up, and costs down, in many sectors. This has made many aspects of day to day life materially more affordable.

The four billion humans connected to the internet have a diversity of information, resources and entertainment at their fingertips that was unimaginable just a few decades ago. Satellite launches can now be watched live via a camera transmitting directly from the rocket. Cars are iPhones on wheels, with operating systems that can be updated over the air, improving performance (and the entertainment system) long after the vehicle has left the showroom. Amazon can fulfil orders for tens of thousands of items, delivering to addresses in major cities in just two hours. Travellers can rent each other's homes from across the globe via AirBnB.

Education – the great enabler of social mobility and economic opportunity – has advanced radically too. Mathematics and technology, history, music, languages and much more can now be studied online by anyone. Most of the world has access to a modern-day Great Library of Alexandria for free, not to mention software that helps us to learn. Education is no longer a privilege, or even a right. It has become a choice, almost as freely available as the air we breathe, at least to those with access to the internet and time to study.

Figure 1: Major Technological Revolutions: 1650 to Date



The Robot Revolution has dawned, and its effects will transform many aspects of our lives. After two centuries of the automation of tasks, we now see *the automation of decision-making*, with machines now able to replace many of the remaining white and blue-collar jobs. The prospects are both exciting and terrifying. Harnessed in the right way, artificial intelligence and machine learning can drive dramatic reductions in the cost of living and significant improvements in social prosperity. But if the wrong decisions are made, and robotisation replaces the existing stock of jobs too rapidly, economies may experience a deflationary death spiral. This would have profound implications for employment patterns and society. In short, there is phenomenal opportunity and extreme risk for companies, governments, investors and individuals alike.

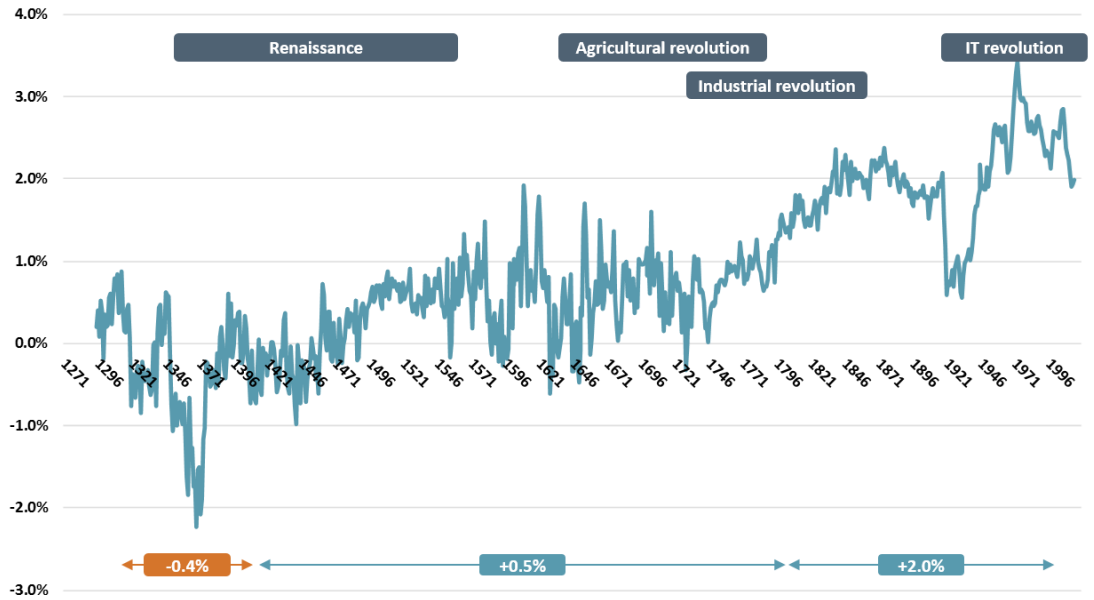
1.2 Beyond the Future of Work: Defining *The Future of Society*

Over the last decade, there has been a growing discussion regarding the potential impacts of artificial intelligence and robotisation on employment, often referred to as "The Future of Work". The analysis undertaken to date has, however, been almost exclusively qualitative in nature. Even the 2013 Oxford University study, "The Future of Employment"[1], which quantifies that over half of all existing roles can be automated today, using existing technology, does not address how rapidly these shifts will occur, nor what the associated social or economic implications might be.

Many commentators suggest that changes of this nature are not new, and typically assert that new jobs are likely to emerge to replace the old jobs. Few offer any evidence to support this hope. We believe this approach is dangerous, given the scale of changes that are under way.

History holds important lessons regarding the effect of such revolutions. For example, the UK saw compound economic growth of just 0.5% a year between 1400 and 1800. Over the following two centuries, overall growth accelerated to 2% a year in real terms, before slowing to 1% since the year 2000.

Figure 2: Smoothed Growth in Total UK GDP (25 year compound annual growth rate)



Approximately a third of this growth was attributable to population increases. In the UK, GDP per head remained level in real terms from around 1400 to 1700. The subsequent agricultural revolution brought significant benefits to society over the longer term, but the transition involved nearly a century of societal disruption. Between 1700 and 1800, GDP per head only increased by around 0.3% per year in real terms[2]. Land-owners accumulated huge wealth, whilst hardly any benefits flowed to the significant majority of workers.

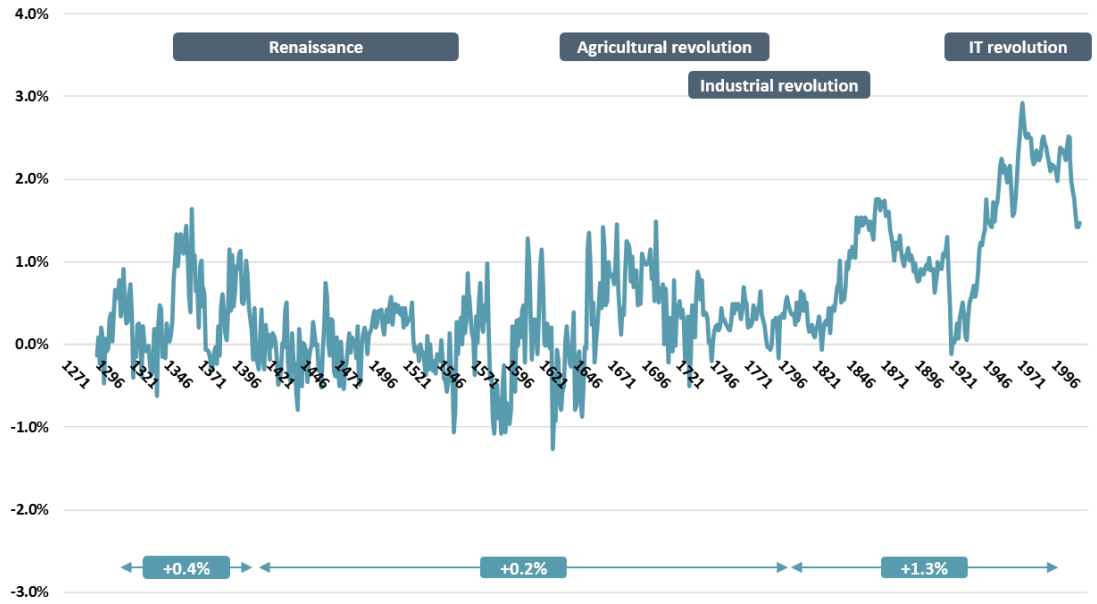
From around 1800, Britain began to industrialise. Agricultural workers migrated to the cities to find work. Without capital to invest, they were forced to live in slums and to work in dangerous factories for low pay. By 1850, more than half the population lived in cities and towns, and

[1] The Future of Employment: How Susceptible Are Jobs to Computerisation? Frey and Osborne, September 17, 2013

[2] Broadberry et al. and Bank of England

growth in GDP per head had accelerated marginally. Yet average wages had stagnated for 40 years[3]. Industrialists amassed fortunes relatively quickly, but it took much longer for the benefits to flow through to society at large, at least as measured by incomes. Meanwhile, between 1850 and 1900, typical wages for agricultural workers increased by just 0.9% a year in nominal terms[4], only modestly higher than inflation over that period of around 0.2% a year.

Figure 3: Smoothed Growth in UK GDP per head (25 year compound annual growth rate)



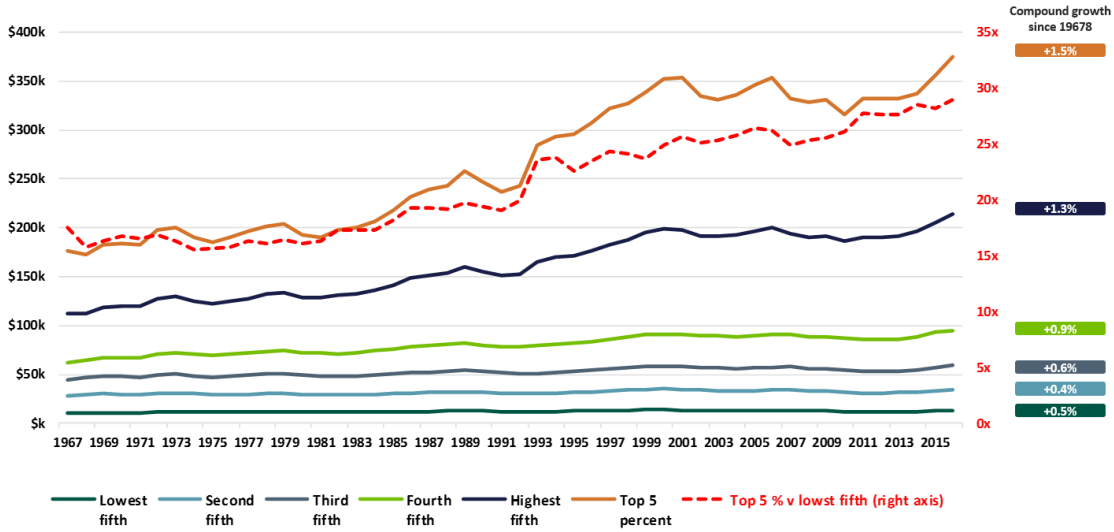
Eventually, after nearly a century, the union movement was born in 1881, and grew to become a substantial force in UK politics for the next century. The history of industrial relations is beyond the scope of this paper, but we note that tensions between the owners of capital and employees have remained a significant challenge in many countries for many years, and they remain at the heart of the challenges that we now face.

Neither growth in GDP or nor growth GDP per head tell you much about how life has changed for the large majority of the population. In particular, increasing concentration of wealth may mean that most or all of the benefits flow to a very small part of society. As a practical example from recent times, during the technology revolution of the last fifty years, real wages in large economies have stagnated. Over the last half century, the real income of the bottom 80% of Americans only increased by around 36%, or 0.6% a year in real terms. In comparison, the top 5% saw their income more than double over this period.

In the USA, average hourly wages have remained roughly constant in real terms for fifty years (having peaked in the early 1970s). Increased participation rates, and an increase in the working week, means that average incomes have increased at a slightly better rate, but at the expense of reduced leisure time. US Census Bureau data tells a chilling tale. Household incomes for the lowest three quintiles (60% of the population) have remained almost constant in real terms for fifty years, and are lower now than in 2000. Incomes for the top two quintiles have increased over the last fifty years, though even these are both barely above the levels seen at the turn of this century.

[3] Clark, Average Earnings and Retail Prices, UK, 1209-2010, 2001
[4] British Labour Statistics: Historical Abstract 1886-1968 (Department of Employment and Productivity, 1971)

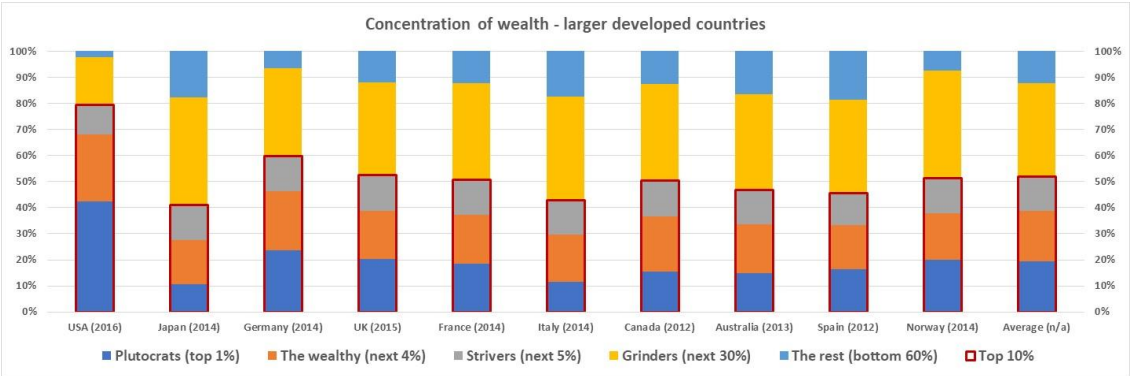
Figure 4: Real Average Household Incomes in the USA by Quintile[5]



As illustrated above, the gap between the top 5% and the bottom four quintiles has increased significantly, with no sign that this trend will reverse.

Meanwhile, in the US, the top 5% now owns around 68% of all wealth, and the top 10% owns 80%. The bottom half own very little at all – exacerbated by poor access to healthcare. Similar wealth concentration patterns are now seen in many other countries, albeit to nothing like the same extent as the USA. As illustrated below, in many countries the top 10% own approaching half of all wealth.

Figure 5: Concentration of Wealth – Larger Developed Countries



In mathematical terms, the concentration of wealth in the USA means that (on average), the top 5% individually have over 40 times the wealth of the rest of society – conditions which historically have fomented revolutions. Even in socially progressive countries such as Germany, average wealth of the top 5% is over 17 times that of the rest of society. Trickle-down economics has proved to be exactly that: in most countries, the economic upside unlocked at the top of the food chain has only seeped down very slowly to the rest of society. It is, perhaps, no surprise that radical leaders are emerging in many western nations on both sides of the political divide, highlighting the risk of political revolution that may be highly disruptive to the interests of today's political and financial elite.

We note that the above addresses only financial wealth and does not draw out the welfare benefits and protections that are available to individuals in the form of universal no-charge

[5] Source: Pottinger analysis based on data from the US Census Bureau

access to services such as education and healthcare. In some countries, progressive social welfare regimes offset the impact of wealth polarisation to a significant degree. We intend to address these issues further in Phase 2 of our work.

Looking forward, this matters all the more because robotisation will result in an even greater proportion of overall economic output being produced by machines rather than human effort. Assuming capital assets continue to be owned by large companies, further concentration of wealth is likely, not only within countries but also between nations. This continues a trend seen over the last two decades: most new technology giants are based in those two countries. Thus, it's not just rich people that get richer – rich countries do too.

Already, the world's six largest countries (USA, China, Japan, German, the UK and France) account for some 60% of the world's GDP and some 30% of global population. This trend will be exacerbated by robotisation, as the substantial majority of robotisation companies will be based in either China or the USA, as these are the world's two largest markets for their services. At an individual level, a recent report by Credit Suisse estimated that the richest 1% of society is estimated to own around half of all the world's wealth. Meanwhile, the poorer half of the world's population – some 3.5 billion people, account for just c. 3% of global wealth.

Increasing robotisation will drive increased polarization of wealth. This will lead to declining participation in the labour force and reduced demand, resulting in economic stagnation. For those with capital, investment returns will decline, as will the range of investment opportunities, and risks will increase. A growing pool of surplus capital will be forced to pursue speculative assets (including shares, real estate, art and bitcoins), creating new investment bubbles. These will inevitably burst, leading to significant loss of wealth.

This rise in inequity – past and coming – poses enormous and growing challenges to society, and creates huge risks for investors, companies, governments and citizens alike. In the shorter term, companies already face significant growth challenges and many governments face significant fiscal strain. In the longer term, rising society tension implies a growing risk of disruptive change to societal norms. So, although these issues are challenging and the solutions may not appear ideal, the risks associated with kicking this particular can down the road are high, both for individuals and for entire countries.

Figure 6: From Robots to Revolution

Although many of the conceptual issues are well understood, few governments, major corporations or large investors appear to have understood fully the risks that these changes pose. Many studies and indeed many commentators appear to believe that new jobs will be created rapidly enough to offset the effects of robotisation, with little or no evidence to support this conclusion. From our ongoing engagement with large commercial enterprises, there does not appear to be much awareness amongst business leaders of the multi-decadal periods of real wage stagnation observed in previous revolutions, nor for that matter of the political dangers (including complete societal revolutions) triggered by extreme polarisation of wealth.

1.3 Quantifying the Impact of Artificial Intelligence and Robotisation

To address these challenges, Pottinger has been working with Professor Jorgen Randers of the BI Norwegian Business School over the last twelve months to establish a basis for quantitative analysis of these shifts, to identify and analyse alternative policy responses, and to establish dialogue with leading companies and progressive governments to support implementation of our recommendations. Our approach is built on six core elements:

- To provide a **conceptual framework** for understanding the shifts that are likely in the workforce, and to address related matters such as the implications for education and retraining;
- To **assess the speed with which robotisation will impact society**, and to establish whether there are any factors that would either catalyse or alternatively slow or impede these changes;
- To **quantify the impacts of robotisation** on society, through the development of a systems model (the "Earth3+" model) of the economic effects at a country level;
- To **define the complete set of responses available** to relevant actors, ie governments, companies (and other collective enterprises) and individuals;
- To **identify the recommended responses**, by assessing the practical problems arising and the political feasibility of the available responses, finding the subset that appear viable; and
- Most importantly, to consider **how best to communicate** the above challenges, solutions and implications to stakeholders, so that they can better understand the inherent risks, as well as the benefits of implementing the recommended solutions.

Our approach combines systems thinking, research and communication elements with a strong focus on engagement with stakeholders. Our fundamental objective is to identify how best to stimulate engagement with and action by the boards and management teams of very large private enterprises, senior politicians and leading bureaucrats in Federal and State Governments, as well as influential ultra-high net worth individuals.

A further motivation is to reduce the risk of societal tension, conflict and possibly revolution, through solutions that both help the potentially unemployed find alternative income, and by reducing the risk of violent redistribution of wealth.

Our initiative embraces parallel commercial[6] programs of work designed to inform boards and management teams of the risks and opportunities posed by robotisation, and the response options available to them. It also leverages our respective involvement in various intergovernmental initiatives, such as the UN's Sustainable Development Goals, the B20 programme and China's One Belt One Road initiative, as well as our team members' work with organisations such as The Global Partnership for Education and The Brookings Institute.

Our work programme leverages prior and current research and analysis, including Professor Randers' book "2052" (www.2052.org) and the underlying world model and the ideas in *Reinventing Prosperity*, as well as Pottinger's work in relation to improved techniques for financial decision-making (eg *Ending Accidental Time Bias*).

[6] To ensure that the organisations in question which are supportive of our agenda pay attention to our findings and are able to drive successful implementation of our proposed response strategies.

2. Phase 1 Findings and Recommendations

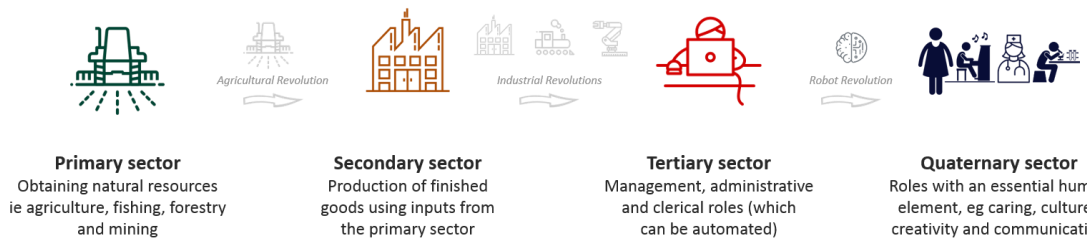
2.1 Framing the Problem

The starting point for our work was to develop an overall framework to describe the challenges that we are facing, and to assist with understanding the forces that are at work.

In considering these issues, it is helpful to think about the underlying challenge as shifting a large part of the productive capacity of the total labour force from administrative tasks to creative, cultural, caring and communication roles that have an inherent requirement for human involvement – a profound shift in how human capacity is currently utilised.

In exploring this inevitable reshaping of the economy, it is thus helpful to separate the tertiary or services sector into two parts. The first, which comprises many administrative, clerical and management roles, can already be substantively automated, and will experience dramatic productivity improvements over the next twenty years, with many jobs being eliminated. The second comprises a quaternary C4 (*creative, cultural, caring and communication*) sector. This will be the last bastion of employment opportunity. Meanwhile, in the primary and secondary sectors, the march to near total automation will continue relentlessly.

Figure 7: The Four Sectors of the Economy



Active management of this transition is critical. After all, the creation of new jobs occurs only once there is new and sustainable money-backed demand for something more than what is already produced. This will not occur easily if more workers/consumers lose their income, and the elite accumulate even more wealth. This is because the elite will have much more than they can spend on consumer goods and services (which would in turn increase demand and output) or that they can spend on investment goods and services (as there will be no market demand to make this addition of capacity profitable).

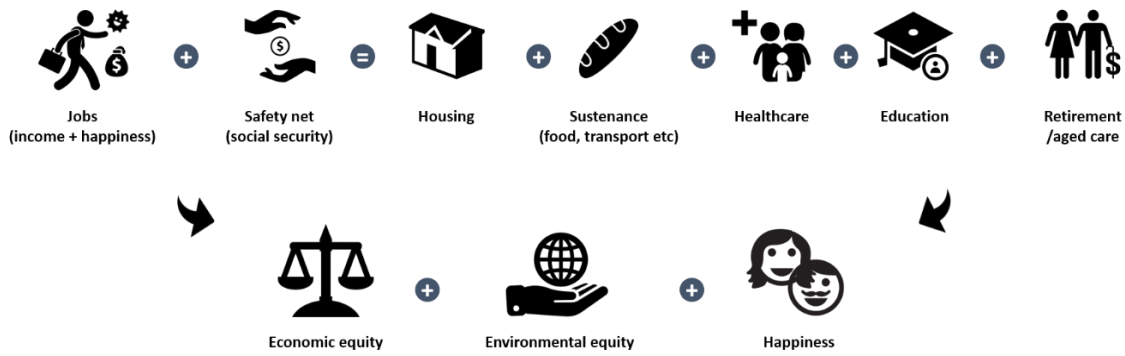
In this way, the effectiveness (or otherwise) of the redistribution of wealth through the economy contributes to overall societal outcomes, in the form of economic equity, environmental equity and wellbeing[7].

A successful regime should promote both social and environmental equity and ultimately should increase human wellbeing and thus underpin societal stability. This benefits the political and financial elite, as well as the rest of society. Conversely, an unsuccessful regime will increase the risks of substantial societal disruption due to inequity, environmental degradation and ultimately unhappiness.

[7] Due credit to William Lake (then age 9) for reminding us of the fundamental importance of happiness!

To consider the areas in which policy support might be provided, we have considered the fundamental components of human needs, and how they impact societal outcomes[8]. We outline these below.

Figure 8: Human Needs and Societal Outcomes



To these could be added safety – ie effective rule of law and prevention of violence within any particular society, as well as the maintenance of military force to provide similar protection for the nation as a whole. For the present we have excluded this element, but anticipate addressing it during our second phase of work.

With this framework as a starting point, the second part of the equation is to identity which party will pay for each of the above items. In simple terms, there are only three possible ways in which this can occur:

- **Individuals (and certain types of mutually owned collective organisation)** take sole responsibility for their own income and wellbeing. They must generate income, whether by working for an employer, being self-employed as an individual or through working in some form of co-operative or mutual structure. Without a job, they must live off their savings, be supported by friends or relatives, or rely on some form of charity. This also includes the role played by not-for-profit foundations and other benevolent organisations that take on responsibility for caring for people. This is essentially the US approach, with a very limited social safety net;
- **Governments** provide a safety net or welfare state. Governments collect taxation revenues from individuals, companies and other organisations across society to pay for social security benefits, thus acting as an intermediary for wealth redistribution from the more affluent members of society to those who are less well off. This is the approach adopted in many EU countries, with a significant social safety net, including universal free or low-cost access to housing, education and healthcare; and
- **Companies (including non-profits)** take on broader responsibility for the welfare of their employees, whether in their role as employers or more broadly through the role they play in society. This approach was more common at a time when employees were guaranteed a job for life, though elements of this have become more usual once again in some segments, such as at the largest technology companies[9]. This approach has recently been proposed by Amazon, JP Morgan and Berkshire Hathaway in relation to the provision of healthcare for these companies' employees.

In practice, the modern welfare state in most countries combines these three elements, placing requirements on and raising revenues from both companies and individuals, to provide a social safety net. The new challenge is for political and corporate leaders to make the case that

[8] IE what Francis Fukuyama describes as "state capacity"
[9] Eg Google provides its employees with food, transport to and from work, onsite access to doctors etc

increasing polarisation of wealth is not in the longer-term interests of voters and shareholders (thought they may do very well in the near term), and to find politically and commercially acceptable ways to affect societal change in a manner that improves equality. This is a vexed set of issues, but the rapid acceleration of robotisation means that they must be tackled now. The greatest leaders of the 21st century will be those that resolve them.

2.2 Identifying a Complete Set of Policy Measures

The next step is to identify a complete set of policy measures that could be used to rebalance economic and social welfare across society. Given the nature of the problem, inevitably these measures must reduce the relative share of income and assets held by the richest in society and must increase the share of the poorest. They need not, however, result in absolute declines in wealth. Rather, measures could be designed to slow the rate of wealth accumulation by the richest, and thus engineer a slow but steady shift to a more equitable society, reducing the risk of societal disruption along the way.

In the first instance, we have considered these potential measures in the context of individual nations, as this is the most straightforward level at which action can be taken. However, some measures can be implemented effectively at a state or city level. Examples include increasing the minimum wage, access to affordable housing, and in some cases access to healthcare (where the health system operates at a state-based level, as in the USA).

To ensure nothing has been missed, we have sought to identify the broad *types* of measures that are possible, as well as the complete set of *stakeholders* who could in theory "pay for" the implementation of the measure in question. We have then considered ways in which each of these combinations could be applied to increasing average wellbeing. In doing so, it is helpful to consider how to tackle each of the main elements of the cost of living, distinguishing between measures paid for primarily by governments, companies (and other organisations), and individuals.

There are numerous measures which could be adopted – we have identified over 40 in the table below. Some of these are more temporary in nature, and thus are helpful to address the need for jobs in the near to medium term, or otherwise to smooth the transition to a workforce focused on creativity, culture, caring and communication. Others are longer term in nature, and thus can form part of a fundamental restructuring of each nation's social contract.

The first two rows ("Jobs" and "Safety net") include measures that are general in nature, and the following rows tackle more specific areas, such as access to affordable housing. The analysis builds on the solutions set out in *Reinventing Prosperity*[10] (the numbers in the table reference the solution numbers included in that book).

[10] *Reinventing Prosperity: Managing Economic Growth to Reduce Unemployment, Inequality and Climate Change* – Graeme Maxton and Professor Jorgen Randers, Greystone Books

Figure 9: Overview of Measures Segmented by Payer

	Governments	Organizations	Individuals
Jobs (income + happiness)	Shorter work year (1) Print money (6) Restrict trade (11) Build infrastructure Robotization in government	Greater unionization (10) Increase the minimum wage Tax robots (or link company tax to jobs)	National community service
+			
Safety net (social security)	Pay carers (3) Higher (4) social security Universal basic income (13)	Higher company tax rates (5) Green stimulus or tax fossil fuels (7) Tax resource use (8) Employment requirements	Higher individual tax rates (9) Employment co-ops Legislated insurances Smaller families (12)
=			
Housing	Deliver more social housing Enhanced urban efficiency/zoning	Corporate responsibility for housing	Tax on vacant or 2nd properties
+			
Sustenance (food, transport etc)	State-owned infrastructure	Road pricing (commercial vehicles) Corporate responsibility for transport	Means-tested user charges Transport cost-efficiency measures
+			
Healthcare	Universal healthcare	Corporate responsibility for welfare	Legislated health insurance Health cost price controls or regulation
+			
Education	Universal education	Legislated retraining Education levies	Education cost price controls or regulation
+			
Retirement /aged care	(2) Later retirement (4) Higher benefits New retirement living market structures	Greater employment of seniors	Legislated pension savings Retirement co-ops

In practice, a number of these measures may be grouped together. For example, several naturally come together under the notion of a "universal basic income", where every member of society is guaranteed sufficient income to afford a reasonable basic standard of living. In practice, elements of a universal basic income may be delivered by direct service provision, for example via universal no-charge access to education, healthcare, social housing and transport

infrastructure. We have drawn out the individual components as this helps to identify where other parties (such as companies) may be able to address part of the challenge directly.

The measures we have identified serve one of four broad purposes. These comprise:

- **Redistribution**: These are measures that directly redistribute income and/or wealth from the richer members of society to those who are less well off, or otherwise give poorer people better access to adequate employment opportunities;
- **Spending**: These are policy measures that provide broader and/or deeper social security support, whether directly paid for by government, or which are otherwise legislated to be paid directly by companies or other organisations or even individuals;
- **Taxation**: These are mechanisms that raise revenues (from richer members of society) or reduce outgoings for government (by reducing payments to richer members of society), to fund proposed spending measures; and
- **Efficiency**: Policies or initiatives that reduce the cost of living, thus reducing the amount of income individuals need to earn and improving the overall efficiency of the economy. The latter may include not only government initiatives, but also actions by companies that will generate economic returns for that company, but still reduce the cost of living (such as various forms of renewable energy), or similar investments by not for profit organisations.

In the table below, we have categorised the various measures in this way. In practice, some will span multiple categories, but for simplicity we have set down each measure in just one place.

Figure 10: Overview of Measures Segmented by Impact

	Redistribution	Taxation	Spending	Efficiency
Jobs (income + happiness)	Shorter work year (1) Greater unionization (10) Restrict trade (11) Increase the minimum wage	Tax robots (or link company tax to jobs) Print money (6)	Build infrastructure National community service	Robotization in government
Safety net (social security)	Employment requirements Employment co-ops	Higher company tax rates (5) Higher individual tax rates (9) Legislated insurances	Pay carers (3) Higher (4) social security Universal basic income (13)	Green stimulus or tax fossil fuels (7) Tax resource use (8) Smaller families (12)
Housing	Corporate responsibility for housing	Tax on vacant or 2nd properties	Deliver more social housing	Enhanced urban efficiency /zoning
Sustenance (food, transport etc)	Corporate responsibility for transport	Road pricing (commercial vehicles) Means-tested user charges for transport	State-owned infrastructure	Transport cost-efficiency measures
Healthcare	Corporate responsibility for healthcare	Legislated health insurance	Universal healthcare Universal childcare	Health cost price controls or regulation
Education	Legislated retraining requirements	Education levies	Universal education	Education cost price controls
Retirement /aged care	Greater employment of seniors	Later retirement (2) Legislated pension savings Retirement co-ops State ownership of the most profitable businesses	Higher retirement benefits (4)	New market structures to fund aged care and retirement

None of the above measures is perfect, and every individual item will have supporters and opponents. To address this challenge, our approach is designed to identify a *complete* set of

possible measures. There may be other variants on these policy responses that could be implemented, but our hope is that they are all essentially variants of the measures that we have identified. This way, we hope to focus political and other leaders on the choices for action that are available, with the only remaining option being not to act at all.

This last option is particularly unattractive in our view. **The risks to the incumbent economic and political elite are high, and failure to act will dramatically increase the risk of significant societal disruption and financial losses that would ensue.** All the measures are designed to reduce inequality, and hence to reduce the risk of societal revolution. Even a partial approach, where modest steps are taken, should be helpful, in that it should reduce the rate of polarisation of wealth, and hence reduce risk.

There is no silver bullet to address these challenges – in most countries, a combination of measures will be required, and will need to be applied over a sustained period of decades to have maximum beneficial effect. As with any long-term investment, the sooner you start to act, the more quickly the inexorable forces of compounding can start to accrue.

2.3 A Short-list of Recommended Policy Priorities

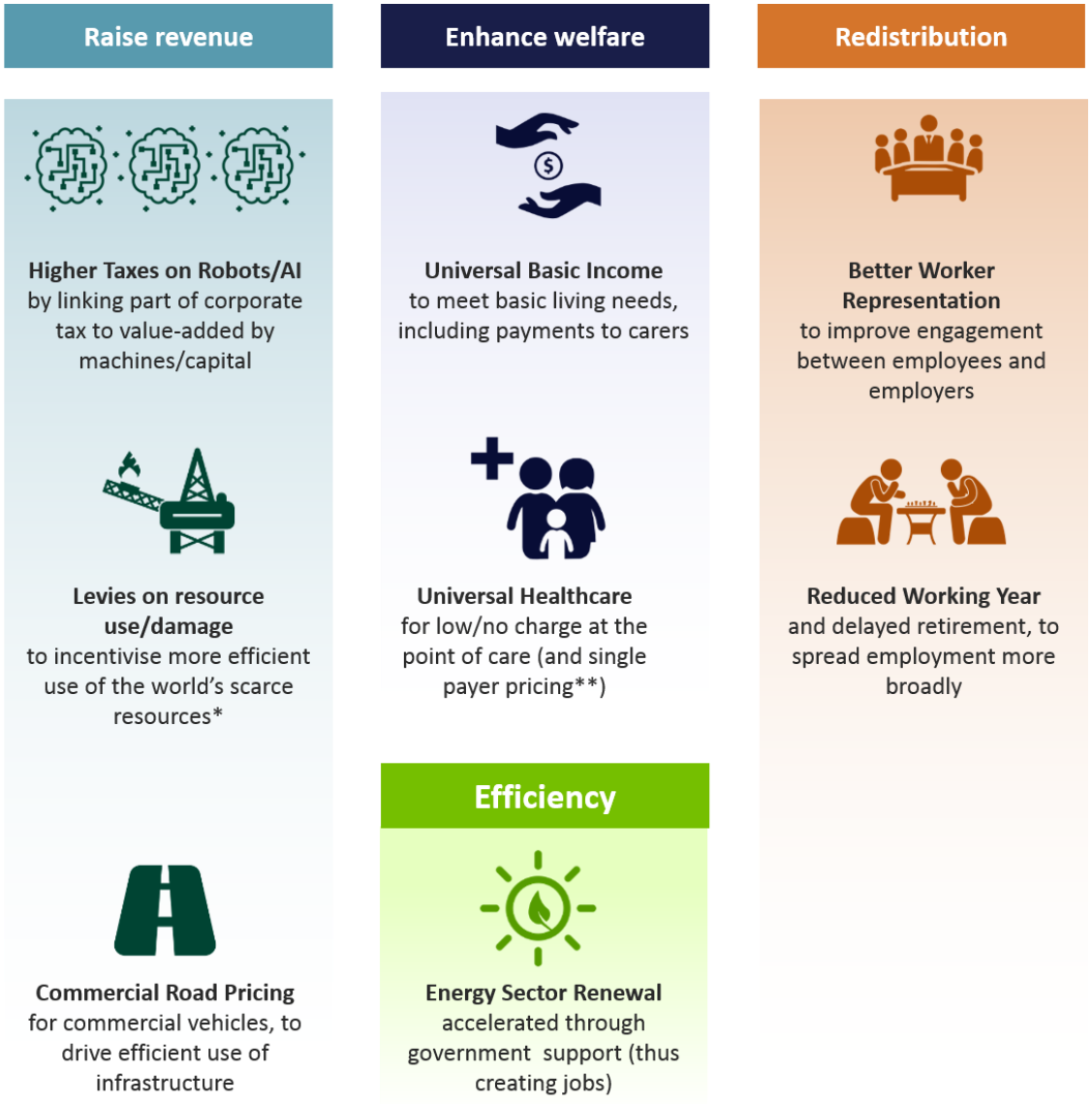
We have identified below the measures that we believe are likely to prove the most palatable across the political spectrum, and which we believe also offer realistic potential of having a meaningful impact. We have focused on measures that are particularly relevant to developed economies such as the USA and other countries where inequality is already high in historic terms. Our criteria for selecting measures include:

- **Impact**: The measures selected must have potential to have a material effect on the issues at hand, in order that they can drive a meaningful shift over the period of one to two decades;
- **Focus**: We have favoured policy levers that target core issues directly, in part because this creates a more direct and visible link between the problem and the solution, which will be helpful for communication purposes;
- **Fiscal prudence**: We have been mindful of the need for governments to balance budgets, and for the corporate sector to be able to continue to achieve growth in profits and dividends;
- **Practicality**: We believe there are ways to implement each of the proposed measures in a manner that is politically viable on both the left and right of politics;
- **Commercial appeal**: The measures create attractive commercial opportunities for the private sector to generate returns from assisting the proposed reshaping of the economy; and
- **Equity**: We have recommended measures that will, if implemented in the right manner, be demonstrably "fair" from most peoples' perspectives.

Any set of measures needs to be essentially self-funding – ie to generate enough revenue (through taxation or other measures) to pay for the proposed spending. In theory, this might be judged over the expected lifetime of the measures. Given the current pressure on government finances, it is likely that a shorter-term focus will be required, other than perhaps in relation to investment in long-term infrastructure.

Out of the comprehensive list of potential policy options outlined above, we identified eight of particular importance for early implementation. We emphasise that this is just one approach and that different countries (and indeed different companies) may favour a different emphasis.

Figure 11: Recommended Policy Priorities



*Including better environmental outcomes over the medium to long term
**IE national negotiation of pricing, similar to Australia's Pharmaceutical Benefits Scheme

These measures would have different impacts, as illustrated below.

Figure 12: Measures Recommended for Early Implementation

Measure | *Purpose →*	*Redistribute*	*Spending*	*Taxation*	*Efficiency*
Tax AI and robots, and other 'low employment' businesses, by linking company taxation to the value added per job. Implement incentives for companies that create new jobs	✓		✓	
Increase taxes on the use of natural resources and on environmental degradation, to raise revenue and incentivise more efficient resource use			✓	✓
Introduce **road pricing for commercial vehicles**, to incentivise more cost-efficient use of transport infrastructure, and to generate revenue to fund improvements to national infrastructure			✓	✓
Implement **a universal basic income**, to include payments to carers of any age	✓	✓		
Provide universal healthcare for no or a low charge at the point of care, combined with "single payer" negotiation on price for key elements of cost		✓		✓
Encourage more effective engagement between shareholders and employees, whether via greater unionisation or other measures	✓			✓
Shorten the working year and delay retirement, to spread employment more broadly, reduce the risks related to unfunded retirement costs, and increase quality of life through greater leisure time during a working career	✓			
Provide government support to renew the energy value chain, thus creating jobs and reducing the marginal cost of electricity (and reducing risks associated with climate change)		✓		✓

Collectively, these measures could potentially raise significant new tax revenues (primarily from companies that stand to gain the most from the ongoing Technology Revolution and the Robot Revolution), create employment opportunities (in infrastructure construction), incentivise the efficient use of infrastructure and the environment, and fund the payment of a universal basic income, including to those providing care to the young, sick and elderly. The last measure would also increase the proportion of caring activities captured by conventional measures of economic activity and growth.

2.4 Key Recommendation: Implement "Robot Value-added Taxes"

Of all these measures, we believe the single most important step is to introduce a new element of taxation linked to the increased use of artificial intelligence and robots. The fundamental objective in doing so is to create a feedback loop that rewards companies that provide higher levels of employment and thus reduce the burden on the welfare state. Thus, capital-intensive business that generate substantial profits, but employ very few people, would pay more tax than companies that generated similar profits but employed more people. In parallel, incentives may also be provided for companies that create new jobs – as already widely used by Federal, State and local governments around the world.

In developing such a system, it will be important to ensure that companies cannot defer payment of these taxes for long periods due to deductions from the depreciation of up front

capital investment. Accordingly, we anticipate that this measure would be implemented through some form of addition to existing sales or value-added taxes, to ensure that incentives operated and revenues were received by government from the outset. Furthermore, taxes should likely be levied in the jurisdiction where the goods or services in question are received, in order to distribute income across national borders.

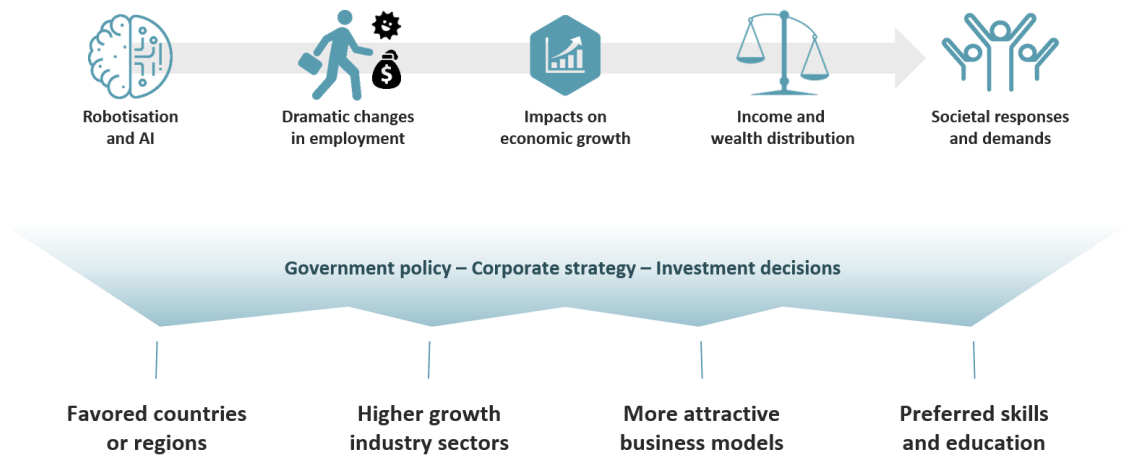
From the perspective of companies, there will be an additional incentive to use the benefits of robotisation (reduced costs, increased reliability) to add increased levels of service to their businesses. In other words, where robots can be used to replace human activity, that effort should be redirected towards creative, communication or customer-care activities, rather than simply being eliminated in a short-term cost reduction drive. Amongst other things, this approach may help to avoid a "race to the bottom", where companies maximise the use of robots to minimise costs and hence increase profits in the short term, but see their products and services commoditised over time through lack of customer service and/or innovation. As a result, this approach creates incentives for companies to focus on the longer-term benefits to their own businesses of creating more employment opportunities, rather than simply maximising short term profits by cutting costs.

Let us put this in context.

Robotisation will reshape numerous industries. For a start, automation of decision-making will allow dramatic further cost efficiencies to be achieved in the near term. Much of this can be achieved using existing technologies, and will by accelerated by any economic downturn that may emerge. Robotisation will increase service standards, but will also eliminate many jobs. So, there is significant short-term upside from a corporate performance perspective, but there are also substantial longer-term problems that must to be tackled head on.

Robots and artificial intelligence will also allow companies to become much more agile. This is because computerisation allows more complex problems to be tackled more rapidly, enabling greater granularity of analysis, more precise solutions, and more nuanced decision-making. As a result, companies that adopt these technologies will not simply be more competitive on price. They will also be able to adapt more quickly to changing market conditions and tailor new propositions much more rapidly. Those that innovate more effectively will be able to accelerate, and those that do not will be left behind. In this way, the corporate playing field will become even more tilted in favour of companies who lead through innovation than it is today. This will, in turn, have profound implications for corporate strategy, as illustrated below.

Figure 13: Implications for Corporate Strategy

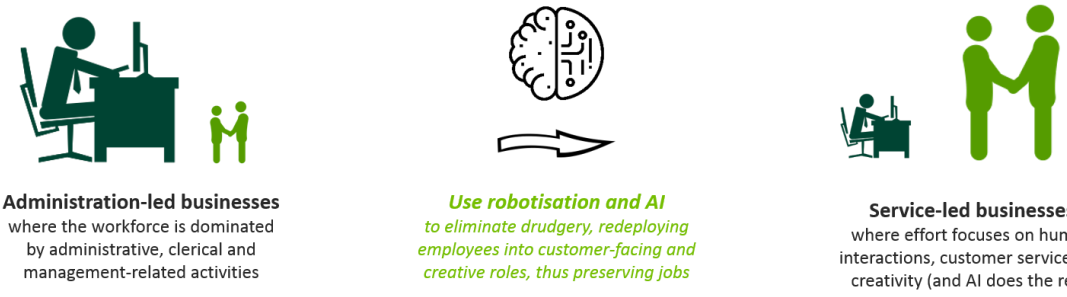


The first order implication for most companies is that they need to move early, or move out. Favouring the apparent conservative safety of a "late adopter" strategy is becoming riskier month by month. For those that are not convinced, we have already seen what can happen through the slow-motion decimation of the traditional media industry over the last twenty years. The incumbents had more than a decade to adapt to the social media revolution, but simply failed to do so. Many are still struggling to this day. Looking forward, the incumbents in industries impacted by AI will not have the luxury of a decade to reflect. We expect the findings of our Phase 2 work to show that the effects of robotisation will play out in double time, and that the stragglers will disappear in less than a decade.

Recognising the need to act is one thing, but identifying how and when to automate, what technologies to employ and which service providers to work with is another matter entirely. Companies will need to develop robotisation strategies that cut through the extensive hype that surrounds subjects such as artificial intelligence and data science. As a word of warning, the early stages of the Technology Revolution spawned corporate empires of technologists whose senior management did not really understand the importance of IT, and often failed to control spending. As the obsession with data, robotisation and AI grows in big business, there is every likelihood that the current generation of leaders will be bamboozled by the jargon.

In grappling with these opportunities and challenges, companies must also consider the wider social implications of automation carefully. They must identify how to create new employment opportunities, by shifting staff to new roles such as relationship development and customer care where human involvement will remain critical, rather than simply eliminating jobs outright.

Figure 14: Using Robotisation and AI to Humanise Business Products and Services



In short, companies must use robotisation to humanise their businesses, increasing person to person connectivity, rather than reducing or even eliminating it. Those that do not will run a growing risk of being cast as the villains of the piece, and subjected to new government taxes and levies, such as robot-value-added taxes, or higher rates of corporate tax on profits, to fund increasing social welfare costs. Measures of this nature have already been suggested by various commentators. Additionally, these issues highlight the potential benefit to companies of exploring ways to balance the interests of relevant stakeholders (including customers, employees and shareholders) more effectively, whether through greater worker representation, collective bargaining, board level representation or other measures.

Meanwhile, companies can reduce risk by taking a more proactive and longer-term approach to their use of natural resources, as well as to any negative impact that their activities have on the environment (ie environmental degradation). In some – or perhaps many – industries and countries, companies do not pay a full economic price for the resources that they utilise, nor do they pay a full economic charge for negative impacts on the environment.

The most pressing issue of this nature relates to emissions of carbon dioxide, and other greenhouse gases, and their impact on the world's climate. Despite the Paris Agreement on

climate change, emissions levels continue to increase, adding inexorably to the maximum temperatures that will be reached over the course of the next 100 to 200 years.

We believe it is likely that governments will increase taxes and levies on the use of natural resources and degradation of the environment, to fund other initiatives that are required to maintain a level of equality in society, or simply to fund existing budgetary shortfalls. As consumer attitudes shift slowly but progressively towards caring about environmental outcomes, these types of strategies become progressively more politically acceptable. Examples already exist, including carbon prices in around forty countries, resource rent taxes and similar mechanisms. These taxes need not, however, be particularly high – full adaptation of economies to address climate change problems can be achieved for something in the order of a few percent of national income.

By way of example, various industries entail significant remediation costs at the end of a particular project's life, such as nuclear power stations, mines and landfill operators. Typically, an allowance for these costs is made during the life of the asset in question, but discounted to allow both for time and associated risks (essentially a measure of the chance that the company will not survive long enough ever to have to meet these costs). The capital associated with such provisions is typically *not* segregated from the company's other assets. Where governments bear residual risks of this nature, they could logically levy duties on the companies concerned. Again, analogous measures have been introduced around the world, including bank deposit levies (to recognise the economic benefit of an implied government guarantee[11]) and terrorism insurance schemes (eg Pool Re in the UK, a collective owned by the insurance sector, and supported by government).

Ultimately, companies and industries that are more effective at managing this aspect of their interaction with society are more likely to be better regarded, and are arguably less likely to be exposed to punitive taxes or unexpected levies. Conversely, governments looking for new sources of funding to balance their budgets should feel justified in applying such taxes. And, as voters become progressively more supportive of environmental and social sustainability, market pressures will grow on property lessors to address these challenges.

Care will be required in designing and implementing any given measure (or set of measures) to ensure that potential feedback effects are accounted for, and that the measures incentivise the right outcomes over the longer term. In contrast, any temptation to focus on short run effects may lead to sub-optimal choices being made. This problem is accentuated by traditional decision-making techniques (especially discounted cash flow valuations), as these over-emphasises short run outcomes and ignore both upside benefits and downside risks that will emerge over longer timeframes. Ultimately, the economic rules that are set will define the game that corporations play. Changing the rules is exceptionally difficult, highlighting the importance of choosing the right set of policy measures at the outset.

2.5 The Importance of Incentivising Job Creation

Above all, governments must recognise that companies will need incentives to focus on long term job creation, rather than short term profitability. The simplest way to do this is for governments to provide money-backed demand for goods (eg public transport infrastructure) and services (eg general health care) that will increase the wellbeing of the citizens. This demand can be financed through taxes or through deficit spending.

[11] Recently implemented in Australia by the Liberal (right wing) government

Over the longer term, this will help to drive growth and maximise profitability and value creation. It will also reduce the burden on the welfare state. This is important because companies operating in truly "free market" economies have a propensity to sacrifice longer term results for near term profits. In addition, competitors may band together to achieve greater market power, reducing the benefits of competition. In short, "letting the market decide" does not always result in the optimal outcome for society. There are some simple reasons for this:

- First, **the voices of the status quo are typically louder**, better organised, and much better funded than those who (for example) are calling for more competitive markets, or innovation and change for that matter. The incumbents can and do exert influence and market power to their own advantage, slowing regulatory change, sowing seeds of doubt about those who oppose them[12], and even actively misleading consumers. This makes it harder to build the *case* for action;
- Second, **industry structures can themselves create barriers to change**. This happens where the benefits of technological or other improvements accrue to one party, but the capital investment is the responsibility of another[13]. This inhibits action, as there may be little financial incentive to act for the party that needs to make the required investment. Worse, where large amounts of capital have been sunk into technologies or business models that are becoming outdated, investors will fight tooth and nail to extend the lives of their businesses for as long as possible, so that they can get at least some of their capital back. This makes it harder to *act*; and
- Third, **current decision-making frameworks place a very strong emphasis on short run results** and are actively biased against choices that require greater effort and investment up front, to achieve a better long run outcome[14]. As a result, investments are geared to the short term, frequently leading to progressively worse outcomes over time. Meanwhile, incentives in both business and government are typically focused on short term results – crystallising a bonus based on this year's profits or short-term share price appreciation or winning the next election, for example. This makes it harder to *persuade* stakeholders that it is in their near-term interest to implement the necessary policies or strategies.

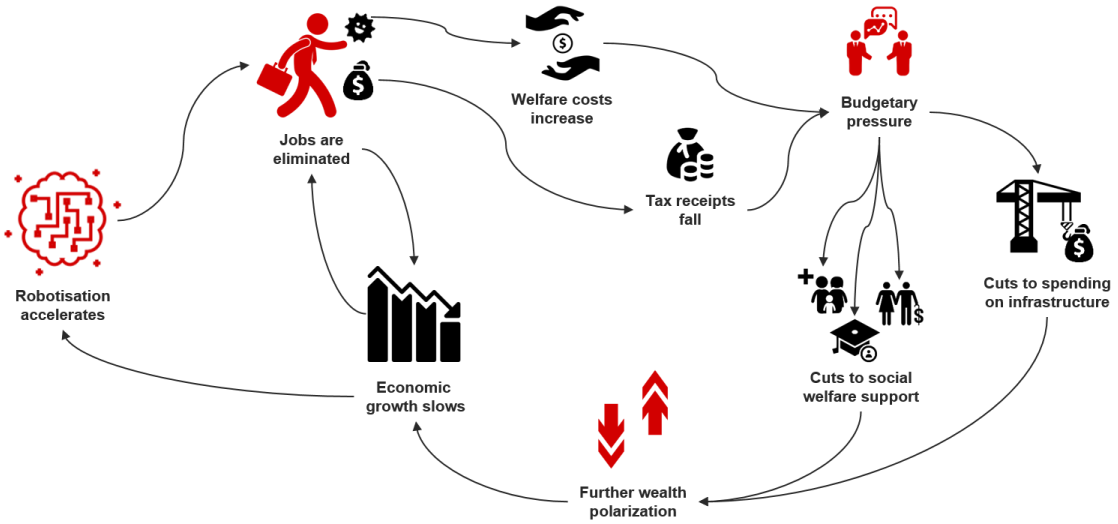
Together, these factors create a huge inertia that favours doing nothing over long (multi-decadal) time periods. We have a burning platform, but few people have noticed the smoke. Thus the proposed robot value-added tax creates an important incentive for companies to behave in a manner that will deliver better results over the medium to long term.

[12] There are many examples, eg opposition by the tobacco industry to the idea that smoking caused cancer

[13] EG energy efficient fridges, where the cost was born by manufacturers, but the cost savings from lower power consumption accrued to customers, resolved by the EU introducing industry-wide labelling

[14] Discounted cash flow models add a premium to allow for "risk", which has the mathematical impact of largely ignoring longer run upsides and risks. Option valuation techniques do not do this, instead addressing risk and uncertainty explicitly and directly. See Nigel Lake's paper on Accidental Time Bias in decision-making.

Figure 15: Risks to Government of Ignoring the Risks of Robotisation and Automation



Importantly, governments can also increase their own efficiency and reduce their costs through effective use of automation – in other words, all the lessons that are relevant to companies apply equally to the public sector. Again, there will be important opportunities to use efficiency gains to improve service and increase human interactions, rather than simply to eliminate cost. Given the inherent and heightened sensitives around "cost-cutting" in the public sector, a watertight communication strategy around any such changes is vital.

Despite budgetary pressures, many governments and countries also have a pressing need to repair or replace aging infrastructure. Whether it is crumbling bridges, decrepit airports and hospitals, or over-stretched transport systems, this investment is critical to ensure economic competitiveness. This infrastructure is also essential to help constrain increases in the cost of living. But, with budgetary pressure on governments growing year by year, paying this investment entirely out of general public-sector tax revenues will become increasingly difficult.

To address these funding gaps, governments will need to cut services, and/or cut capital investment, and/or increase taxes. As a short-term measure, governments can take on additional borrowing, but the associated debt will still need to be serviced, and this borrowing simply spreads the funding gap out over time, in part by shifting it on to future generations. With national debts growing in many countries, borrowing from the future to pay for the present is becoming progressively less viable.

As noted above, potential funding sources include taxes on robots (or higher taxes on capital intensive businesses), as well as new or increased charges for use of natural resources and environmental degradation. These issues also highlight, however, the importance of ensuring that the right economic signals are in place to drive efficient use of existing infrastructure.

One important area for governments to consider in this regard is road pricing, especially for heavy commercial vehicles (as these have a much greater impact on wear and tear than passenger cars). This is used selectively in various countries[15], generating significant revenue in addition to commonly applied petrol taxes. Road pricing for commercial users can also provide a level playing field between on-road transport (where infrastructure costs are typically paid for

[15] Distance based charges implemented in New Zealand (RUC), Switzerland (LSVA), Germany (LKW-Maut), Austria (Go-Maut), Czech Republic, Slovakia, Poland, and four US states (Oregon, New York, Kentucky and New Mexico)

by taxpayers, rather than directly by users[16]) and other infrastructure (where costs are met directly by the user), thus encouraging more efficient use of infrastructure. This approach need not be limited to commercial vehicles – passenger car journeys could also be taxed, with a number of kilometres of "free" driving allowed per year to help the poor.

Over the longer term, the shift to electric vehicles for consumer transport that is currently under way will significantly reduce governments' income from petrol duties, implying that a shift to some form of direct distance-based charging[17] for consumers may be appropriate in due course.

Road pricing alone cannot fund the investment required in transport infrastructure, which emphasises the importance of leveraging private sector expertise to minimise the cost of new infrastructure. Given that a political majority opposes material increases in state borrowing to pay for infrastructure investment, this implies that new funding models must be developed that concentrate the burden of paying for this infrastructure onto stakeholders who can better afford it. Once again, we must recognise that this requires an element of wealth redistribution to maintain overall economic and social stability, rather than a pure "user-pays" approach[18].

As a further specific example, the shift to renewable energy, originally due to concerns related to climate change, and increasingly now driven by attractive economics, will drive a substantial reshaping of the entire energy value chain. This will require at least five to ten trillion dollars of investment globally and, in many countries, will result in lower energy costs than today, as well as marginal energy costs that are very close to zero. This has potentially attractive implications for society, including contributing to a real reduction in one element of the cost of living. It is thus potentially attractive for governments to take pro-active steps to incentivise the shift to renewable energy, to accelerate the benefits, whilst creating a significant number of jobs in the meantime. For example, a US Department of Energy study released in 2017 identified 374,000 people employed in the solar industry, double the 187,117 workers employed at coal, oil, and natural gas power plants.

2.6 Sharing Economic Benefits Via Alternative Ownership Structures

In most Western economies, a significant majority of economic activity is undertaken through companies, ie corporate entities that are owned by shareholders. Ownership of the means of production is thus separated from the provision of labour. As an increasing proportion of economic output is accounted for by capital investment (rather than labour), these structures further concentrate wealth in the hands of investors. As context, remember that in the rich world, less than 20% of wage earners work in goods production.

It is logical, therefore, to consider other ownership models which may be useful in addressing the concentration of wealth. None of these corporate structures are new – all have been in existence for hundreds of years, and are common in sectors such as banking, insurance and investments, where there is a natural benefit to customers or industry partners sharing costs, assets or risks. They thus represent an alternative to productive assets being state-owned (which would thus ensure that the economic benefits of operating individual businesses operated for the benefit of society as a whole.

[16] We note that where toll road operators charge commercial vehicles a higher rate than vehicles, this is rarely commensurate with the wear and tear costs on the road

[17] Rather than fuel levies, which are an indirect distance based charge, impacted also by the efficiency of the vehicle, type of fuel consumed, and available subsidies (eg for industrial and/or agricultural use)

[18] See Pottinger's December 2013 submission to the Australian Productivity Commission *Building Australia: New Models for financing infrastructure*

Just as many governments have focused on expanding home ownership, as a way of building wealth for many in society, looking forward it is logical to seek out new ways to expand ownership of robots, as these become progressively more responsible for all production. We comment on three common structures below.

Mutual organisations

Mutual organisations are owned by their customers, thus aligning the interests of the organisation's owners with the individuals who the organisation serves. Typically, these organisations have been banks (including savings and loans companies in the USA and building societies in the UK), insurers (including roadside assistance providers[19]) and investment companies.

In our own experience, these ownership structures have typically created a longer-term mind-set on the part of management, and a stronger focus on the needs of the customer, or member, who is also the ultimate owner. The primary challenge for these entities is access to capital to support growth, as typically this must be internally generated. This is particularly problematic in financial services, where there are legislated capital adequacy requirements, creating a significant barrier to entry. Meanwhile, returns on capital have typically been relatively modest, making it challenging for mutuals to generate sufficient capital internally to enable growth. These companies rely heavily on organic growth to achieve scale, as capital structures and lack of access to third party capital make acquiring (non-mutual) competitors challenging. As a result, many large companies have demutualised[20], but some significant companies remain, including Mutual of Omaha and Vanguard in the USA, and most motor clubs globally.

Co-operatives

Co-operative organisations are very similar in nature, typically existing to pool capital resources and associated infrastructure between end-users such as farmers. They have been common in the agricultural sector, providing a mechanism for growers to have an economic stake in and control of processing and refining plants. Given the symbiosis between growers and processors – who are often each entirely reliant on the other, shared ownership provides a very logical alignment of interests. Once again, we have seen these structures prove highly effective in encouraging strategic and investment decisions that align well with the long-term interests of customers. Access to third party capital remains challenging, however, and this can lead to financial stress through taking on too much debt, or the pressure to sell-down equity to outside shareholders to finance large capital investments.

Partnerships

Many professional services organisations have grown up utilising partnership structures, whereby experienced employees become part-owners of the organisation, and progressively share in the profits that it generates. This includes law firms, accounting practices and management consultants, as well as some investment management firms[21] and engineering consulting businesses. These structures create long-term incentives for senior employees to remain with the business, and the most successful have evolved into some of the largest

[19] IE motor clubs such as the AAA in the USA, AA in the UK (now privatised), NRMA in Australia and similar organisations in many countries

[20] Such as Prudential Insurance Company of America, Metropolitan Life Insurance Company and Washington Mutual, as well as most larger building societies in the UK and similar organisations in other countries.

[21] Particularly venture capital firms and hedge funds

employers in the world. There are, however, several drawbacks, including lack of access to third party capital, as well as complexities associated with managing international partnerships[22].

Despite these challenges, each of these structures creates a closer alignment between the interests of owners on the one hand, and employees and/or end customers on the other. They may thus provide useful precedents as we explore mechanisms to address the various challenges associated with increasing robotisation.

One near term application of these structures relates to the replacement of what are typically owner-operated heavy truck haulage fleets. The shift to driverless trucks will, quite likely, mean that haulage fleets are owned by large corporate entities, increasing overall industrial efficiency, but eliminating virtually all the associated jobs. In the USA, there are currently some 3.5 million professional truck drivers, ie elimination of these jobs would increase unemployment by over half. As an alternative, if truck drivers converted their ownership of conventional vehicles to driverless vehicles, they could continue to earn income, whilst simultaneously having spare capacity to undertake other potentially remunerative roles.

Ultimately, the quaternary sector is unlikely to be very capital intensive. And this is where most people will work. Thus the art is to take (much of) the profit from those few who work in capital intensive (ie highly productive, robotised) sectors and transfer it to those who work in other sectors, or who have no work at all.

[22] Many partnerships still operate separate legal structures in each country, or even individual jurisdictions within countries, creating significant complexity in relation to management structures, governance and investment

3. Key Focus Areas for Phase 2

Early responses to our work – from governments, large enterprises and ultra-high net worth individuals – have been positive and supportive. A copy of our "long paper" on which this discussion document was based is available separately to companies and governments who are supporting our Future of Society programme.

Looking ahead, complete quantification of the effects of any proposed set of measures will require further, more detailed analysis. This will include quantification of the rate at which existing jobs are likely to be consumed due to mechanisation, the rate at which new roles will be created, and the anticipated effects on wages, economic output and inequity. This analysis will also need to address changes in the anticipated cost of living and to quantify the potential cost of a mechanism such as a universal basic income.

The second phase of our work is ongoing and we anticipate completing the following during 2018:

- **Further develop and refine the proposed response options**. This will include investigating further the historic rate of transition of jobs to the quaternary sector[23], as well as assembling empirical data on the change in value added per employee in the sectors that have been hardest hit (eg financial institutions and certain types of manufacturing);
- Utilise the "Earth3+" or "Earth4" model to **complete the quantitative analysis** referred to above;
- Complete our **assessment of the viability of proposed responses**, with a particular focus on the political challenges within different political environments (eg the EU, USA, China etc); and
- Reach **a definitive view on the recommended responses** for governments, companies and individuals (including drawing out specific recommendations for ultra-high net worth individuals). This will include further research into the economic effects of prior revolutions on major economies, as well as considering in more detail the factors that will impact corporate decision-making, and hence potential triggers for or catalysts of rapid robotisation;
- **Engage further with relevant stakeholders**, as we seek to catalyse action by those who are best placed to effect the required changes.

In parallel, Professor Randers has made significant progress in developing the "Earth3+" model, as well as identifying the range of issues that need to be addressed for the model to provide a realistic view of future economic development. Once complete, this will enable us to finalise our planned quantitative analysis, a key aspect of the second phase of our project.

We anticipate producing a variety of outputs from our combined work targeted primarily at government, private sector and ultra-high net worth stakeholders.

[23] IE splitting the traditional tertiary sector of the economy into two, creating a quaternary sector consisting of caring, creative, cultural and other roles that necessitate a human element from others that do not and hence can more readily be automated

4. Where Does This Leave Us?

Robotisation will have profound effects, eliminating many service sector jobs and driving a shift to the quaternary caring and creative sector. There is no evidence to suggest that new jobs will be created more rapidly than machines replace existing jobs. Indeed, the evidence from previous revolutions is to the contrary. Individuals will still need to work, so existing downward pressure on wages will continue. This will translate into declining participation in the labour market and weak growth in total wages, and hence declining demand.

As a result, without intervention, there will be significant further polarisation of wealth. This will lead to increased social tension, and increased risk for all of society, including the owners of capital and leaders in government.

Robotisation may lead to economic growth, but the benefits will flow to very few people in society. Wealth will not really be created, but rather will be accumulated in hands of the few. Elite individuals and countries will see significant "wealth creation", but most of society will not.

Worse, the next economic downturn may create a confluence of economic contraction, government indebtedness and fiscal overload greater than has been seen before. The last financial crisis was triggered by overleveraging of the world's financial system, and as a result played out in financial markets at breakneck speed. In contrast, without pre-emptive action, the next crisis may be a low speed, high momentum economic train wreck that leads to much greater, much more long-lasting economic and societal pain.

Ultimately, we believe that growth is likely to decline, and returns to shrink. The societal and economic risks are too great to leave these outcomes to chance, let alone to the whims of individual companies or governments. Shooting in the economic dark, armed only with hope and hubris, will at best replicate the outcomes from previous revolutions.

So we need to act now.

5. List of figures

List of figures

Figure 1: Major Technological Revolutions: 1650 to Date 3
Figure 2: Smoothed Growth in Total UK GDP (25 year compound annual growth rate) 4
Figure 3: Smoothed Growth in UK GDP per head (25 year compound annual growth rate) 5
Figure 4: Real Average Household Incomes in the USA by Quintile 6
Figure 5: Concentration of Wealth – Larger Developed Countries 6
Figure 6: From Robots to Revolution 7
Figure 7: The Four Sectors of the Economy 9
Figure 8: Human Needs and Societal Outcomes 10
Figure 9: Overview of Measures Segmented by Payer 12
Figure 10: Overview of Measures Segmented by Impact 14
Figure 11: Recommended Policy Priorities 16
Figure 12: Measures Recommended for Early Implementation 17
Figure 13: Implications for Corporate Strategy 18
Figure 14: Using Robotisation and AI to Humanise Business Products and Services 19
Figure 15: Risks to Government of Ignoring the Risks of Robotisation and Automation 22