# Artificial Intelligence and its Impact on Political Economy

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for

Dr. Dumas - Spring 2020 Spring 2020 PPPE 8V01.021

**Introduction**

Regarding artificial intelligence (AI), Stephen Hawking is quoted as saying, “The rise of powerful AI will be either the best or the worst thing ever to happen to humanity.” Thus Dr. Hawking pointed the way to the range of attitudes many feel towards AI. Before one can determine where to land on this spectrum it is first necessary to understand the meaning of AI. The dictionary defines AI as, “The capability of a machine to imitate intelligent human behavior “ (Merriam-Webster, n.d.). This definition is similar to John McCarthy’s (1927-2011) vision. Dr. McCarthy was involved in AI research since 1948 and was the first to use the term AI. Dr. McCarthy’s 1955 proposal was that, “… every aspect of learning and other properties of intelligence can be described so precisely that a machine can simulate it" (Lischka, 2011). But Dr. McCarthy later added, “… as soon as it works, no one calls it AI anymore” (Vardi 2012).

AI is being called the fourth industrial revolution. The first industrial revolution began around 1800. During this revolution, for the first time, goods and services were produced by machines. “Hard” capital in the form of railways, heavy industry, and the steam engine were essential inventions during this phase. The second revolution began at the end of the 19th century with electrification and the “soft” process innovation of the assembly line. The third industrial revolution began in the 1970s and was distinguished by further automation through electronics. With the personal computer and the internet, global access to information became possible. Human labor was replaced by machines in serial production. The newest revolution is the technical integration of cyber and physical systems into physical production processes. The introduction of AI distinguishes this fourth revolution. Now production is becoming controlled by decentralized self-organized machines being optimized in real time (Lischka, 2011).

In the near term, AI is predicted to have wide-ranging applications, including: 1) Machine learning that automates analytical model building by using algorithms that allow machines to operate without human assistance. Potential applications include predicting cause-and-effect relationships from biological data, identifying new drugs, self-driving cars, and protecting against fraud. 2) Improved natural language processing that allows computers to continue to better analyze, understand, and generate language to interface with humans using natural human languages. Examples of applications include transcribing notes dictated by physicians, automatically drafting articles, and translating text and speech. 3) Virtual personal assistants that help users by providing reminders, scheduling appointments, organizing their personal finances, and finding providers of various services. 4) Machine vision that allows computers to identify objects, scenes and activities in images. Current applications of machine vision include providing object descriptions for the blind, realistic facial reconstructions, car-safety systems that detect pedestrians and bicyclists, and street-view maps (Chen, et al., 2016).

In the longer term, Kurzweil (2005) sees nonbiological intelligence matching the range and subtlety of human intelligence by 2029 and what he calls the "Singularity" – point at which AI surpasses human intelligence - to occur by 2045 (Pratt, 2015). This sentiment is professed by numerous other technical pioneers such as Bill Gates and Elon Musk (Anderson, 2015). According to Kurzweil the "Singularity" will bring "the dawning of a new civilization that will enable us to transcend our biological limitations and amplify our creativity. In this new world, there will be no clear distinction between human and machine, real reality and virtual reality." He also noted that machines have a new capability that no biological species has: the ability to share knowledge and skills almost instantaneously with others (Pratt, 2015).

David Ricardo wrote that the "substitution of machinery for human labor, is often very injurious to the interests of the class of laborers" (Ricardo 1821). Many fear that these advances will bring extreme

Taylorism. Taylorism is a production efficiency methodology that breaks every action, job, or task into small and simple segments (BusinessDictionary.com, n.d.). Those that fear this outcome suggest that only the simplest tasks will be left to humanity if any task at all. About 47 per cent of total US employment is at risk from AI develops, read the catch line in the report by Frey/Osborne in 2013 (Frey & Osborne, 2017). Consistently according to a survey by Pew Research Center, 65 percent of US citizens expect that within 50 years a robot or an intelligent algorithm will be doing their work (Smith, 2019).

AI in some form is currently being implemented worldwide. According to Marianne D'Aquila, research manager of IDC, a worldwide technology consulting company "AI has moved well beyond prototyping and into the phase of execution and implementation." Retail will overtake banking to become the industry leader in terms of AI spending. Retail firms will spend billions on a range of AI use cases, including automated customer service agents, expert shopping advisors and product recommendations, and merchandising. Much of the dollars spent by the banking industry will go toward automated threat intelligence and prevention systems, fraud analysis and investigation, and program advisors and recommendation systems. Discrete manufacturing will be the third largest industry for AI spending investing in a range of efforts including automated preventative maintenance and quality management investigation and recommendation systems. The fourth largest industry, healthcare providers, will allocate most of its investments in diagnosis and treatment systems IDC (2018). Additionally, according to the Boston Consulting Group, the worldwide spending on military robotics (narrowly defined as only unmanned vehicles) will reach $16.5 billion by the year 2025 (Sander& Wolfgang, 2014).

There are four key drivers behind the rapid progress in AI technology: 1) Decades of exponential growth in computing performance, 2) Increased availability of large datasets upon which to train machine learning systems, 3) Advances in the implementation of machine learning techniques, and 4)

Significant and rapidly increasing commercial investment (Allen & Chan, 2017). These drivers are unlikely to decelerate.

The expected changes being brought by AI technologies will be significant and hard to predict for two reasons. First, they will depend on the speed that AI technologies will succeed in automating non-repetitive mental tasks currently performed by humans and replacing them in the process, and secondly the extent of the accelerated process of technological change as intelligent computer programs will become available and capable of developing new programs on their own (Makridakis, 2017). When previous “disruptive” technologies were introduced planning was important. Perhaps with AI it is more critical than ever for decision makers to plan and perhaps now is the time. Correctly predicting the impact of a revolution as far reaching as intelligent machines may become our final prediction.

This report will review the impact AI may have on economics/politics, firms, labor, and other areas. It will then concluded with a list of other areas deserving investigatory expansion and/or investigation.

## AI Impact

### Economic / Political

AI GDP growth includes direct growth from sectors that develop AI technology and indirect growth from increased productivity of existing sectors. Using multiple estimation techniques (i.e. implied impact of private industry investment, implied impact of venture capital investment, and benchmarking using past technological advancement), one study projected global economic impact associated with the use, development, and adoption of AI over a ten year period, to be in the range of $1.49 trillion to $2.95 trillion (Chen, et al., 2016).

AI may shape the agenda for economic growth. One theme that emerges is based on Baumol's "cost disease" insight.  Baumol (1967) observed that rapid productivity growth in some sectors relative to others could result in a "cost disease" in which the slow growing sectors become increasingly important in the economy. As a consequence, economic growth may be constrained not by what we do well but rather by what is essential and yet hard to improve. For example, the share of U.S. GDP and employment from agriculture, a now highly automated production process, has fallen toward zero. Maybe automation increases the capital share in these sectors and also interacts with other sectors in production or consumption to drive the GDP shares toward zero.  Automation tends to increase the share of capital within an economy. But because these automated goods experience faster growth, their price declines, and the low elasticity of substitution means that their shares of GDP also decline.  That is, automation is equivalent to a combination of labor-augmenting technical change and capital-depleting technical change (Aghion, Jones, & Jones,  2017).  In addition to the sector impacts, wages and interest rates have an impact on the choice of technology. Higher wages induce adoption of the automated technology, since it saves labor, while higher interest rates reduced adoption.  If one assumes capital mobility, interest rates are equal everywhere, but wages differ across countries and so wages have a positive effect on technology adoption since adoption involves purchasing machines that replace workers (Zeira, 1998).

If we look at a growth model (Jones, 2002), in which long-run growth arises from the discovery of new ideas, final output depends on physical capital, hours worked, human capital per person, and the stock of ideas.  Traditional growth accounting (Solow, 1957) calculates the stock of ideas as a residual. Modern growth theory explains that residual in terms of economic forces. Embedded in the modern production function is the key insight of Romer (1990): the nonrivalry of ideas leads to increasing returns. As a result, income per person depends on the total number of ideas, not on ideas per person. This contrasts sharply with capital or other rival inputs. Adding one new tractor to the economy benefits one farmer. Adding one new idea potentially benefits everyone, regardless of the size of the economy, because the idea is not depleted with use. New ideas come from an idea production function that depends on the number of people looking for new ideas as well as on the existing stock of ideas. In the long run, the stock of ideas is proportional to the number of researchers, which in turn is proportional to population. Thus, scale (e.g., the population of countries producing new ideas) matters for idea-based economies (Fernald & Jones, 2014).

These general premises seems reasonable enough and lead to our current state of worldwide economic dynamics with poorer country's lower wages being attractive to the developed world's investment. These models only consider the effects of gradual automation in the production of goods and ideas.  However, many observers, as noted above, have suggested that A.I. opens the door to something more extreme — a "singularity" - where growth rates will explode. Good and Vinge have suggested the possibility of a self-improving AI that will lead to an "intelligence explosion" associated with infinite intelligence in finite time (Good (1965), Vinge (1993)).  Such a situation leads to frontier technology development to become automated.

The result of such a change, as well as the general progress from AI, will have considerably different impacts on the developed and developing world (EIU, 2018).  Low-labour-cost countries, such as China, India and Bangladesh, are still benefiting from their surplus of low-skilled workers, while Western companies are still outsourcing their production to these countries. If, however, these companies decide to produce in their countries of origin in the future, using production robots and only a few workers, the surplus of low-skilled workers might turn into a curse for these developing countries (UBS 2016). Western developed countries will profit from the relocation of the companies' production sectors when robotic production becomes cheaper than human production in low-labour-cost countries. This will create new jobs in these countries and destroy many routine jobs in the low-labour-cost countries (Lischka, 2011). Additionally, countries with low education rates, lack of legal frameworks, lack of digital infrastructure will also be hamper (Lischka, 2011). In addition, as machines begin to figure out in no time how to imitate frontier technologies. Then a main source of divergence might become credit constraints, to the extent that those might prevent poorer countries or regions from acquiring super-intelligent machines whereas developed economies could afford such machines. Thus one could imagine a world in which advanced countries concentrate all their research effort on developing new product lines (i.e. on frontier innovation) whereas poorer countries would devote a positive and increasing fraction of their research labor on learning about the new frontier technologies as they cannot afford the corresponding AI devices. Overall, one would expect an increasing degree of divergence worldwide. A second conjecture is that, anticipating the effect of AI on the scope and speed of imitation, potential innovators may become reluctant to patent their inventions, fearing that the disclosure of new knowledge in the patent would lead to straight imitation. Trade secrets may then become the norm, instead of patenting. Or alternatively innovations would become like what financial innovations are today, i.e. knowledge creation with huge network effects and with very little scope for patenting. Finally, with imitation and learning being performed mainly by super-machines in developed economies, then research labor would become (almost) entirely devoted to product innovation, increasing product variety or inventing new products (new product lines) to replace existing products (Aghion, Jones, & Jones, 2017).

While the possibility of an explosive “singularity” exists, for now the impacts will be hard to monitor at the national level. The required adjustment costs, organizational changes, and new skills are intangible capital and often slow to exhibit an impact. This concept is known as the Solow (1987) Paradox: we see transformative new technologies everywhere but in the productivity statistics. In the development of general purpose technologies (GPT) there can be implementation and restructurings lags. Basically, it takes a considerable time—often more than is commonly appreciated—to be able to sufficiently harness new technologies. There are two main sources of the delay between recognition of a new technology's potential and its measureable effects. One is that it takes time to build the stock of the new technology to a size sufficient enough to have an aggregate effect. The other is that complementary investments are necessary to obtain the full benefit of the new technology, and it takes time to discover and develop these complements are and to implement them (Brynjolfsson, Rock & Syverson, 2017).

It is likely that as AI develops there will become countries that have this important resource and that resource develops into its most important and largest asset. This could lead to what is known as the Resource Curse. This problem refers to countries where natural resources comprise a large portion of the economy. AI may become such a "resource." In this type of situation countries tend to be more unstable than countries with more diversified economies. The main mechanisms for the Resource Curse: 1) The composition of extractive industries promotes inequality and poor governance, 2) Redistribution of resource revenues risks government corruption (i.e. inequality promotes political and civil conflict), and, 3) Success in the particular resource export sectors harms other industries: (Stevens, Lahn, & Kooroshy, 2015).

Another implication of AI, is that its introduction may speed up the process by which each individual sectors becomes congested over time. This in turn may translate into faster decreasing returns to innovating within any existing sector (see Bloom, Garicano, Sadun and Van Reenen (2014)), but by the same token it may induce potential innovators to devote more resources to inventing new lines in order to escape competition and imitation within current lines. The overall effect on aggregate growth will in turn depend upon the relative contributions of within-sector secondary innovation and fundamental innovation aimed at creating new product lines (see Aghion and Howitt (1996)) to the overall growth process. In the end, whether escape competition or discouragement effects will dominate, will depend upon the type of sector, the extent to which A.I. facilitates reverse engineering and imitation, and upon competition and/or regulatory policies aimed at protecting intellectual property rights while lowering entry barriers. (Aghion, Jones, & Jones, 2017)

Finally, there is one cautionary note. Because of autonomous systems' high speed and the potential for unexpected interactions, any errors can spiral out of control rapidly. One ominous example is the stock market "Flash Crash" of May 2010, which the U.S. Securities and Exchange Commission reported was enabled and exacerbated by use of autonomous financial trading systems (Pisani, 2015).

National security is likely to become an important state issue as AI develops. AI has the potential to be a transformative national security technology, on a par with nuclear weapons. Advances in AI will affect many issues of military security. Progress in AI will both enable new capabilities and make existing capabilities affordable to a broader range of actors. For example, commercially available, AI-enabled technology (such as long-range drone package delivery) may give weak states and non-state actors access to a type of long-range precision strike capability. AI-enhanced forgery of audio and video media is rapidly improving in quality and decreasing in cost. In the future, AI-generated forgeries will challenge the basis of trust across many institutions. Propaganda for authoritarian and illiberal regimes increasingly becomes indistinguishable from the truth. Population size will become less important for national power. Small countries that develop a significant edge in AI technology will punch far above their weight.

Firms

AI is likely to produce large internal reorganizations and work design changes at the firm level. When implementing large enterprise planning systems, firms almost always spend several times more money on business process redesign and training than on the direct costs of hardware and software.

Hiring and other HR practices often need considerable adjustment to match the firm's human capital to the new structure of production. But such changes take substantial time and resources, contributing to organizational inertia. Firms are complex systems that require an extensive web of complementary assets to allow the GPT to fully transform the system. Customers will have to be "retrained" (Brynjolfsson, Rock & Syverson, 2017).

Changes in work structures will likely result in virtual working groups. These virtual teams will work independently with shared purpose across space, time, and organization boundaries. Matrix structures will dominate. The increased interconnection and internationalisation of companies changes not only the traditional internal company structures, but also the need for the establishment of cross-company and cross-border units (Wisskirchen, et al. 2017).

Smaller organization may develop as AI potentially favors the development of self-employment for at least two reasons: 1) it may induce AI intensive firms to outsource tasks, starting with low-occupation tasks and 2) it makes it easier for independent agents to develop individual reputations as more responsive to changes in the environment (Aghion, Jones, & Jones, 2017).

Firms dominated by AI technology are likely to become more secretive. In a paper by Baslandze (2016) the argument, which may apply to A.I., rests on the following two counteracting effects of IT on innovation incentives: on the one hand, firms can more easily learn from each other and therefore benefit more from knowledge diffusion from other firms and sectors; on the other hand, the improved access to knowledge from other firms and sectors induced by IT (or AI) increases the scope for business-stealing. In high-tech sectors where firms benefit more from external knowledge, the former - knowledge diffusion - effect will dominate whereas in sectors that do not rely much on external knowledge the latter - competition or business-stealing- effect will tend to dominate. Indeed in more knowledge dependent sectors firms see both their productive and their innovative capabilities increase to a larger extent than the capabilities of firms in sectors that rely less on knowledge from other sectors (Aghion, Jones, & Jones, 2017).

Labor

The critical question for labor is: "what will the role of humans be at a time when computers and robots could perform as well or better and much cheaper, practically all tasks that humans do at present?" The optimists argue that humans will be able to spend their time performing activities of their choice and working, when they want, at jobs that interest them. The pessimist counter with AI will make humans an endangered species (Makridakis, 2017). The predictions of the optimist sound inviting, if probably unrealistic; the predictions of the pessimist are likely overstated. There will likely not be a dramatic decline in unemployment due to AI. In general, although employment in certain industries has been reduced in the past due to technological advancements, the net effect of technological advancement has not appeared to lead to a reduction in long-term total employment. (Atkinson, 2013). Clearly, the past two centuries of automation and technological progress have not made human labor obsolete: the employment-to-population ratio rose during the 20th century even as women moved from home to market; and although the unemployment rate fluctuates cyclically, there is no apparent long-run increase. Automation does indeed substitute for labor—as it is typically intended to do. However, automation also complements labor, raises output in ways that lead to higher demand for labor, and interacts with adjustments in labor supply (David, 2015). Extrapolating from the impact of the Industrial and digital revolutions it seems that technology has created more jobs than it has destroyed; although there may be a transitional period of increased unemployment until new opportunities are created to serve the emerging needs of those with increased incomes (Stewart et al., 2015).

The transitional reallocation of labor is likely along the following lines. Job categories likely to see reduction: 1) High-routine occupations (e.g. accountant, court clerk or desk officer at fiscal authorities, and 2) Simple physical work/manual work (e.g. simple work mostly carried out by mere physical strength will be increasingly, but never completely, performed by machines). Job categories likely to see increases: 1) IT Management and science positions, 2) Teaching professions, 3) Humanistic, social science, and artistic professions. In addition to changes in job opportunities, changes such as working relationships, job profiles, working times, and remuneration models will undergo changes (Wisskirchen, et al., 2017) (Aghion, Jones, & Jones, 2017).

During transitional labor phases or if laborers become permanently unemployed, how social security systems will compensate and who will ultimately pay the costs, will be a central issues. The companies will share the costs in part by bearing the costs for retraining and by making severance payments in the event of dismissals. Many people will not be able to retrain for another position for physical or cognitive reasons. These people will become long-term unemployed and will have to be supported by the state. The high financial pressure on social welfare systems will be a central problem. As an alternative to the unconditional basic income, governments could introduce higher minimum social standards by revolutionizing the progressive tax systems, distributing subsidies or vouchers or offering rewards/prizes. The advantage these alternatives have over the unconditional basic income is that working is not rendered unattractive. As a substitute, the state could reduce the maximum working hours by law so that existing jobs must be allocated to several employees (Wisskirchen, et al. 2017).

Changes in labor health and safety regulations will need to keep up with technological progress. To make dealings with safe between humans and robots possible, safety and insurance law standards will likely need updating to adapt to newer technologies. The right mixture that gives companies enough room for innovation, but at the same time serves the purpose of providing employee protection will not be easy to strike (Wisskirchen, et al., 2017). Additionally, the breakdown of boundaries for working time means that both employers and employees have leeway to organize working hours. This will require rule updating. Customarily, the risk that an employee became sick, needed vacation, and appropriate terminations were borne primarily by the employer. If technology breaks down those traditional understandings, new rules will have to be developed (Wisskirchen, et al., 2017).

Other Issues

Issues of ethics will need sociality vetting. For example, algorithmic bias occurs when a system produces undesirable or unfair results. This may be because the training data sets for the algorithms are themselves biased in some way, or because the operation of the algorithm itself creates bias. This will be an especially difficult issue where the AI involved lacks transparency. For example, recruiters are going to favor the competent, other things being equal. However, if certain groups in a recruiting algorithm are less represented than other groups because they are identified as more competent by the algorithm this can create a whole host of legal, political, sociological and moral issues. "Training" algorithms to avoid these complications will likely be challenging. Especially, if these algorithms on shared internationally (Boddington, 2017).

AI so far has developed in a legal/regulatory vacuum. Virtually no courts appear to have developed standards specifically addressing who should be held legally responsible if an Al causes harm. Ex ante regulation may be difficult because Al research and development may be discreet (requiring little physical infrastructure), discrete (different components of an Al system may be designed without conscious coordination), diffuse (dozens of individuals in widely dispersed geographic locations can participate in an Al project), and opaque (outside observers may not be able to detect potentially harmful features of an Al system). The autonomous nature of Al creates issues of foreseeability and control that might render ex post regulation ineffective, particularly if an Al system poses a catastrophic risk. Moreover, regulation at any stage is complicated by the difficulty in defining what, exactly, "artificial intelligence" means. AI systems will perform actions that are unforeseeable to their designers and operators; and the potential for AI to be developed so clandestinely or diffusely as to render effective ex ante regulation impracticable. These issues will need to be addressed (Scherer, 2015).

Few countries have begun to address the impact of automation through educational policy. Intelligent automation is expected to boost the importance of both education related to STEM (science, technology, engineering and mathematics) and of so-called soft skills, which allow workers to trade on their uniquely human capabilities. However, in all but a few countries, little has been done to prepare future workers through school curricula or, just as importantly, teacher training (EIU, 2018).

## Areas for Further Exploration

The below is a listing of areas deserving investigatory expansion and/or investigation:

- Methods for indexing AI country and firm level deployment of AI technology.
- Techniques for calculating the firm level intangible costs in AI deployment.
- Methods to evaluate industry implementation of AI and associated value generation.
- Processes for monitoring labor flows and developments associated AI.
- Indexing progress of government/social response to AI implementation.
- Tracking public awareness of and attitudes toward AI deployment.
- Evaluating Impact from governmental expenditures on and transferability of basic AI research.
- Estimating endogenous creation of AI and it impact on economic growth.
- Estimating exogenous adoption of AI and it impact on economic growth.
- Modeling “Singularity” growth and observing its impact economic growth.
- Modeling impact from governmental establishment of AI ethics, rules, and guidelines.
- Methods to evaluate the impact from AI educational preparatory strategies.

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