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Navigating the 4th Industrial Revolution: Taxing automation for fiscal sustainability

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Abstract

“Labour and capital will be interchangeable in the future due to automation ... we cannot just wait for this to happen ... we need to find another plan.”

(Thomas Piketty, cited in Fernholz, 2014)

The 4th industrial revolution has arrived; however, this industrial revolution is unlike those witnessed in the past. Equal opportunity and growth have been replaced by the 21st century trend of rising inequality, in which advancement through digitisation and automation brings fortune to the few and hardship to the many, as income and property stratification grows. As a result, current tax systems are under pressure with displaced workers requiring support, and the fiscal purse, which has historically been funded by income taxes, being eroded due to a decreasing number of workers to tax. Conceivably, it is up to governments to address this ‘double negative effect’, but it is unclear how this could be achieved and what theoretical basis should be leveraged to do so.

This paper provides a discussion of three important normative philosophies of distributive justice: utilitarianism, libertarianism, and John Rawls’ theory of justice, to determine a theoretical basis on which the redistribution of income via a tax on automation is justified. The pertinent theory is then operationalised with the proposal of three alternate models of taxation: a Pigouvian tax; a tax on economic rents; and an appreciation tax. Each of these models is evaluated alongside a discussion on the shift in global tax policy from taxing income to taxing capital. This paper argues that this shift is necessary to reduce income inequality and to ensure even the lowest common denominator is provided for, for we are the 99%.

Keywords: 4th Industrial Revolution, Taxing Robots, Fiscal Sustainability, Income Inequality, Tax Policy

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1. Introduction

The 4th industrial revolution has arrived. However, this industrial revolution is unlike those witnessed in the past that saw advancements through manufacturing and trade accompanied by higher standards of living for many. This latest industrial revolution is a technological tipping point (World Economic Forum, 2015) characterised by advances in technology, communication and connectivity, which will dramatically improve the efficiency of business and organisations and “fundamentally alter the way we live, work and relate to one another” (Erdogdu and Karaca, 2017, pg. 2) ¹. In addition, market compensation mechanisms, which are usually triggered by technological change, can no longer counterbalance the impact of innovation through job and product creation or increased product demand, wages, or investment (Vivarelli, 2007). Automation or ‘robots’ now act as a substitute not a complement to humans. In the past this was not possible or even imaginable.

Current estimates of the impact of the 4th industrial revolution suggest that between 30 to 50% of human activities, with wages totalling almost \$15 trillion globally, could be automated by 2035 if technical progress, costs and social and regulatory acceptance align (McKinsey Global Institute, 2017; PWC, 2017)². The activities predicted to be most susceptible to automation involve the collection and processing of data, or physical activities in highly structured and predictable environments. As such, a key distinction appears to be education³; that is, low qualified workers in manufacturing, transportation, wholesale and retail trade and some knowledge work involving middle-skill white collar jobs (including accountants and lawyers⁴) are likely to bear the brunt of change (Arntz et al., 2016). If realised, this ‘advancement’ will propagate the 21st century trend of rising inequality, bringing fortune to the few but threatening to leave the rest behind as income and property stratification grows (Weyer, 2016).

¹ Examples of these technologies include quantum computing, robotics, artificial intelligence, autonomous vehicles, the Internet of Things (IoT), nanotechnology, biotechnology, and 3D printing, to name a few.

² Estimates in Australia, based on the Committee for Economic Development of Australia (CEDA) report entitled ‘Australia’s Future Workforce?’ are redundancies of approximately 40% of jobs (predominantly driving jobs), including highly skilled roles, in 10 to 15 years (Florance and Partland, 2015).

³ Frey and Osborne (2017) demonstrate that wages and educational attainment exhibit a strong negative relationship with an occupation’s probability of computerisation.

⁴ The International Bar Association, in their report entitled ‘Artificial Intelligence and Robotics and Their Impact on the Workplace’ (2017), predicts that robots will likely replace humans in high-routine occupations including accountants and lawyers, calculating a “98 per cent probability that the work of an accountant will be done by intelligent software” in the years to come (pg. 20).

It is no wonder therefore that the 4th industrial revolution has been described as the “*defining challenge of our times*” (Bakhshi et al., 2017, pg. 27). Labour-displacement and income inequality have wide-ranging consequences for society, from greater health and social problems, to managing conflict and disparities in consumption, particularly in education. The solution proposed by most commentators, including Elon Musk (Clifford, 2016), is that as jobs are replaced by automation, people will need to be supported and sustained by payments from the government. However, for these payments to occur, a government must have a fiscally sustainable tax system in place. Bill Gates, co-founder of Microsoft, asserts that such a system should be sustained by taxing automation:

“at a time when people are saying that the arrival of that robot is a net loss because of displacement, you ought to be willing to raise the tax level and even slow down the speed of that adoption somewhat to figure out, “OK, what about the communities where this has a particularly big impact? Which transition programs have worked and what type of funding do those require?”

(Bill Gates, cited in Delaney, 2017, pg. 3).

Such a view, whilst bold, unconventional and indicative of a defining challenge, is not new. In May 2016, Mady Delvaux, a member of the European Parliament (MEP), submitted a draft report (European Parliament, 2017)⁵ explaining how automation could exacerbate income inequality, with fewer possibilities for employment in low-skilled positions, and proposed the introduction of “corporate reporting requirements on the extent and proportion of the contribution of robotics and AI to the economic results of a company for the purpose of taxation and social security contributions” (Shiller, 2017, pg. 1). Given the findings of Frey and Osborne (2013) who examined the susceptibility of jobs to automation and concluded that 47% of total US employment was at risk (particularly in low skill/wage positions), this report is right on the mark. Public reaction to this proposal was however overwhelmingly negative. But should we have been so quick to judge? A comparison of the distribution of wealth in OECD countries in the last three decades provides evidence that a trend of rising income inequality has already begun. The income gap between the rich and the poor is at its highest level in 30 years, that is, the richest 10% of the OECD population earns 9.5 times

⁵ Report title: “Report with recommendations to the Commission on Civil Law Rules on Robotics (2015/2103(INL))”.

more than the poorest 10%⁶. Further, the Gini coefficient, a broader measure of inequality that ranges from zero (perfect equality) to one (perfect inequality) has increased in OECD countries on average by three points from 0.29 in 1980 to 0.32 in 2012 (OECD, 2014). Re-estimations of Frey and Osborne's (2013) work by the Federal Reserve (Hong and Shell, 2018) demonstrate that the Gini coefficient is expected to increase exponentially (by 4 to 39 points) due to automation and its tendency to displace the lowest-paid workers. Further, a report by UBS (2016) predicts that not only will income inequality increase within countries, but between countries (developed and developing). As such, inequality will rise, impeding long-term economic growth and progress towards the United Nation's (UN) Sustainable Development Goals (SDGs) (an initiative of the UN to promote peace, share wealth, end poverty and protect the planet by 2030), specifically, Development Goal 10 – Reduced Inequalities,⁷ which is tasked with redistributing income from the rich to the poor and supporting marginalised groups.

Consequently, current tax systems are under pressure, with an increasing number of displaced workers requiring transitional support, that is, vocational education and training to facilitate the acquisition of new skills, income support and safety nets. In addition, the fiscal purse, which has historically been funded by income taxes is being eroded due to a decreasing number of workers to tax. For example, taxes on income and profits in OECD countries have dropped from 37.5% of total taxation revenue in 1990 to 34.1% in 2015 (OECD, 2018). To address this defining challenge, governments must evolve and implement bold policies⁸ such as a tax on automation.

Taxing an inanimate object such as automation or a robot is difficult, primarily due to the complicated nature of identifying and defining the tax base (Florida, 2017; Orton-Jones, 2018; Vishnevsky and Chekina, 2018)⁹. Richards and Smart (2016) attempt to address this regulatory challenge, proffering a definition of a 'robot' to be used in legislation: “a

⁶ According to Benioff (2017), the top 1% of the world owns more than 50% of the world's wealth, while the bottom 50% of the world owns less than 1% of the world's wealth. This gap is widening as the 4th industrial revolution progresses.

⁷ Other SDGs that will be affected include Development Goal 1: No Poverty; Development Goal 4: Quality Education; Development Goal 8: Decent Work and Economic Growth; and Development Goal 9: Industry, Innovation and Infrastructure.

⁸ Similar bold policy proposals include Zaman et al.'s (2018) abolition of corporate tax incentives for debt and Sadiq's (2015) unitary taxation with formulary apportionment.

⁹ Amendments to tax policy or new taxes can also have capital market consequences including investment efficiency (Khurana et al., 2018), firm performance and stock return behaviour (Dash and Raithatha, 2018).

*nonbiological autonomous agent*¹⁰. This definition however is limited to tangible (hard) systems; that is, it does not include intangible (soft) ones, for example software-based AI. Patias and Leventi (2017) address this limitation by defining automation and/or a ‘robot’ using pure financial terminology as “*a capital investment*”. This paper adopts this latter definition to tax companies that profit from robots and automation. Specifically, there are three main tax bases: capital, labour and expenditure. A tax on robots is simply a tax on the capital employed by businesses and is a move away from the trend of taxing labour and expenditure. While taxing robots seems like a bold paradigm shift, it can be argued that it is simply a reconfiguration of the current tax regime (consistent with society’s replacement of labour with capital), which could create an incentive to hire workers (Walker, 2017).

The remainder of this paper is structured as follows. Section 2 discusses extant policy proposals for addressing inequality by redistributing income through taxation. Section 3 provides the theoretical basis on which a tax on automation, as a means to redistribute income to advance equality, is justified. Section 4 then proposes three discrete taxes on automation designed to redistribute income and ensure that governments have the ability to meet rising demands on revenues. Section 5 discusses the current environment that suggests a nascent shift from taxing income to taxing capital, and Section 6 concludes.

2. Extant policy proposals for addressing income inequality

Extant policy proposals for addressing inequality by redistributing income through taxation fall under two main categories: a direct tax on companies that profit from automation (Section 2.1); and alternate proposals that do not directly tax companies due to fears of impeding or stagnating innovation, particularly in healthcare and transportation where delays in automation impede quality and efficiency (Section 2.2). For example, medical robots reduce costs and improve quality, whilst saved resources are used to enhance prevention and improve qualifications of healthcare professionals (Bessen, 2017; Floridi, 2017; Patias and Leventi, 2017).

¹⁰ Richards and Smart (2016) propose the following working definition, “*a robot is a constructed system that displays both physical and mental agency but is not alive in the biological sense*” (pg. 6).

2.1 Taxing companies

Current proposals for addressing inequality by redistributing income through a direct tax on companies that profit from automation include taxes on capital items or a tax on the income generated by capital items. For example, James (2017) proposes a tax on the capital employed by a business to automate processes, or a tax on the notional salary earned by a 'robot' (Oberson, 2017) paid in the jurisdiction it is earned. This option has a dual purpose of taxing automation and combatting tax avoidance. Other proposals proffer a performance related levy which would vary according to the computing power or capacity of the 'robot' (Orton-Jones, 2018) or a tax on the income received from automated activities such that the tax is levied on the use of robots, not on the robot itself (Vishnevsky and Chekina, 2018).

Other proposals advocate for a sectoral or industry tax, for example a tax on autonomous vehicles applied uniformly across the transportation industry (Orton-Jones, 2018) or a tax based on a worker to profit ratio, that is, a tax on firms with high profits but a small workforce (Walker, 2017; Oberson, 2017). Similarly, a corporate self-employment tax, namely an increase in corporate tax rates if businesses produce outputs without human labour (Abbott and Bogenschneider, 2018), has also been proposed. These proposals have been extended by D'Orlando (2018) to include a tradeable permits approach, similar to pollution quotas or 'emission units' adopted in the Emissions Trading Scheme and implemented by the Kyoto protocol, where quotas on human employment can be bought and sold to other firms or countries.

Lastly, an automation tax, where firms pay additional amounts into an insurance plan or sovereign wealth fund if they automate at the expense of workers, has been widely proposed (Oberson, 2017; Smith, 2017; Walker, 2017; Abbott and Bogenschneider, 2018; Vishnevsky and Chekina, 2018). A sovereign wealth fund, as suggested by Economics Professor Miles Kimball (Smith, 2017), or a state trust is designed to operate by the government investing tax revenue in stocks and real estate, ultimately distributing profits to the population via a Universal Basic Dividend (UBD) (Vishnevsky and Chekina, 2018). Such a system has been operating in Alaska since 1976, where revenues from state oil revenues are distributed to citizens via the Alaska permanent fund. A UBD is a larger version of this, involving investment from every industry in the nation (Dunlop, 2017).

2.2 Alternate proposals

There are a variety of alternate proposals that do not directly tax corporations due to fears of impeding or stagnating innovation. First, creating a tax neutral system that allows the market to choose the most efficient unit of production, be it a human or a robot. For example, the South Korean ‘robot tax’ has removed tax incentives for investments in automated machines (Abbott and Bogenschneider, 2018). Second, creating a tax system with inherent bias towards human workers. This can be achieved by providing tax incentives to retrain and upskill displaced workers (Paul-Choudhury, 2017), and wage subsidies or cuts to payroll tax for low-income workers (Erdogdu and Karaca, 2017; Smith, 2017; Abbott and Bogenschneider, 2018; D’Orlando, 2018). Notably, current tax systems encourage automation and penalise human labour by providing tax incentives via accelerated depreciation on capital costs and avoiding employee (and employer) wage taxes (Abbott and Bogenschneider, 2018).

Other proposals include: encouraging the expansion of capital ownership to displaced workers, for example displaced drivers investing in driverless vehicles that operate as taxis (Depczyk, 2017); adopting a mandatory quota on the number of human workers a business must maintain (International Bar Association, 2017; Ferguson, 2017); and evolving or re-purposing workers to do more complex and interesting things (Patias and Leventi, 2017; Clifford, 2016; Orton-Jones, 2018). For example, Sweden’s job security council conducts ‘personality inventories’ to redirect workers to new positions which best suit their attributes (Mann et al., 2018). Lastly, the benefits of instituting a Universal Basic Income (UBI), where regardless of engagement in education or paid labour, people are sustained by payments from the government (Clifford, 2016; Floridi, 2017; Abbott and Bogenschneider, 2018; Mann et al., 2018) has been revisited. This regime is currently being trialled in Canada, Finland and Scotland to prepare for what is commonly dubbed the inevitable (Janda, 2017). However, opponents to UBI suggest that this scheme is “*no panacea for the challenges of our modern economy*” (Foster, 2016, pg. 1). It may not be sustainable and has an adverse effect on work incentives as unconditional handouts suppress the incentive to work (PWC, 2017).

Notably, a theoretical basis upon which to justify the redistribution of income via a tax on automation is starkly missing from these proposals.

3. Theoretical basis for taxing automation: redistributing income to advance equality

Whilst tax itself is defined as a compulsory exaction of money, taxes in modern society are used by governments for three distinct purposes: to raise revenue for necessary government functions; to reduce inequalities in the distribution of income and wealth; and as a regulatory component to steer certain behaviour and aid economic stability (Avi-Yonah, 2006). To accomplish this, tax revenue must be generated at a rate that grows with the needs of the populace, be exacted from those with income and redistributed to those without income, and be designed to attain societal benefits for all, rather than some. As such, tax law is inherently political. Historically, wars have been started and fought and elections have been won and lost based on taxes and tax policy¹¹, with classes and political parties often defining themselves by their position on tax from a spectrum of views ranging from a pro-business, free market economy platform to a pro-worker, egalitarian platform. These positions on tax are ultimately determined by core beliefs of fairness and justice. The crux of the perpetual argument therefore stems from the determination of what is ‘fair’ or ‘just’, which is divisive as it depends on one’s broad beliefs, values and experiences.

This section explores three important normative philosophies on distributive justice: utilitarianism (Section 3.1), libertarianism (Section 3.2), and John Rawls’ theory of justice (Section 3.3). Each of these theories offer a means to confront the current global challenge and address inequality by redistributing income via a tax on automation, with overlapping issues of fairness, equality, desert, and rights.

3.1 Utilitarianism

The foundations of modern utilitarianism originate in the works of Jeremy Bentham, who theorised that all social actions should be evaluated by the fundamental axiom: “*it is the greatest happiness of the greatest number that is the measure of right and wrong*” (Library of Economics and Liberty, 2002, pg. 1). As such, utilitarians adopt two fundamental positions. First, happiness is paramount and should be used as the benchmark to decide the ‘rightness’ of an action. Second, no one person is worth more than another; therefore, in human welfare terms, equal weight is given to each individual. Applying these positions to economic policy implies that an economic regime that brings the most happiness to society as a whole

¹¹ For example, one of the primary causes of the American and French revolutions was the high level of taxes levied on the poor to support the wealthy.

(maximisation of utility) is 'right' and should establish the framework for designing a public policy model.

The application of the utilitarian approach to distributive justice via taxation has limitations due to individual perceptions of utility and fairness. For example, utilitarianism, in a simple economy where all individuals have homogenous utility (satisfaction) functions, dictates a full redistribution of incomes. That is, the government confiscates 100% of earnings, funds its operations and redistributes the remaining revenue equally to all individuals ensuring equality (Piketty and Saez, 2013). The validity of this approach however, is limited by one specious condition, utility functions are not homogenous across individuals; that is, individuals have different preferences for utility. These preferences can be based on legitimate reasons (for example the number of dependent children) and illegitimate reasons (such as a desire for goods or leisure consumption). They may also derive from moral objections to confiscatory taxation on the grounds that if fairly earned through effort (as opposed to nepotism or luck) people deserve to keep a portion of the income they have generated. These heterogenous preferences for utility ensure that optimal taxation is achieved by weighing individual preferences (benefits and losses) for a given regime to determine an aggregate position. Such aggregation however, does not serve to mediate inequality; one person's good can be sacrificed to serve the greater good of a group of people. As such, in a utilitarian regime, conditions such as slavery or inequality cannot be excluded if they represent higher aggregate utility than the alternative (Stark et al. 2014).

Further, under utilitarianism, tax collection and redistribution should depend on all observable characteristics correlated with the ability to earn, for example gender, race, age (Weinzierl, 2011), disability, family structure and height (Mankiw and Weinzierl, 2010). This specification ensures that if the immutable characteristic is binary (gender), funds are redistributed from one group (male) to another (female) to achieve maximum aggregate utility. In practice however, taxes and transfers use only a few of these characteristics (family structures and disability status) to facilitate redistribution due to horizontal equity concerns¹² that perceive such distinctions as unfair (Piketty and Saez, 2013). Put simply, perceptions about recipients' matter. For example, most individuals support transfers for those who are genuinely unable to work, such as the elderly or truly disabled, but they do not support

¹² Horizontal equity (Musgrave, 1959) states that individuals with similar incomes and assets should pay the same amount in taxes; that is, no preferential treatment should be given to individuals and companies (e.g. deductions, credits or incentives).

transfers for those who ‘choose’ not to work. Taken together, these perceptions about fairness demonstrate that behavioural responses impact optimal taxation. Such distinctions of equity are however irrelevant under utilitarianism and as such this theory fails to capture the level of distributive justice required to address income inequality in the modern world.

3.2 Libertarianism

Libertarianism is a philosophy that claims the rights of individuals to liberty and to acquire, keep and exchange property, with the primary role of the state to protect those individual rights. Libertarians associate justice with the notion of personal liberty and the protection of liberty for all people. Within this context, justice means that each person can order their life how they choose without interference from others. This also entails a duty not to interfere with the way of life and choices of others, including the coercion of others in order to prevent them from living according to their own choice. Consequently, basic rights coexist with basic obligations. While utilitarians adopt the view that there should be maximum social wellbeing and interference with personal choices may be appropriate to achieve this, libertarians believe that this personal liberty is paramount and even the government does not have the right to interfere with individual choices. The resulting view is that a government should limit their interference to protecting its citizens and basic maintenance functions, with taxes charged on the benefits received from such services (the benefits principle).

A libertarian approach to the issue of redistributing income through a tax on automation, based on John Locke’s theories of justice (1689), would see the government taking up a night watchman position only, on the basis that they do not have the right to interfere with individual choices. Further, any tax on individuals that goes to support less privileged people is vehemently opposed on the basis that it is an unjust confiscation of income and a violation of personal liberty, to force one to support activities that have not been freely chosen. Instead, libertarians propose that a ‘trickle-down effect’ will address income inequality by rewarding labour with property ownership and motivating individuals to invest more effort that in turn creates benefits for others. This system however, is based on two provisions: first, that the accumulation of property does not result in wastage; and second, that accumulation is only permissible where there is enough left over for others. The state of today’s society, where the wealthiest 1% of the world’s population owns more than half the world’s wealth (Credit Suisse, 2017), signifies that neither of these two conditions are met. This, along with the

prediction that automation will ultimately replace labour, with labour as the basis of the argument for the success of the trickle-down effect, demonstrates that the libertarian approach will not work.

3.3 John Rawls' theory of justice

Arguably, the most influential economic justice theory in recent decades is John Rawls' work in *A Theory of Justice* (1999). This theory associates the redistribution of income via taxation with fairness and morality (or distributive justice), proffering a cooperative societal view where utility is maximised for the most disadvantaged (the maxi-min objective) rather than via aggregate happiness or individual entitlement as proposed by the Utilitarian and Libertarian approaches, respectively. Specifically, Rawlsian theory asserts that basic social structure and a philosophical underpinning determined by society is the starting point for designing a tax system. This approach is based on an artificial construct called the 'original position' that asks a hypothetical question as to what principles people would choose as the principles of justice and fairness were those principles decided behind a veil of ignorance. The veil of ignorance removes any self-interest bias derived from position, status or wealth (as individuals are assumed to know nothing about themselves or the situation they will be in when the veil is lifted) and asks what kind of society a person would devise given they could be the lowest common denominator. Rawls argues that the establishment of this 'original position' will result in equal and unassailable liberty, with economic and social rewards made available to all on the basis of full and fair opportunity. As such, inequalities are justified if they advantage the lowest common denominator. In the context of tax, this approach justifies the taxation of a particular group of taxpayers or a particular activity based on the ability to pay principle¹³ (Sneed, 1965) and benefits to the most disadvantaged. On this basis, a tax that redistributes income to address inequality is justified.

Recent work by Piketty (2014) extends Rawlsian theory by suggesting perceived or forecasted failures of our free market (capitalism), predicated by inequality, can be remedied through government intervention and progressive taxes; that is, via a redistribution of wealth. In his magnum opus 'Capital in the Twenty-First Century', Piketty (2014) tracks movements in capital over the last century and forecasts a significant increase in the value and unequal

¹³ The ability to pay principle relies on vertical equity (the burden of tax is distributed according to the capacity to bear the burden of payment) and on the notion of redistribution of wealth (those on higher incomes pay more in taxes to allow for a redistribution to those on less income) (Sneed, 1965).

distribution of capital (or wealth) due to wage inequality, low economic growth and high returns on capital. Piketty (2014) argues that this is a major problem and posits a global solution to stem the tide of rising inequality due to the divergence of wealth distributions via a worldwide tax on capital¹⁴. He asserts that inequality is a consequence of modern times and is propagated by automation, permitting wealth or capital (r) to accumulate more rapidly (4-5% p.a.) and for longer periods of time than income and growth (g) (1-1.5%), that is “the inequality” $r > g$ (pg. 571). As such those that ‘have’ fare much better than those who ‘have not’. Picketty’s (2014) proffered solutions of a progressive annual tax on capital (15%) and inherited wealth (80%), along with an automatic exchange of banking data regarding information on assets held in foreign jurisdictions and the use of inflation to redistribute wealth downwards, have been applauded as a utopia (Mason, 2014; VanderMey, 2014)¹⁵ and criticised as a confiscatory global tax based on flawed data and arguments (Potter, 2014).

Historically, suggestions of a Rawlsian tax have not garnered widespread support and acceptance from governments or the voting public, boding ‘political suicide’ to any politician, political party or advocate who would propose one due to the impact it will have on voters. For in truth, a Rawlsian tax would only make sense politically if the disadvantaged, those with minimum utility, constitute a majority of the population (Piketty and Saez, 2013). Given that such large numbers of workers will be displaced by automation, it may be time for such an approach.

4. Proposed taxes on automation

Having identified John Rawls’ theory of justice as an appropriate theoretical basis to address income inequality, this paper now builds on Piketty (2014), operationalising Rawlsian theory by proposing three discrete taxes on automation designed to redistribute income and ensure governments have the ability to meet rising demands on revenues. These three proposed taxes are a Pigouvian tax on capital (Section 4.1), a tax on economic rents (Section 4.2), and an appreciation tax (Section 4.3).

¹⁴ Piketty (2014) suggests a capital tax schedule with rates of 0.1-0.5 % on fortunes under 1 million euros; 1% on fortunes between 1 and 5 million euros; 2% on fortunes between 5 and 10 million euros; and 5-10% on fortunes in excess of 10 million euros.

¹⁵ A discussion on the success of Picketty’s book, ‘Capital in the Twenty-First Century’, is provided by VanderMey (2014).

4.1 Pigouvian Tax

Pigouvian taxes, named after British economist Arthur Pigou, are taxes designed to offset externalities; that is, consequences and social costs of production or consumption activities that are not incorporated into market prices but borne by external/third parties. Pigouvian taxes are designed to recoup these social costs by requiring businesses and consumers to internalise their externalities. Specifically, if an activity generates a consequence or cost for society, then taxing this activity will raise its market price and generate revenue to meet societal costs. This process is exemplified by taxes on carbon, tobacco and alcohol. For example, a Pigouvian tax on tobacco raises the price of cigarettes and generates revenue to meet the societal costs of tobacco related disease. An additional benefit of this tax is its ability to lower demand and ultimately supply through higher prices. For example, taxes on tobacco have contributed to a 6.7% reduction in consumption globally (World Health Organisation, 2018), which will hopefully translate into lower mortality rates and costs of healthcare for tobacco related disease that are predominately funded by government. Such a benefit is not apparent when applied to alcohol nor is it expected when applied to automation.

So, given these fundamental principles, what would a Pigouvian tax on automation look like? To answer this, the externality that automation presents must be targeted, namely the use of technology (robots/capital) to automate and replace production processes traditionally operated by human workers. Presently, the consequences and social costs of automation (i.e. the displacement of human workers) is externalised by businesses and as such is not incorporated into market prices. Instead these costs are borne by society as governments respond to support displaced workers in times of unemployment. What therefore needs to occur is the imposition of a tax on automation to force businesses to internalise the costs of worker displacement, representing a Pigouvian tax on automation. This tax should be equal to the social cost of the externality that automation presents, namely the costs to re-educate and support displaced workers, which could be determined by the amount of capital investment annually that substitutes rather than complements human workers (Vermeulen et al., 2018). Estimations and observations of worker displacement (or the ratio of workers to capital over time) given the level and type of capital investment would first need to be collected and analysed across industries in order to determine a suitable schedule of taxation.

Opponents to a Pigouvian tax on automation argue that such a tax would stifle innovation by raising the cost of research and investment relative to other activities (Bessen, 2017; Caron, 2017; Florida, 2017; Patias and Leventi, 2017). Others argue that it is unnecessary as this is just the next in a long line of technological shifts in the economy, with old jobs ultimately replaced by new ones (Borland and Coelli, 2017; Walker, 2017). While that may be the case, a Pigouvian tax on automation is a “natural and obvious” solution (Shiller, 2017) that will immediately address the impact of the 4th industrial revolution by forcing businesses to internalise externalities. Notably, if these externalities no longer exist in the future (i.e. displaced workers have been relocated into newly created occupations) this tax will no longer be required and the pace of technological innovation can be restored. Consequently, the implementation of this tax will require continual monitoring and evaluation in addition to political agreement to enact amendments if and when negative externalities are alleviated (Englisch, 2018). In the meantime, the application of a Pigouvian tax on automation will transfer income from those who benefit from automation (business) to those who don’t (displaced workers) based on the Rawlsian ability to pay principle (Rawls, 1999) and Piketty’s (2014) first proffered solution of a progressive annual tax on capital. This will ensure that income inequality propagated by automation is mitigated or managed whilst society adjusts to the minutia of the 4th industrial revolution.

4.2 Tax on Economic Rents

The concept of economic rent, as defined by David Ricardo in 1817, is the difference in productivity (profits) between a specified piece of land and the poorest (infertile, difficult to work, furthest from market), most costly piece of land that produces the same commodities under the same conditions. Put simply and after contextualising this definition to modern times, economic rent is surplus or excess profit above the level required to cover the costs of material and labour, and to reward capital via the average market return. Such excess profit has been referred to as ‘unearned gains’ or ‘unearned wealth’ (Kieper, 1961); that is, a reward from privilege not from effort or hard work (Passant, 2012). As such, the taxation of these gains is recommended to restore equity by mimicking the effect of competition, rather than a monopoly, and reducing after-tax returns (Marx, 1959).

Given similar concerns regarding equity and ‘unearned gains’, the application of such a solution to our current defining challenge is apt, requiring a tax on surplus or excess profits

due to automation, namely a tax on those earnings over and above cost plus a reward for capital (for example, the average market return¹⁶). Such a tax is similar in intent to the Australian Petroleum Resource Rent Tax (PRRT), which has been in operation since 1987. Ideally, the PRRT provides a fiscal regime that encourages investment in the exploration and production of petroleum, while ensuring a fair and adequate return to the Australian community via a tax on profits generated from the sale of marketable petroleum commodities (MPCs)¹⁷. A tax on automation is expected to operate in the same manner; that is, to encourage innovation and automation whilst securing an adequate return to cover the additional costs of automation borne by the government (re-education and support for displaced workers) via a tax on the excess or ‘unearned’ profits generated by those businesses benefitting from automation.

The adoption of this approach is consistent with Rawls (1999), as it justifies the taxation of a particular group of taxpayers or a particular activity based on the ability to pay principle, and with Piketty’s (2014) second proffered solution of a progressive annual tax on wealth. Further, this approach is supported by Ricardo himself in the third and final edition of his book (1821):

“I thought that the labouring class would, equally with the other classes, participate in the advantage from the general cheapness of commodities arising from the use of machinery ... but I am convinced, that the substitution of machinery for human labour, is often very injurious to the interests of the class of labourers”

(Chapter 31, paragraph 2-3).

Ricardo (1821) considered the influence of machinery on the interests of the different classes of society: the landlord, the capitalist and the labourer. He concluded that although funds to landlords and capitalists will increase with mechanisation, funds to support labourers may diminish if the pace of mechanisation is not met by increases in demand and growth, rendering the population redundant and deteriorating the conditions of the labourer to one of distress and poverty. Although this reasoning was applied to investment in technology now

¹⁶ The average market return could be calculated for the whole market or for a particular industry.

¹⁷ The effectiveness of the PRRT has been widely criticised. Most recently this is due to the ‘uplift rate’, the level of deductions that ventures can carry forward to future years, and its suitability to Liquefied Natural Gas (LNG) projects that require greater capital expenditure (Coorey and Macdonald-Smith, 2018). In response to these concerns and those of the Callaghan PRRT Review (Treasury, 2017) the Australian Government has introduced changes to the PRRT to take effect from 1 July 2019. These include lowering the ‘uplift rate’ to limit excessive deductions, removing onshore projects from the PRRT to limit the transfer of deductions to profitable offshore projects, and a review of gas transfer pricing regulation (Treasury, 2018).

almost 200 years old, its impact on society as discussed in Picketty (2014), the inequality $r > g$, remains the same.

4.3 Appreciation Tax

An appreciation tax is a new tax proposition based on the fundamental principles of taxing capital gains, namely the concept of the comprehensive tax base originally proposed in 1938 by the Schanz-Haig-Simons framework. This framework defines income (and thus the comprehensive tax base) as consumption plus changes in wealth:

“the algebraic sum of (1) the market value of rights exercised in consumption and (2) the change in the value of the store of property rights between the beginning and the end of the period in question”

(Simons, 1938 cited in White, 2015).

As such, under this framework capital gains should be taxed. This will ensure that gains in the form of capital appreciation are not treated preferentially (Evans et al., 2015) and that both horizontal and vertical equity are achieved. Horizontal equity (Musgrave, 1959) in this context ensures that individuals with the same income, whether from labour or capital gains, are taxed at the same rate. Vertical equity (Sneed, 1965) ensures that the burden of tax is distributed to those with a greater capacity to bear the burden of payment, namely that wealth is redistributed from those who have, to those who have not.

In addition to fiscal equity, there are several policy reasons for taxing capital. These include widening the tax base, limiting tax avoidance and reducing investment distortion (Cooper et al., 2016). Competing considerations argue that the taxation of capital retards investment, reduces stocks of capital, discourages risk-taking behaviour and interferes with the mobility of capital (Blum, 1957). Last but notably, the bunching of net capital gains, that is the taxation of accumulated capital gains on realisation, is viewed as the most prominent argument due to inequity (Blum, 1957; Merrett, 1964). The “obvious” solution proposed by this stream of literature is an averaging or accrual of capital gains, in line with this paper’s final proposal.

This paper proposes an appreciation tax, a tax on capital gains that is accrued annually instead of on realisation of the capital item (i.e. when sold). This proposed tax is particularly

relevant given the unique nature of the 4th industrial revolution where the growth of automation and the value of capital assets are expected to increase exponentially due to the self-learning capabilities of artificial intelligence (International Bar Association, 2017). Coupled with rates of depreciation that accurately reflect the effective life of capital items rather than those offering accelerated rates of depreciation, that is, a neutral tax system (Abbott and Bogenschneider, 2018), this approach mitigates the impact of the 4th industrial revolution on the fiscal purse. This approach however is not without criticism. Problems with valuations on infrequently traded assets whose value fluctuates or is unquoted, along with inequity which sees accrued gains taxed at a higher rate than accrued losses and forced realisations to meet tax liabilities are notable (Merrett, 1964). These considerations are outweighed by the “difficulties and inequities in any of the systems of capital gains taxation so far proposed” (Merrett, 1964, pg. 265), namely determining an equitable rate at which realised or bunched net capital gains are taxed.

In terms of achieving equity, the adoption of this approach is perhaps the most appropriate solution given that it is based on the Rawlsian ability to pay principle (Rawls, 1999) and Piketty’s (2014) first and second proffered solutions of a progressive annual tax on capital and on wealth. Further, this tax will signal a shift from taxing labour to taxing capital which, according to Piketty (2014), is required to reduce income inequality.

5. A paradigm shift to a broader tax on capital

Historically, taxes have been garnered from three main tax bases: capital, labour and expenditure, with the majority of funds coming from the latter two based on the historic belief that the taxation of labour income is more efficient than the taxation of capital (Abbott and Bogenschneider, 2018). In recent times however, the accumulation of capital (4-5%) has far exceeded increases in income and growth (1-1.5%) (Piketty, 2014). Current rates of global capital expenditure have increased by 18.28%, from US\$2,576 billion in 2010 to US\$3,047 billion in 2015 (OECD, 2016), while increases in gross net income (GNI) lag behind capital market returns (by 3.68% in the United Kingdom, 8.87% in the United States and 1.72% in Australia from 2009 to 2016). Taken together this evidence supports a shift in tax bases in the form of a paradigm shift in the current tax regime from taxing labour to a broader tax on capital.

To date, governments have taken a piecemeal approach towards a fairer tax system. In Australia, policy proposals that seek to increase taxation on capital include: eliminating cash refunds of franking credits for pension funds and low-income self-funded pensioner taxpayers; abolishing negative gearing tax refunds for new investors in existing properties; and imposing a 50 per cent increase in the capital gains tax liability when newly purchased assets are sold (Dixon, 2018). In the United Kingdom, the Labour government committed at the last election (2017) to reverse conservative cuts to the capital gains tax and to a 5% increase (freeze) in income tax for the top 5% (bottom 95%). A review of property taxes (which are based on out-dated valuations or a flat rate) and consideration of a land value tax which would be levied as a percentage of current property value has also been promised (Jones, 2018). Wealth taxes in France, Norway, Spain and Argentina have been adopted, taxing net assets worth more than EUR800,000, NOK1.48 million, EUR700,000, and MEX1,050 million at a rate of 0.5-1.5%, 0.85%, 0.2-3.75% and 0.25%, respectively (West, 2018). Conversely, in the United States, the ‘one-time’ tax on those with a net worth of 10 million US dollars, proposed by Donald Trump in 1999 as a “*win-win for the American people, (but) an idea no conventional politician would have the guts to put forward*” (West, 2018, pg. 2), still lacks the constitutional fortitude of its leaders, with little progress made toward equality through taxation.

Consequently, what is proposed in this paper is speculative but plausible. What remains to be determined however, is the economic substance of each of these proposals which we suggest is a task for Treasury, given its access to the Independent Economics’ computable general equilibrium model¹⁸, or for future research. This future work should additionally model the impact of automation on jurisdictional equality, as current research (Schlogl and Sumner, 2018) suggests this is a profound yet different challenge in developing countries with automation leading to stagnant wages and deindustrialisation.

¹⁸ The Independent CGE model is a mathematical model that determines the effects of policy proposals on the economy, firms and households using rich, detailed up-to-date information on the economy, industry, production processes, labour forces, fixed factors and the company tax system including foreign investment and profit shifting (Treasury, 2018b).

6. Conclusion

Described as the “*defining challenge of our times*” (Bakhshi et al., 2017, pg. 27), the 4th industrial revolution is characterised by advances in technology, communication and connectivity, which will dramatically improve the efficiency of business, but fundamentally alter the way we live due to the inability of market compensation mechanisms to counter-balance the impact of innovation. Current estimates from multiple reports (Committee for Economic Development of Australia, 2015; International Bar Association, 2017; McKinsey Global Institute, 2017; PWC, 2017) suggest that automation will replace between 30 to 50% of human workers in the next twenty years. As such, labour-displacement and income inequality will abound, bringing with it wide-ranging social consequences including the erosion of the fiscal purse that has historically been funded by income taxes.

The proposed solution to this double negative effect, consistent with Picketty (2014) and notably Bill Gates, is government intervention via a progressive tax on automation; that is, addressing inequality by redistributing income. Extant policy proposals for addressing inequality through taxation have been systematically reviewed, including those that directly tax companies and those that do not, due to fears of impeding or stagnating innovation. Next, theoretical bases of taxation are considered to justify a tax on automation that redistributes income to advance equality, including utilitarianism, libertarianism and John Rawls’ theory of justice. The latter theoretical basis and its ‘veil of ignorance’, which removes any self-interest bias derived from position, status or wealth and asks what kind of society a person would devise given they could be the lowest common denominator, justifies the taxation of automation. Additional support for this conclusion is provided via a discussion of Picketty (2014) who asserts that inequality is a consequence of modern times, propagated by automation, where wealth or capital (r) are permitted to accumulate more rapidly (4-5% p.a.) and for longer periods of time than income and growth (g) (1-1.5%), constituting the inequality, $r > g$. Solutions proffered by Picketty (2014) consist of government intervention and progressive taxes on capital (15%) and inherited wealth (80%). These solutions bode political suicide if the displaced or disadvantaged do not constitute a majority of the voting public. However, given that this is expected to be the case, this paper suggests that it is time for such an approach.

In this vein, three discrete taxes on automation are proposed, operationalising Rawlsian theory and building on the work of Picketty (2014). These three proposed taxes are: a Pigouvian tax on capital; a tax on economic rents; and an appreciation tax. Each of these proposals are evaluated followed by the provision of evidence in the form of examples of recent developments in taxation across jurisdictions that demonstrate a nascent paradigm shift from taxing income to taxing capital. Although these developments appear largely uncoordinated and unilateral, it is hoped that a cohesive multilateral approach will be taken in the future to ensure ‘automation shifting’ is not the next priority of the OECD and equality is achieved for all, for we are the 99%.

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