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The Impact of Artificial Intelligence on Innovation

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Abstract:- The difficulties associated with sustainability and the digital transformation are causing significant social changes that are exerting significant pressure on competitiveness. A multidisciplinary field called artificial intelligence (A.I.) aims to automate tasks that presently require human intelligence. Artificial intelligence (AI), despite not being widely known, is a technology that is transforming all facets of existence. The development of artificial intelligence, the financial implications of novel investigation tools, the interaction between new invention techniques and universality of invention, and how it impacts innovation are the topics covered in this paper.

I. INTRODUCTION

Making computers operate more like humans in a small fraction of the time it takes a person to do it is the goal of artificial intelligence. Therefore, it is referred to as artificial intelligence. The advancement of computer science in real applications is another goal of artificial intelligence. Business and society at large will be greatly impacted by the quick development of artificial intelligence. With significant ramifications for productivity, employment, and competition, these developments have the potential to have a direct impact on both the production and the characteristics of a wide range of goods and services. Although these effects are likely to be significant, artificial intelligence also has the potential to alter the innovation process itself, with implications that could be just as significant and that could eventually outweigh the direct impact.

While deep learning holds out the possibility of not only productivity gains across a wide variety of sectors but also changes in the very nature of the innovation process within those domains, some applications of artificial intelligence will undoubtedly constitute lower-cost or higher-quality inputs into many existing production processes, raising concerns about the potential for significant job displacements. The "invention of an invention method" has the potential to have a much greater economic effect than the development of any single new product, as notably stated by Griliches (1957), by allowing innovation across many applications. Here, we contend that recent developments in machine learning and neural networks are likely to have a disproportionately significant effect on innovation and growth due to their capacity to enhance both the functionality of end use technologies and the nature of the innovation process. As a result, developing an understanding of the circumstances under which various potential innovators are able to access these tools and use them in a pro-competitive manner is a key concern for policy. These factors include the incentives and barriers that may shape the development and diffusion of these technologies.

II. THE FINANCIAL IMPACT OF NEW RESEARCH TOOLS: THE INTERACTION BETWEEN NEW INVENTION METHODS AND INNOVATION

Economists are aware of the possibility of significant underinvestment in research, especially in fundamental research or areas of invention with low inventor appropriability. There has been significant progress made in understanding the circumstances in which the incentives for innovation may be slightly or significantly distorted, both in terms of the overall strength of those incentives and the way in which that research is going.

Two concepts stand out as particularly significant as we consider the potential effects of AI advancements on innovation: the potential for contracting issues related to the creation of a new, broadly applicable research tool and the potential for coordination issues related to the adoption and diffusion of a new "general purpose technology." We contend that those branches of artificial intelligence that are developing most quickly—like deep learning—are likely to raise significant challenges in both dimensions, in contrast to technological advancement in relatively limited domains, like traditional automation and industrial robots.

First, think about how difficult it is to offer the right incentives for innovation when a given innovation has the potential to affect a wide range of different uses in terms of organisational and technological change. These "general purpose technologies" frequently come in the form of fundamental discoveries that have the potential to substantially raise productivity or quality in a variety of industries or fields.

According to David's groundbreaking research on the electric motor, industries as varied as manufacturing, agriculture, retail, and residential building all experienced significant technological and organisational change as a result of this invention. Such "GPTs" are typically understood to satisfy three requirements that set them apart from other innovations: they have widespread application across many sectors; they encourage additional innovation in those sectors; and they are themselves improving quickly.

According to Bresnahan and Trajtenberg (1995), the existence of a general-purpose technology causes both vertical and horizontal externalities in the innovation process, which can result in underinvestment as well as distortions in the direction of investment. based on how differently private and social returns perform across various application sectors. In particular, if there are "innovation complementarities" between general purpose technology and each of the application sectors, a dearth of incentives in one sector can cause an indirect externality that results in a system-wide decline in innovative investment itself.

The market structure and conditions for appropriability determine the private incentives for innovative investment in each application sector, but regardless of these factors, the innovation in that sector advances innovation within the GPT, which in turn stimulates demand (and additional innovation) in other application sectors that are downstream. Rarely is the originating industry able to appropriate these gains. Therefore, a lack of coordination within and across application sectors, as well as between the GPT and application sectors, is likely to result in a substantial decrease in investment in innovation. Despite these obstacles, as the rate of innovation rises across all sectors, a reinforcing cycle of innovation between the GPT and a broad range of application sectors can lead to a more systemic transformation of the entire economy.

The economics of study tools serves as a second conceptual framework for reasoning about AI. Some innovations in the research fields lead to new lines of enquiry or merely increase productivity "in the lab". Some of these innovations seem to have a lot of promise. over a wide range of fields, beyond the context of their original use: Some new research tools are innovations that don't just create or improve a specific product; rather, they represent a new way of creating new products, with much wider application, as Griliches (1957) emphasised in his classic studies of hybrid corn.

Machine learning and neural network developments seem to have a lot of promise as a research tool for classification and prediction issues. In a variety of research projects, these are both significant limiting factors, and, as demonstrated by the Atomwise example, application In R&D initiatives where these are major challenges, the use of "learning" approaches to AI holds out the promise of dramatically lower costs and improved performance.

Many research tools are neither IMIs nor GPTs, and their main effects are to lower the price or improve the standard of an already established innovation process. For instance, new materials in the pharmaceutical sector claim to increase the effectiveness of certain study methods. While other study tools can be conceptualised as IMIs, their scope of use is still fairly constrained. In contrast to innovation in fields like information technology, energy, or aerospace, the creation of genetically engineered research mice (such as the Oncomouse) has had a significant effect on how biomedical research is conducted and organised.

The problem with advances in AI is that they seem to be research tools that not only have the ability to alter how innovation is conducted but also have implications for a very broad variety of fields.

III. THE FIELD OF ROBOTICS SYMBOLIC SYSTEMS, AND NEURAL NETWORKS IN THE DEVELOPMENT OF ARTIFICIAL INTELLIGENCE

Nilsson defines AI as "that activity devoted to making machines intelligent, and intelligence is that quality that enables an entity to function appropriately and with foresight in its environment" in his exhaustive historical account of AI research. He describes how various disciplines, including but not limited to biology, languages, psychology, and cognitive sciences, as well as mathematics, philosophy, and logic, engineering, and computer science, have contributed to the advancements in AI. Without a doubt, Turing (1950) and his discussion of the possibility of mechanising intelligence have been a central point of engagement for artificial intelligence study since its inception, regardless of their particular methodologies.

Though often grouped together, the intellectual history of AI as a scientific and technical field is usefully informed by distinguishing between three interrelated but separate areas: robotics, neural networks, and symbolic systems. Perhaps the most successful line of research in the early years of AI—dating back to the 1960s—falls under the broad heading of symbolic systems.

Robotics has generally been the focus of a second important trajectory in AI. Although the idea of "robots" as machines that can carry out human tasks has been around since at least the 1940s, it wasn't until the 1980s that the field of robotics really started to take off. This was due to a combination of enhancements in mathematically controlled machine tools and the creation of more adaptive but still rule-based robotics that depend on active sensing of a known environment. With the widespread use of "industrial robots" in manufacturing uses, this field of AI may have seen its most economically significant application to date.

These devices have been carefully programmed to perform a specific job in a tightly regulated setting. These purpose-built tools, which are frequently contained in "cages" within highly specialised industrial processes (most notably automobile manufacturing), might be better described as highly advanced numerically controlled machines than as robots with substantial AI content. Manufacturing and automation have benefited significantly from robotics innovation over the past 20 years, particularly with the development of more responsive robots that depend on preprogrammed response algorithms that can react to a variety of inputs.

This strategy, which Rod Brooks (1990) notably pioneered, shifted the commercial and innovation orientation of AI away from the modelling of intelligence akin to that of humans and towards providing feedback mechanisms that would enable useful and efficient robotics for particular applications. The Roomba and other flexible industrial robots that could communicate with people, like Baxter from Rethink Robotics, were among the applications of this insight. Wider application and adoption outside industrial automation may result from continued innovation in robotics technologies (particularly in the capacity of robotic devices to perceive and interact with their environment).

These developments are significant, and whenever the word "AI" is used, the most sophisticated robots continue to capture people's attention. However, typically speaking, robotics advancements are not IMIs. Although the automation of laboratory equipment increases research productivity, these developments in robotics are not (yet) fundamentally linked to the ways in which researchers may create methods for pursuing innovation in a variety of areas.

Naturally, there are examples that refute this statement: robotic space probes have been a crucial research tool in planetary science, and the ability of automated remote sensing devices to gather data at very large scales or in difficult environments may revolutionise some areas of study. Robots are still primarily employed in specialised end-use "production" uses, though.

Finally, a third area of study that has been crucial to AI since its inception can be generally referred to as a "learning" strategy. The learning approach seeks to develop trustworthy and accurate methods for the prediction of specific events (either physical or logical) in the presence of specific inputs rather than being concentrated on symbolic logic or precise sense-and-react systems. In this context, the idea of a neural network has been especially significant. A neural network is a computer programme that translates a set of inputs into a set of outputs using a mix of weights and thresholds, evaluates how "close" these outputs are to reality, and then modifies the weights it employs to close the gap.

The field of neural networks has gone in and out of style, especially in the US, after being originally hailed as showing great promise. Their issue seemed to be that the technology had significant limitations that could not be easily rectified by using bigger training datasets or by adding extra layers of "neurons" from the 1980s until the mid-2000s. However, a limited number of novel algorithmic techniques showed promise for improving prediction through back propagation through multiple layers in the middle of the 2000s. As they were applied to ever-larger datasets, these neural networks' predictive power grew, and they could scale to any level.

IV. WHAT POTENTIAL EFFECTS ON INNOVATION MIGHT VARIOUS BRANCHES OF ARTIFICIAL INTELLIGENCE HAVE?

Distinguishing between these three streams of AI is a critical first step towards developing a better understanding of how AI is likely to influence the innovation process going forward, since the three differ significantly in their potential to be either GPTs or IMIs—or both. First, though a significant amount of public discussion of AI focuses on the potential for AI to achieve super-human performance over a wide range of human cognitive capabilities, it is important to note that, at least so far, the significant advances in AI have not been in the form of the "general problem solver" approaches that were at the core of early work in symbolic systems.

Infact, most recent developments in robotics and deep learning pertain to areas of problem-solving that are relatively limited in scope and require a substantial amount of human planning. (e.g., face recognition, playing Go, picking up a particular object, etc.) Although it is undoubtedly conceivable that future developments will produce technology that can accurately imitate the characteristics of human subjective intelligence and emotion, the most recent developments that have garnered scientific and commercial attention are distinctly unrelated to these fields.

Second, it is crucial to emphasise that there is a significant difference between the potential applications of deep learning which have come to the fore in recent years and the advancements in robotics which were a primary focus of applications of AI research during the 2000s. While most economic and policy analysis of AI draws out consequences from the last two decades of automation to consider the future economic impact of AI (e.g., in job displacement for an ever-increasing number of tasks).

The majority of current robotics advancements are connected to highly specialised uses that are more concerned with end-user needs than with the innovation process itself, and these advancements do not yet appear to have led to a more broadly applicable IMI. Thus, we might concentrate on the effects of innovation (improved performance) and diffusion (more widespread application) in the context of robotics in terms of job displacement versus work enhancement. Since the use of robotics outside

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of manufacturing is likely to require significant advancements in the capacity to sense, respond to, and control the physical environment, there is currently little evidence of widespread robotics uses outside of industrial automation.

While lacking generality, some research tools and IMIs based on algorithms have changed the way some areas of research are conducted. These algorithmic research tools, which are based on a static set of programming instructions, are useful IMIs but do not seem to have widespread applicability outside of a particular area, so they do not meet the criteria for GPTs. For instance, even though they are far from perfect, sophisticated algorithms to scan brain images (known as functional MRI imaging) have fundamentally changed our understanding of the human brain. This is due to the knowledge they have produced as well as the fact that they have established a completely new paradigm and protocol for brain research. Although fMRI serves as a potent IMI, it lacks the kind of all-purpose utility that has been connected to the most significant GPTs.

These concepts are outlined in the below table:

Table 1 General Purpose Technology

	No	**Yes**
NO	Industrial Robots Example -Fanuc R 2000	Sense Robots Example- Automated vehicles
YES	Statically coded Arithmetic tools	DEEP LEARNING

V. CONCLUSION

This research paper does not aim to offer a systematic analysis or forecast of the probable effects of AI on innovation, nor does it aim to offer clear recommendations for management or policy. Instead, we wanted to raise the possibility that deep learning is a brand-new, universally applicable invention of an invention technique and to identify some initial management, institutional, and policy implications of that hypothesis.

Our preliminary research identifies a few crucial concepts that have not yet been at the forefront of the debate over economics and policy. First, it's important to make a distinction between significant and significant advancements in fields like robotics and the potential for a general-purpose invention method based on the application of multilayered neural networks to large amounts of digital data to be a "invention in the method of invention," at least from the perspective of innovation.

Our early empirical analysis and the qualitative data already available show a notable shift since 2009 towards deep learning-based application-oriented research, which is consistent with this possibility. Second, and in a related vein, the possibility of a change in the innovation process poses important questions for a variety of policy and management areas, from how to assess this new type of science to the potential for prediction methods to create new entry barriers across a broad range of industries. Future research in the field of proactive analysis of the appropriate private and governmental responses to these advances appears to be very promising.

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