Do robots dream of paying taxes?

The digital transition should be taxed alongside other societal transitions. Rebecca Christie argues that any tax on companies should be targeted and carefully designed to not stifle innovation

Executive summary

Robot taxes embody the more futuristic challenges of managing automation and legacy workers. As machines and artificial intelligence take on more roles that used to be performed by humans, policymakers and technologists are assessing the costs this transition imposes and what parts of society will pay them.

A robot tax on companies that replace employees with automated systems is easy to dismiss in its most simplistic forms but should be considered in the context of managing the next industrial revolution.

A robot tax is a political construction, a way to shape democratic debate around technological shifts and societal needs. It is a construct of the public debate, and as such can contribute to broader discussions about how to make sure profitable companies pay their way in the economy. The political capital of 'replacement robot' imagery may be useful in designing a tax framework for legacy firms making the most of new economic opportunities.

It is best to consider a 'robot tax' as a rallying concept for targeted levies. These policies should target finance and other data-driven sectors as well as traditional manufacturing and mining automation. Policymakers should consider overall employment, specific job losses and how to assess firms that make layoffs in specific areas of their workforces.

This last will be especially difficult in cases where total headcount rises, even though some generations of employees may be put out of work. Tax policy can compensate for distortions due to shifts from human-driven to capital-intensive production in specific sectors.

On the revenue side, there should be appropriate expectations of what a tech tax can raise and over what period, on the scale of targeted retirement assistance or retraining programmes with measurable outcomes, not long-

running cash cows. Smaller and more innovative firms should not be asked to contribute disproportionately, particularly in legacy markets that are hard to break into, and they should be eligible for waivers and exemptions.

Policymakers should stress that asking producers to help pay the costs of societal change is not immediately equivalent to stifling innovation, and they should make every effort to design policies in ways that protect against this type of side effect.

Finally, any new tax on employers needs to fit with broader discussions of the corporate fair share, and with taxing the most profitable parts of the economy instead of relying on workers and consumers to foot society's bills.

Fair taxation should be the starting point when considering whether to tax companies on their transitions from human to machine-assisted workforces

Welcome to the future

The 1982 movie *Blade Runner*, set in 2019, asked if robots have true emotions. By the actual year 2019, a more relevant question was should they be taxed. The vast technological advances of the late twentieth and early twenty-first centuries had given way to an economy that was more automated than ever, leading top industrialists and policymakers to wonder not whether robots could feel, but whether they should help with government funding.

Microsoft founder turned philanthropist Bill Gates raised the issue in 2017, kicking off serious discussions in areas where the idea had previously lain dormant. The concept had instant appeal for Silicon Valley progressives, who sought technological revolution and also backed a universal basic income.

The plan went something like this: 1) build robots to replace workers, 2) have the government pay former workers enough to live on, 3) tax robots to pay for the benefits, 4) societal profit.

If only the robots were *Blade Runner*-style humanoids, it might have been doable. But in practice, the idea is much more complicated. Human workers are not being replaced by lookalike machines. In some cases, robotic manufacturing has led to human layoffs, but in others the transition has created more jobs to build and program the advanced technologies. It is not a one in, one out exchange of headcount.

Nonetheless, the broader concept of increasing taxes on capital to offset falling revenues from labour is worth revisiting. Specific taxes on capital improvements that make it possible to cut workers are one way to preserve revenue from companies that are increasing their profits while paying fewer employer-related taxes.

Tax policy is social policy. Just as tax policymakers have redoubled efforts to prevent profit shifting to low-tax jurisdictions, it is also worth considering how big firms take advantage of the difference between how workers and capital improvements are levied.

In this context, 'robot' needs to be defined carefully. Plenty of labour-saving machinery has made its way into our daily lives without triggering mass unemployment. Even when machines have arguably made human labour redundant, it does not automatically make sense to dub that technology job-stealing when the labour it replaced was often underpaid and exploited.

For example, a robotic-arm drink vending machine is probably not the kind of robot that should be taxed on the basis that it generates massive shifts in the workforce, even if it did put a drink-seller out of a job. Nor should households pay a 'layoff tax' for buying a washing machine instead of hiring – or exploiting – servants to do laundry in a washtub, as they would have in prior generations.

Rather, policymakers will want to look at types of automation that take over manufacturing jobs and at artificial intelligence (AI) applications that cut back on human review of complex information.

Given that automation and AI improvements often increase overall employment over time, policymakers should not try to discourage such shifts. The goal is to identify sectors where a shift to automation changes the composition of the workforce, not to ban various machines in order to reinforce exploitive labour practices.

Any new tax needs to be scaled so that profitable companies will pay it, rather than see it as an incentive to reduce technological improvements to avoid the levies.

The International Federation of Robotics defines industrial robots as *"automatically controlled, reprogrammable multipurpose manipulators that are programmable in order to move in three or more axes,"*[1] and research on industrial automation has focused on these types of machines and the industries in which they are used.

For the purposes of displacement taxation, however, it may be useful to think more widely. Particularly with the rise of AI, workers may be pushed aside as much because a computer program is taking over their assignments as substituting for them on the factory floor. Financial services and other data-driven sectors may be as much in the crosshairs as car making.

In deciding what is a 'robot', compared to assistive technology or another kind of capital improvement, it is probably worth a measure of anthropomorphism. Early iterations of robotics policy focused on humanoid machines performing recognisable mechanical tasks. Modern forms of robotics will likely include computer brains that perform familiar groupings of analytical and communicative tasks.

Using this framing, a searchable database would not be a robot; but a neural network that used multiple data sets and screening questions to screen a mortgage application might well be. Virtual help desks, virtual loan officers and virtual insurance claims adjusters could thus fit alongside the more tangible familiarity of a mechanical autoworker, even if these humanoid systems only exist in the digital cloud.

Virtual personal assistants, self-driving cars and medical care are some examples of the sectors in which AI is a reality, and in which automated help is taking on roles that were played by humans in decades past. These changes can make our lives easier and also could help tackle longer-term challenges including climate change and cybersecurity (European Commission, 2021).

The AI transformation is rightfully getting more attention in the European Union, boosted by the European Commission's 2021 strategy on how to manage the associated benefits and challenges (European Commission, 2021). It is a plan that seeks to foster innovation and healthy competition balanced by social considerations, in keeping with Europe's longstanding prioritisation of citizens' rights.

The overarching goals are to place the EU at the forefront of technological developments, encourage the uptake of AI by the public and private sectors, prepare for socio-economic changes brought about by AI and ensure an appropriate ethical and legal framework.

The question of an ethical framework is as important for assessing the impact of related economic change as the more straightforward questions of growth and investment. One key safeguard has been to focus on maintaining human oversight of functions that are increasingly turned over to AI networks.

This makes determining the impact on the labour force more difficult. In particular, if net employment increases, has automation created or cost jobs? More likely it has just shifted worker demand.

This rearrangement, rather than replacement, is likely to continue to be the dominant employment trend and tax plans need to be envisioned accordingly. Serious consideration of a robot tax requires acceptance that labour-force shifts will need to be viewed at a more granular level than just assessing whether net employment has gone up or down.

Otherwise, empirical analysis can conclude that unemployment is actually lower in regions that have seen the greatest deployment of robots and information and communications technologies: *"In other words, the robot tax might be a response to a problem that is not real."* (Petropoulos *et al* 2019).

In looking for ways to design a new tax constructively, it is best to consider 'robot tax' as a rallying concept, while looking for temporary and targeted ways to impose levies and make use of those revenues. Policymakers will need to consider overall employment trends, specific job losses and how to help classes of workers who have been laid off due to technological shifts.

This last will be especially difficult in cases in which a firm's total headcount rises, even as it indisputably puts a generation of employees out of work.

In terms of revenues, it is worth considering what scale of money-raising such a tax can be expected to generate. Any new tax finds its proceeds spent five times over before stakeholders have even finished reading the first blueprints.

The robot tax itself was the brainchild not of economists or budget managers but of Silicon Valley would-be visionaries looking for a way to have robots and a civilized society too – hence their dreams that a machine tax could substitute for payroll taxes in bankrolling civil society.

On a practical level, this level of societal subsidy is unrealistic. Rather, policymakers should seek levies on a scale that could pay for targeted retirement assistance or retraining programmes, most likely over a short- to medium-term horizon. Any discussions of a new tax also need to align with overall efforts to tax the parts of the economy with big money instead of relying on ordinary workers and consumers to foot society's bills.

Productivity and globalisation

Increasing productivity, widely regarded as a key pillar of economic prosperity, generally means that companies are able to produce more while using fewer employees. On top of that, the economic shakeup necessitated by

the COVID-19 pandemic has accelerate the move to online and digitally-assisted spaces, as in-person gatherings became impossible due to the need to limit the spread of disease.

An ad-hoc European Central Bank survey of 72 non-financial companies (ECB, 2021) found that 90 percent of firms increased their use of automation and other digital services during the lockdowns. 'Hardly any' recipients expected productivity to decline as a result of the pandemic, and most respondents expected it to increase in the long run. Meanwhile, more than half expected a negative long-term impact on employment (Maqui and Morris, 2021).

We therefore can anticipate that a growing number of people who used to have jobs will not have them anymore, as the economy shifts. Even if the total workforce stays the same or grows – Dixon *et al* (2020) and Koch *et al* (2019) showed net employment increases in some sectors that have adopted more robotics technology – there will still be a population of displaced workers who will need assistance, in the form of retraining or early retirement or other support.

This suggests that companies that turn to automation where they previously turned to human workers should be asked to recalibrate the kinds of taxes they pay to make sure they contribute fairly.

Fair taxation, then, should be the starting point when considering whether to tax companies specifically on their transition from human to machine-assisted workforces. This fits into the broader narrative of how to make sure multinational companies pay their share in the countries where they do business, rather than shifting profits to countries where they can get a better deal from the tax authorities.

It also reflects a new focus on total tax bills that is superseding recent efforts to tax the digital economy specifically (Christie, 2021a, 2021b).

Globally, corporate taxation is on the cusp of a historic breakthrough: 139 countries are deliberating at the Organisation for Economic Cooperation and Development on a 15 percent global minimum tax on corporate profits, accompanied by a new framework for allocating profits in accordance with business activity.

The OECD talks aim to set a floor on corporate tax rates, anchored by mechanisms that will allow participating countries to directly collect 'missing' taxes if a company still manages to pay below the global rate in other jurisdictions.

By July 2021, all but nine of the negotiating jurisdictions had agreed on the 15 percent rate, and the talks were expected to conclude in late 2021 once technical details and a corresponding agreement on profit shifting protocols have been worked out[2]. It remains to be seen whether the deal can close on time, even after 2021's remarkable progress.

Any move to tax automation will therefore need to work with, not at cross purposes to, the OECD framework. While a robot tax is not a specifically digital tax, any new offering will need to mesh with existing digital services taxes that aim to wring more government revenue out of companies like the big American technology giants, whose platform-oriented business lines do not generate profits along traditional lines.

France, the United Kingdom, India and Nigeria are among the countries that have, at time of writing, implemented some kind of digital tax[3]. Importantly, many of these taxes target companies whose business lines are highly dependent on data.

This is a different approach than looking to companies whose production models focus on automated work rather than human labour. There is, however, some overlap, especially when it comes to follow-on policy effects.

Many of the cross-border proposals under discussion, including at the OECD and within the European Union, use a 'formulary apportionment' model that looks at a company's total gross revenues, then allocates them to the countries where that company does business, so the countries can levy taxes accordingly.

In some cases, the formulas are calculated using customer counts. But other proposals look at considerations like employment numbers, and that, in turn, could accelerate the switch from human workers to machines. For example, *"profit allocation connected to employee numbers may unintentionally strengthen the lure of mine automation and reduce local mine employment levels"* in countries dependent on extractive industries (Baunsgaard and Devlin, 2021).

Whose jobs are going away?

Bottone (2018) looked at the possible design and follow-on effects of a robot tax, starting from the premise that if robots have a high elasticity of substitution with labour, tax revenue would be expected to fall because a significant portion of tax revenue has historically come from labour taxes.

Her paper also tackled the definition of AI, which may lead to a new kind of technological transition because of its potential to reproduce human cognitive capabilities. As she noted, it is difficult to assess what role AI is playing in the economy because of the way it diffuses into a wide range of activities.

In a survey of nearly 1,900 technology experts, Pew Research Center (Smith and Anderson, 2014) found an almost even split on whether the coming AI transformation would help or hurt the workforce by 2025. Slightly less than half envisioned mass job displacement for blue- and white-collar workers, followed by potential breakdowns in the social order.

A slim majority, however, predicted that technology would not displace more jobs than it creates. This group had *"faith that human ingenuity will create new jobs, industries, and ways to make a living, just as it has been doing since the dawn of the Industrial Revolution"* (Smith and Anderson, 2014).

Muro *et al* (2019) predicted uneven shifts in employment trends depending on geography, industrial sector and demographics. In a detailed report on automation's coming impact, they noted a cycle of fear and reassurance that has given way to *"a more complicated under- standing, suggesting that automation will bring neither apocalypse nor utopia, but instead both benefits and stress alike. Such is the ambiguous and sometimes disembodied nature of the 'future of work' discussion."*

In thinking about the particulars of a robot tax, Bottone (2018) started from the premise that robots progressively substitute labour and policymakers will have to face massive unemployment, falling tax revenues and a subsequent lack of resources to handle the challenges that follow.

This type of analysis is both common and problematic. At the top level, new technologies have tended to create more new jobs than they erase. Deloitte (2017) and Jensen and Koch (2015, also for Deloitte) found that for the UK and Switzerland, job gains had more than made up for the specific posts lost.

In Britain, for example, a broad shift from low-skill, routine jobs to higher-skill, non-routine occupations took away 800,000 positions and also added 3.5 million new ones. The picture in Switzerland was a little more mixed – the study estimated that nearly half of current jobs could be subject to replacement by automation in coming years, yet it also found that employment on the whole was rising.

Jobs were shifting from low-skilled jobs likely to be replaced to high-skilled positions requiring creativity, social interaction and customer service, where it seemed unlikely machines could take over. According to Jensen and Koch (2015), *"more jobs have been created in the past 25 years than have been lost. Therefore it is reasonable to expect that automation will continue to offer more opportunities in the future."*

Theoretical models back up these assessments. Autor et al (2003) found that computer capital both substitutes for workers and complements them. As a result, demand for college-educated labour increases to take advantage of the new opportunities that come from handing off old tasks to computers and making room for humans to use this to best advantage.

Later research shows how this is bearing fruit: Acemoglu and Restrepo (2018a, 2018b) derived specific predictions and insights about the different impacts of automation, using a task-based approach. They found some negative displacement effects as well as a transfer of tasks.

In a separate paper (Acemoglu and Restrepo, 2017), they found that automation makes production processes more capital intensive, increasing productivity more than wages and thus reducing labour's share of national income.

Bottone herself defined 'robots' more broadly than the official definition for factory-floor machines, considering personal-service robots and speciality machines for tasks like pollution clean-up, mine-clearing and space exploration: *"we cannot imagine a robot tax sic stantibus rebus but according to possible future scenarios which might include a significant use of artificial intelligence and therefore might be very different from the present one"* (Bottone, 2018).

Automation-related job losses are likely to come in waves, according to a 2018 analysis of an OECD dataset of about 200,000 jobs across 29 countries (PwC, 2018). The first wave, taking place now in the early 2020s, was seen as an 'algorithmic' wave in which computational tasks and structured data analysis would take a growing role in financial services and similar data- driven fields.

For the latter half of the 2020s, the analysis predicted an 'augmentation' wave, in which clerical support and decision-making take on more technology, along with semi-autonomous tasks like moving objects around a warehouse.

The 'autonomous' wave, not projected until the mid-2030s, involves more complicated tasks like transport and construction. Job losses in the first wave were projected to be relatively mild and evenly distributed across education levels, before ramping up dramatically and targeting lower-skilled workers more directly in later iterations. PwC (2018), like most reports of its kind, calls for training pro- grammes and government support to help the workforce make the necessary transitions.

Acemoglu (2021) took those recommendations one step farther, arguing that tax policy itself is one of the best levers available to governments looking to ease the transition. He argued that the first step is to address asymmetries in how labour and capital are taxed, raising taxes on capital to correct the imbalance and shift revenue-gathering to sectors of the economy more equipped to bear it.

This type of shift would need to be coupled with explicit support for technologies that enhance worker demand rather than undercut it: *"for example, via R&D subsidies targeted to specific technologies that help human productivity and increase labour demand"* (Acemoglu, 2021).

Frey and Osborne (2017) in a widely cited study identified 47 percent of all US jobs as at risk, looking at the workforce at the occupational level. But further research studying tasks instead of occupations, and accounting for shifts in how human talents are deployed, leads to less alarming conclusions.

Arntz *et al* (2016) found that on average across 21 OECD countries, 9 percent of jobs are automatable, and concluded that the threat from technological advances is much less pronounced than an occupation-based approach would suggest.

Getting a proper read on the situation will require considering all the things humans can do once they hand over some of their former responsibilities to the computers, not just the task transfer itself. An assessment of 46 countries from McKinsey (2018) found that even if you accept that half of all jobs will be affected, the proportion of prospective layoffs is far lower. By 2030, the range of displaced work is between nearly 0 and about 30 percent, with a midpoint of 15 percent. McKinsey (2018) also found that even with automation, the demand for work and workers could increase as economies grow.

Big shifts in sectors are nothing new – for example, the agricultural share of total employment declined from 60 percent in 1850 to less than 5 percent by 1970, and a third of China's workforce moved out of agriculture between 1990 and 2015 (McKinsey, 2018). Once again, the combination of technology, productivity and social considerations looks to outpace the specific losses to new automation.

Petropoulos *et al* (2019) raised the question of where tax revenues come from, particularly because different automated technologies interact with wages in different ways. Overall, employment in the EU is high, and welfare state spending is a big part of EU gross domestic product – around 25-30 percent in big countries pre-pandemic.

Meanwhile the share of national income going to labour is down, raising questions of who is taxed to fund the state, and the welfare state in particular. Capital income has gone up, but taxation of capital has been flat, leading policymakers to turn to consumption levies like value-added tax to make up the difference.

The complexity is summed up in the trade-offs between rising employment and sup- pressed wages that come from new technologies able to take on some jobs previously done by humans. Exposure to industrial robots and technology-related capital improvements are both positively correlated with employment rates.

"On average, a marginal increase in a region's exposure to industrial robots is associated with an increase in the employment rate of 1 percent- age point. A marginal increase in the exposure to ICT capital has a similar effect on employment rates" (Petropoulos *et al* 2019).

This makes the future difficult to predict. Automation may have a huge impact, but it will not necessarily lead to massive unemployment even in the most affected sectors.

Practicalities of an actual robot tax

Bill Gates brought robot taxes into the mainstream in 2017 when, in an interview in *Quartz*[4], he walked through some of the potential benefits and consequences of increased automation: *"Right now, the human worker who does, say, $50,000 worth of work in a factory, that income is taxed and you get income tax, social security tax, all those things. If a robot comes in to do the same thing, you'd think that we'd tax the robot at a similar level,"* Gates said.

"There are many ways to take that extra productivity and generate more taxes. Exactly how you'd do it, measure it, you know, it's interesting for people to start talking about now."

Gates predicted the extra taxes would come on two fronts: some from general taxation on corporate profits, which he predicted would rise from labour-saving efficiencies, and some from an actual robot tax. He predicted the companies benefiting most from the shift would be willing to pay up: *"I don't think the robot companies are going to be outraged that there might be a tax. It's OK."*

After Gates put the idea in the spotlight, it was immediately shot down by economists from across the political spectrum, from Tyler Cowan to Larry Summers to Yanis Varoufakis (Merler, 2017).

Policymakers did not like it either: *"No way. No way,"* said Andrus Ansip, the former European Commissioner for Digital Single Market issues. Ansip said he opposed *"taxing progress"* as others would take a lead in areas such as artificial intelligence, leaving Europe behind[5].

The European Parliament had already made a statement on the issue the day before the Gates interview was published, rejecting a resolution supporting a robot tax even as it also endorsed calls for the EU to lay out robotics ethics rules[6].

So far, the real-world policies have been more soundbite than substance. Also in 2017, South Korea proposed one of the first robot taxes[7]. But it was technically a reduction in tax deductions for increasing automation rather than an explicit tax on robots as worker replacements, drawing criticism that it was more of a protectionist move to shield older jobs than true technology policy (Lewis Silken, 2019).

Academics have put forward a range of proposals. Bottone (2018) started from the premise that a tax should be designed to raise revenue, not just tinker with policy incentives, and needs to be considered in a global context to avoid cross-border tax evasion.

That said, policy goals do and should play a role; neutrality is not a requirement though it is frequently politically invoked. When it comes to how to actually impose the tax, however, she laid out a laundry list that covers everything from a value added tax on robot activities – which would be complicated, especially if the robot itself had already been taxed at an earlier point in the supply chain – to a Gates-style robot income tax, to even a financial-transactions tax to raise money for worker benefits.

The rationale for that last one is to avoid impeding technological innovation, which is ironic because most large-scale financial-transactions tax plans would be likely to extensively slow down capital markets, and hence financing for innovation too.

Thümmel (2018) designed a model in which robots substitute for routine labour and complement non-routine labour, finding that a US tax could be modestly effective by either taxing or subsidising robots in general pursuit of the optimal way to distort robot adoption.

He used the price of the robot as a way to assess the marginal returns for the companies that want to profit from them. This model tries to account for the effect of a tax on median-income workers while also noting differing effects on high earners, who might make more because their work cannot be done by robots, and those at the bottom of the wage scale, who are likely to be the most displaced.

Thümmel also tried to account for workers who switch occupations, and those whose employment depends enough on their relative cost of robotic labour to be swayed by what kind of tax is in place.

By its nature, introducing the tax is likely to reduce production efficiency and also change the current incentives for investing in capital improvements, trying to compress wages and other business strategies.

In the end, the model spat out some small numbers about what rate would generate the most money. Without occupational switching, it found the optimal robot tax to be 1.8 percent, with a welfare gain of $21.14 per person per year; with occupational switching, the robot tax equals 0.86 percent, and its welfare impact is reduced to $9.22.

Such a tax would likely become obsolete: *"As the price of robots falls, inequality rises but the robot tax and its welfare impact become negligible"* (Thümmel, 2018).

You do not have to be a quantitative tax specialist to imagine ways in which the burden of a robot tax, however imposed, is borne by someone other than the company officially assessed, either by the company raising prices on their customers or reducing the price at which they are willing to buy the machine from its creators.

Particularly for robots already in use, adding a new tax is a move more likely to squeeze smaller players in the value chain than the big companies who are more able to pay up, and more likely to employ tax optimisers so they will not have to. Given the role of populist politics in designing and passing tax legislation, these kinds of optics are worth bearing in mind.

Artificial intelligence

Robots do not need to physically resemble humans to play a growing role in the economy. In terms of job displacement, policymakers need to think conceptually about technological systems that take over human roles, rather than a machine with two arms, two legs and binary optical sensors. The invisible robots of the AI revolution thus need to play as prominent a role in the workforce transition conversation as the humanoid robots that automatically populate our visual minds.

Merely calling for human oversight can create shallow protection that companies and governments can easily avoid in superficial ways[8]. Policymakers and companies will need to acknowledge and engage with the limits of human oversight, rather than counting on human involvement as an antidote to algorithmic harms.

This requires moving away from abstract understandings of both the machine and the human in isolation, and instead considering the precise nature of human-algorithm interactions. Who is the specific human engaging with the algorithm? This is relevant for deciding who gets taxed, as well as who is ethically in charge.

So far, most computers are not in danger of being mistaken for human. Andrew McAfee and Erik Brynjolffson, in an article for the *Financial Times*[9], made the case that policymakers should not assume a coming era of mass unemployment, but should rather consider the digital transformation in the context of a long-running race between technology and education that began with the nineteenth century industrial revolution.

"For most of the 20th century, humans won that race," they wrote. *"We have yet to see a truly creative computer, or an innovative or entrepreneurial one. Nor have we seen a piece of digital gear that could unite people behind a common cause, or comfort a sick child with a gentle caress and knowing smile."*

Giving humans the skills to work alongside new technologies could therefore be just as effective as it was in earlier transitional eras. As McAfee and Brynjolffson wrote, it would be a mistake to assume human workers will be permanently marginalised, especially when policymakers can actively create an environment that allows innovation and workers to thrive.

That does not mean AI can be taken lightly or bundled in with legacy technologies.

Bruegel's Mario Mariniello (2021) has written persuasively of the need for regulators to give AI special consideration. New technologies can exacerbate old biases while also creating new hurdles, and policymakers need to be mindful of everyone affected, not just the specific intentions of individual innovators: *"No matter how objective we try to be, the mere decision to adopt artificial intelligence solutions has profound implications. That decision is inherently subjective and thus comes with some political responsibility"* (Mariniello 2021).

What kind of innovation will matter as much as the sheer quantity of new developments. In the long run, innovators could compete to create human-centric technologies rather than chasing short-term business goals and absorbing corresponding failures.

Planning for the future

The movie *Blade Runner* was based on Philip K Dick's 1968 novel *Do androids dream of electric sheep?*, published when 'the future' was dominated by space travel.

The film came out in 1982, when robots as we think of them today were just beginning to revolutionise manufacturing. The internet was still entirely contained within the US defence department, and labour unions were still trading wages for pensions and not yet preoccupied with offshoring, let alone full automation.

Unlike *Blade Runner's* imagined future, as the actual year 2019 approached, humans had not conquered interstellar travel or developed artificial intelligence with good judgment. Instead, we connect to space through pocket computers that talk non-stop to location-tracking satellites, and we all traded in our slide rules for spreadsheets.

The future, therefore, is not something we are good at imagining. Our efforts to do it anyway reflect our current fears as much as any particular prescience. Any discussion of future taxation needs to keep this in mind. Technology

transition taxes are by their nature designed around liminal conditions. They should not be forecast as permanent sources of large and steady revenue.

That said, the move toward increased automation could be the basis for a smaller, more limited tax designed specifically to benefit displaced workers. Just as there are carbon offsets, there could be more done with layoff offsets. The trick will be tailoring these levies carefully to the broader context.

The goal is to foster innovation and provide a path forward for workers who need help adjusting. The potential peril is illustrated by the experience of urban planners who have tried to address homelessness via a veneer of affordable-housing construction rules rather than a real plan to get unhoused families off the streets and into shelter.

Tech luminaries like Bill Gates have lauded the robot tax as a way to levy companies directly on their use of robots and to apply those revenues toward a universal basic income.

This approach, while philosophically appealing, is overly simplistic. At the same time, it will be unrealistic to expect that companies will pay for it through an income tax on their robots and AI networks.

To the extent the concept of a robot tax is retained, it needs to be reframed as a rallying point rather than a literal strategy. Proposals for any new tax quickly degenerate into political slugfests accompanied by extensive lobbying from prospective winners and losers.

A successful tax plan therefore needs to be focused and bounded in ways that make it seem worth the trouble of pushing through. In that spirit, the following recommendations might make a deal possible:

- Taxes should be assessed on specific sectors that have demonstrable patterns of laying off classes of workers as they switch to new technology. A robot tax or other technology levy will be easier to impose if voters and legislators can see a connection to specific changing industries, rather than try to set a one-size-fits-all definition of a labour-saving machine.

- Such taxes should be time-limited and reassessed regularly, to make sure the transitions they are associated with are still relevant.

- Proceeds from these taxes should be earmarked to programmes that retrain affected workers or pay for early retirement, not to prop up general government budgets.

- Taxpaying target industries should be sought throughout the economy, not just the manufacturing and extractive sectors that are home to traditional industrial robots.

- Financial firms and other data sectors that are replacing human analysts with artificial intelligence should explicitly be included in the framing of which sectors to tax. A computer system that replaces a library card catalogue can be seen as an assistive technology, but a computer system that decides whether to approve a loan is stepping in for a prior generation of workers. 'Robot' needs to include brain as well as brawn.

- The phrase 'robot tax' can be used as political shorthand and as a way to build political support. It should not be invoked as a societal panacea.

- Robot taxes should be assigned to employers and corporate parent companies, not through value added taxes or other points lower down on the consumption chain.

- Carve outs for small businesses may make sense, as a way to encourage growth and innovation for companies with fewer than 50 employees. Companies that start out with robots are not the same as legacy firms that have achieved marketplace dominance through human labour and then used robotics to consolidate their position. Conceptually, policymakers should aim to tax companies with extensive market power and influence, not newcomers battling for a seat at the table, keeping in mind some level-playing field considerations.

- Any new tax needs to be considered in the broader context of global corporate taxation, including profit shifting, digital levies, minimum effective rates and cross-border formulas.

- Taxes on robots or related automation transitions should not be limited to cross-border companies.

- Politically, a tax that involves an explicit payment may be clearer to all stakeholders than a web of incentives and offsets, even if the economic impact is the same.

- Likewise, policymakers should stress that asking producers to help pay for the costs of societal change is not immediately equivalent to stifling innovation.

- Broader efforts to assess the balance between labour taxes and taxes on capital should continue, and existing imbalances should be actively challenged.

- Fair taxation should be a founding principle that is readily identifiable when making the case for a new tax. Fair is, by definition, a political concept, and the politicians who design and implement tax policy need to keep their broader values in mind.

To conclude, robot taxes cannot and should not be counted on to raise lots of money to keep humans fed and housed in the dystopian, automated decades to come. Rather, the digital transition should be managed – and taxed – alongside other societal transitions. To support the society that has allowed them to prosper, the companies that profit the most should pay their fair share. ■

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Endnotes

1. See https://ifr.org/industrial-robots for current definitions and specifications.

2. See OECD press release of 1 July 2021, '130 countries and jurisdictions join bold new framework for international tax reform', available at https://www.oecd.org/newsroom/130-countries-and-jurisdictions-join-bold-new-framework-for-international-tax-reform.htm

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4. See Kevin J Delaney, 'The robot that takes your job should pay taxes, says Bill Gates', Quartz, 17 February 2017, available at https://qz.com/911968/bill-gates-the-robot-that-takes-your-job-should-pay-taxes/

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