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INTRODUCTION

Chairman Wicker, Ranking Member Schatz and members of the subcommittee, I appreciate the opportunity to appear before you to discuss the importance of artificial intelligence (AI) to the U.S. economy and how best to govern this important technology. My name is Daniel Castro, and I am vice president of the Information Technology and Innovation Foundation (ITIF), a non-profit, nonpartisan think tank whose mission is to formulate and promote public policies to advance technological innovation and productivity, and director of ITIF's Center for Data Innovation.

WHAT IS ARTIFICIAL INTELLIGENCE?

AI is a field of computer science devoted to creating computer systems that perform tasks much like a human would, particularly tasks involving learning and decision-making.[1] AI has many functions, including, but not limited to:

- Learning, which includes several approaches such as deep learning (for perceptual tasks), transfer learning, reinforcement learning, and combinations thereof;
- Understanding, or deep knowledge representation required for domain-specific tasks, such as medicine, accounting, and law;
- Reasoning, which comes in several varieties, such as deductive, inductive, temporal, probabilistic, and quantitative; and
- Interacting, with people or other machines to collaboratively perform tasks, and for interacting with the environment.

The cause of many misconceptions about AI, particularly its potential harms, is that some people conflate two very distinct types of AI: narrow AI and strong AI. Narrow AI describes computer systems adept at performing specific tasks, but only those specific types of tasks—somewhat like a technological savant.[2] For example, Apple's Siri virtual assistant is capable of interpreting voice commands, but the algorithms that power Siri cannot drive a car, predict weather patterns, or analyze medical records. While other algorithms exist that can accomplish those tasks, they too are narrowly constrained—the AI used for an autonomous vehicle will not be able predict a hurricane's trajectory or help doctors diagnose a patient with cancer.

In contrast, strong AI, also referred to as artificial general intelligence (AGI), is a hypothetical type of AI that can meet or exceed human-level intelligence and apply this problem-solving ability to any type of problem, just as the human brain can easily learn how to drive a car, cook food, and write code.[3] Many of the dystopian fears about AI—that it will eliminate most jobs or go out of control and wipe out humanity, for example—stem from the notion that AGI is feasible, imminent, and uncontrollable.[4] However, at least for the foreseeable future, computer systems that can fully mimic the human brain are only going to be found in scripts in Hollywood, and not labs in Silicon Valley.

The application of AI has seen a surge in recent years because of the development of machine learning—a branch of AI that focuses on designing algorithms that can automatically and iteratively build analytical models from data without needing a human to explicitly program the solution. Before machine learning, computer scientists had to manually code a wide array of functions into a system for it to mimic intelligence. But now developers can achieve the same, or better, results more quickly and at a lower cost using machine learning techniques. For example, Google uses machine learning to automatically translate content into different languages based on translated documents found online, a technique that has proven to be much more effective than prior attempts at language translation.[5]

WHAT ARE THE POTENTIAL BENEFITS OF AI?

AI will have a substantial and lasting impact on the economy by increasing the level of automation in virtually every sector, leading to more efficient processes and higher-quality outputs, and boosting productivity and per-capita incomes. For example, the McKinsey Global Institute estimates that by 2025 automating knowledge work with AI will generate between $5.2 trillion and $6.7 trillion of global economic value, advanced robotics relying on AI will generate between $1.7 trillion and $4.5 trillion, and autonomous and semi-autonomous vehicles will generate between $0.2 trillion and $1.9 trillion.[6] Deloitte estimates that the federal government could save as much as $41.1 billion annually by using AI to automate tasks.[7] And Accenture predicts that by 2035, AI could increase the annual growth rate of the U.S. economy by 2 percentage points, the Japanese economy by 1.9, and the German economy by 1.6.[8] The report also found that, for the 12 countries surveyed, AI would boost labor productivity rates by 11 to 37 percent.[9]

There are a vast and diverse array of uses for AI, and many U.S. businesses are already using the technology today. Manufacturers are using AI to invent new metal alloys for 3D printing; pharmaceutical companies are using AI to discover new lifesaving drugs; mining companies are using AI to predict the location of mineral deposits; and agricultural businesses are using AI to increase automation on farms. The International Data Corporation (IDC) estimates that the market for AI technologies that analyze unstructured data will reach $40 billion by 2020.[10] And AI startups have attracted significant investment, with U.S. investors putting $757 million in venture capital in AI start-ups in 2013, $2.18 billion in 2014, and $2.39 billion in 2015.[11]

In some cases, the principle benefit of AI is that it automates work that would otherwise need to be performed by a human, thereby boosting efficiency. Sometimes AI can complete tasks that it is not always worth paying a human to do but still creates value, such as writing newspaper articles to summarize Little League games.[12] In other cases, AI adds a layer of analytics that uncovers insights human workers would be incapable of providing on their own, thereby boosting quality. In some cases, it does both. For example, researchers at Stanford have used machine learning techniques to develop software that can analyze lung tissue biopsies with significantly more accuracy than a top human pathologist and at a much faster rate.[13] By analyzing large volumes of data, researchers can train their computer models to reliably recognize known indicators of specific cancer types as well as discover new predictors.

AI is also delivering valuable social benefits, such as by helping authorities rapidly analyze the deep web to crack down on human trafficking, fighting bullying and harassment online, helping development organizations better target impoverished areas, reducing the influence of gender bias in hiring decisions, and more.[14] Just as AI can help businesses make smarter decisions, develop innovative new products and services, and boost productivity to drive economic value, it can achieve similar results for organizations generating social value, and many of these solutions have the potential to scale globally.

Finally, AI will be an increasingly important technology for defense and national security. AI can address many goals, such as improving logistics, detecting and responding to cybersecurity incidents, and analyzing the enormous volume of data produced on the battlefield. Moreover, AI will be a core enabler of the Pentagon's "Third Offset Strategy," a policy designed to keep the United States ahead of adversaries, especially ones capable of fielding numerically superior forces, through technological superiority.[15] Indeed, one top Pentagon general has suggested that the Defense Department should never buy another weapons system that does not have AI built into it.[16]

HOW SHOULD POLICYMAKERS SUPPORT THE ADOPTION AND USE OF AI?

Given the potential economic impact of AI in raising productivity, policymakers should develop a national strategy to support the development and adoption of AI in U.S. businesses. In particular, given the enormous

advantage that AI-enabled firms will have compared to their non-AI-enabled peers, the United States should focus on AI adoption in its traded sectors where U.S. firms will face international competition. Many other countries see the strategic importance of becoming lead adopters of AI, and they have begun implementing policies to pursue this goal. These include:

- Canada: In March 2017, Canada launched the Pan-Canadian Artificial Intelligence Strategy which sets a goal of establishing Canada as an international leader in AI research. The strategy has four goals, which include increasing the number of AI researchers and graduates; establishing three major AI research centers; developing global thought leadership on the economic, ethical, policy and legal implications of advances in AI; and supporting the national AI research community.[17]
- China: China's State Council issued a development plan for AI in July 2017 with the goal of making China a leader in the field by 2030. China's goal is to be equal to countries currently leading in AI by 2020. Then, over the subsequent five years, China will focus on developing breakthroughs in areas of AI that will be a "a key impetus for economic transformation."[18] Finally, by 2030, China intends to be the world's "premier artificial intelligence innovation center."[19] China's plan also signals its intent to require high school students to take classes in AI, which is one of the most ambitious efforts to develop human capital for the AI economy of any nation.
- Japan: Prime Minister Abe launched the Artificial Intelligence Technology Strategy Council in April 2016 to develop a roadmap for the development and commercialization of AI.[20] Published in May 2017, the roadmap outlines priority areas for research and development (R&D), focusing on the themes of productivity, mobility, and health. The strategy also encourages collaboration between industry, government, and academia to advance AI research, as well as stresses the need for Japan to develop the necessary human capital to work with AI. Japan also launched its Japan Revitalization Strategy 2017, which details how the government will work to support growth in certain areas of the economy. The 2017 strategy includes a push to promote the development of AI for telemedicine and self-driving vehicles to address the shortage of workers in Japan.
- UK: The United Kingdom has taken several steps to promote AI. The UK Digital Strategy, published in March 2017, recognizes AI as a key field that can help grow the United Kingdom's digital economy.[21] The UK's new budget, published in November 2017, includes several provisions that have the goal of establishing the UK as a world leader in AI, such as by establishing a "Centre for Data Ethics and Innovation" to promote the growth of AI, facilitating data access for AI through "data trusts," and funding 450 PhD researchers working on AI.[22]

While the U.S. government has put significant funding behind AI R&D— approximately $1.1 billion in 2015—it has not done enough to maintain U.S. leadership.[23] The most ambitious AI program comes from China, which as of 2014 surpassed the United States in terms of total number of papers published and cited in AI fields, such as deep learning.[24] For both economic and national security reasons, the United States cannot afford to cede its existing advantages in AI, and should instead look to capitalize on its head start by developing a strategy to support AI development and adoption. Such a strategy should include policies to address the following:

- Funding: The government should continue to expand its funding to support the "National Artificial Intelligence Research and Development Strategic Plan," a set of R&D priorities identified by the Networking and Information Technology Research and Development (NITRD) program that addresses strategic areas of AI in which industry is unlikely to invest, as well as better plan and coordinate federal funding for AI R&D across different agencies.[25]

- Skills: The federal government should support educational efforts to ensure a strong pipeline of talent to create the next generation of AI researchers and developers, including through retraining and diversity programs, as well as pursue immigration policies that allow U.S. businesses to recruit and retain highly skilled computer scientists.
- AI-Friendly Regulations: Federal and state regulators should conduct regulatory reviews to identify regulatory barriers to commercial use of AI in various industries, such as transportation, health care, education, and finance.
- Data Sharing: Some advances in AI are made possible when large volumes of accurate and representative data are made part of a data commons. The government should continue to supply high-value datasets that enable advances in AI, such as its efforts to produce standardize reference datasets for text analysis and facial recognition. Similarly, federal agencies should facilitate data sharing between industry stakeholders, such as the Department of Transportation's draft "Guiding Principles on Data Exchanges to Accelerate Safe Deployment of Automated Vehicles."[26]
- Economic Indicators: Understanding the degree to which U.S. firms have automated processes using AI will be a key metric to assessing the effectiveness of various policies. The Census Bureau should assess what type of economic data it should gather from businesses to monitor and evaluate AI adoption, much like it has tracked rural electrification or broadband connectivity as key economic indicators.

HOW SHOULD POLICYMAKERS ADDRESS CONCERNS ABOUT WORKFORCE DISRUPTION?

One of the most common fears about AI is that it will lead to significant disruptions in the workforce.[27] This fear is not new—concerns about technology-driven automation have been a perennial policy concern since at least the 1930s when Congress debated legislation that would direct the Secretary of Labor to make a list of all labor-saving devices and estimate how many people could be employed if these devices were eliminated.[28] This concern has been exacerbated by a frequently-cited study by two Oxford academics which predicted that 47 percent of U.S. jobs could be eliminated over the next 20 years.[29]

This study's predictions are misleading and unlikely for at least three reasons. First, the estimate includes a number of occupations that have little chance of automation, such as fashion models and barbers. Second, while this rate of productivity seems high and even threatening, it is only slightly higher than rates enjoyed in the mid-1990s when U.S. job creation was robust and unemployment rates low. Third, it succumbs to what economists call the "lump of labor" fallacy which holds that once a job is gone, there are no other jobs to replace it. The reality is that AI-driven productivity enables organizations to either raise wages or reduce prices. These changes lead to increases in spending, which in turn creates more jobs. And given that consumers' wants are far from satisfied, there is no reason to believe that this dynamic will change anytime soon.

But while predictions about massive AI-driven unemployment are vastly overstated—indeed, by historical standards occupational churn, the rate at which some jobs expand while others contract, is at its lowest levels in 165 years—there will still be some worker displacement as AI creates higher levels of productivity.[30] So policymakers can and should do more to help workers make transitions between jobs and occupations, such as by providing strong social safety net programs, reforming unemployment insurance, and offering worker retraining. The failure to give workers training and assistance to move into new jobs or occupations not only contributes to higher structural unemployment, but also increases resistance to innovation and automation.[31]

HOW SHOULD POLICYMAKERS PROVIDE OVERSIGHT OF AI?

When it comes to AI, the primary goal of the United States should be to accelerate the development and adoption of the technology. But as with any technology, there will be some risks and challenges that require government oversight. The presence of risk, however, does not mean that the United States should embrace the precautionary principle, which holds that new technology must first be proven safe before it can be used. Instead, policymakers should rely on the innovation principle, which says that policymakers should address risks as they arise, or allow market forces to address them, and not hold back progress because of speculative concerns. The innovation principle is especially useful when fears about a new technology exceed public awareness and understanding about how the technology works and how potential problems will be mitigated.[32]

To understand why this is important, consider the differences between the United States and the European Union in the Internet economy. Compared to Europe, the United States has had more success in the Internet economy, at least in part, because of its vastly more simplified data protection regulations. Yet even as the United States continues to produce the majority of the major global Internet companies, the European Union has decided to double down on its onerous data protection rules in the forthcoming General Data Protection Regulation (GDPR), a far-reaching set of policies that will substantially raise the costs, and in some cases, limit the feasibility of using AI in Europe. For example, the GDPR creates both a right to explanation and a right to human review for automated decisions, two requirements that will make it difficult for companies to construct business models that rely extensively on complex algorithms to automate consumer-facing decisions. The GDPR also requires organizations to only use data for the purposes for which they originally collected it, a rule that strictly limits the application of AI to existing data.[33] If the United States wants to compete for global leadership in AI, it should be careful not to follow Europe down this path.

While the United States should not replicate the European model, it should create its own innovation-friendly approach to providing oversight of the emerging algorithmic economy just as it has for the Internet economy. Such an approach should prioritize sector-specific policies over comprehensive regulations, outcomes over transparency, and enforcement actions against firms that cause tangible harm over those that merely make missteps without injury. For example, rather than industry-wide rules requiring "algorithmic transparency" or "AI ethics"—proposals that focus on means, rather than ends—policymakers should look to address specific problems, such as ensuring financial regulators have the skills necessary to provide oversight of fintech companies relying heavily on AI to make lending decisions or provide automated financial advisors.

In many cases, regulators will not need to intervene because the private sector will address problems about AI, such as bias or discrimination, on its own—even if to outsiders an algorithm appears to be a "black box." After all, one company's hidden biases are another company's business opportunities. For example, if certain lenders were to use algorithms that consistently denied loans to ethnic or religious minorities who have good credit, then their competitors would have an incentive to target these individuals to gain new customers.

Moreover, the private sector is actively seeking out solutions to eliminate problems like unintentional bias in AI that may skew its results.[34] For example, a group of leading AI companies in the United States have formed an association to develop and share best practices to ensure that AI is fair, safe, and reliable, while another technology trade association has publicly committed itself to ensuring that the private sector designs and uses AI responsibly.[35] Indeed, given that U.S. companies are at the forefront of efforts to build AI that is safe and ethical, maintaining U.S. leadership in this field will be important to ensure these values remain embedded in the technology.

But policymakers should be careful not to misclassify certain concerns as "AI problems" that would be best dealt with on a technology-neutral basis. For example, discrimination in areas such as access to financial services and housing are best addressed through existing legal mechanisms. No new laws and regulations are needed simply because a company uses AI, instead of human workers, to make certain decisions.[36] Companies cannot use AI to circumvent laws outlawing discrimination.

Finally, certain problems, such as sexism in hiring practices, are not necessarily made worse by AI. On the contrary, using AI can actually reduce human biases. For example, companies can use AI to police undesirable behaviors, like automatically flagging job advertisements that use gender-specific terminology, such as "waitress" instead of "wait staff," or stereotypical images, such as a female nurse.[37] And unlike human processes, where it may take years or decades to change social norms and company culture, businesses can refine and tweak code over a period of days or weeks. For example, Google changes its search engine 500 to 600 times per year.[38] Thus companies will likely have more success eliminating bias when it appears in AI, than when it appears elsewhere in society.

CONCLUSION

AI is a transformational technology that has the potential to significantly increase efficiency and innovation across the U.S. economy, creating higher living standards and improved quality of life. But while the United States has an early advantage in AI given its top talent in computer science and deep bench of companies, large and small, investing in the field, many other countries are actively vying to challenge U.S. leadership in this domain. In particular, China, with its highly skilled computer science workforce and significant funding for AI R&D, could easily catch and surpass the United States, leading to it gaining economic and military advantages.

Unfortunately, U.S. policy debates about AI too often overemphasize the potential impact on worker displacement from automation or bias from algorithms and ignore the much more pressing concern about the potential loss of competitiveness and defense superiority if the United States falls behind in developing and adopting this key technology.

Yet, when it comes to AI, successfully integrating this technology into U.S. industries should be the primary goal of policymakers, and given the rapid pace at which other countries are pursuing this goal, the United States cannot afford to rest on its laurels. To date, the U.S. government has not declared its intent to remain globally dominant in this field, nor has it begun the even harder task of developing a strategy to achieve that vision. Some may think this is unnecessary, believing that the United States will automatically prevail in this technology simply because it has a unique culture of innovation and has prevailed on past technologies.[39] Such views are naïve and dangerous, and if followed, likely will lead to the United States being surpassed as the global leader in AI with significant negative consequences for the U.S. economy and society. However, it is not too late to begin to ensure continued U.S. leadership, and I commend you for holding this hearing so that we can have this conversation.

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