Advancing a More Productive Tech Economy

A WHITE PAPER FOR THE STANFORD INSTITUTE FOR HUMAN-CENTERED ARTIFICIAL INTELLIGENCE AND THE STANFORD DIGITAL ECONOMY LAB

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Response from Erik Brynjolfsson & Georgios Petropoulos

A Notice by the National Institute of Standards and Technology on

Study To Advance a More Productive Tech Economy

Introduction

We are Erik Brynjolfsson, the Jerry Yang and Akiko Yamazaki Professor and Senior Fellow at the Stanford Institute for Human-Centered AI (HAI) and Director of the Stanford Digital Economy Lab, and George Petropoulos, a Digital Fellow at the Stanford Digital Economy Lab. We welcome the opportunity to comment on the National Institute of Standards and Technology (NIST)'s Study to Advance a More Productive Tech Economy. NIST's work in this area is more essential than ever as remote work, artificial intelligence (AI), and other new technologies change the job landscape and the future of the economy. In this submission, we discuss why productivity has not been sufficiently understood or measured, especially from AI; how AI is still emerging and may help workers and economic growth; and the need for immigration reform to attract and retain top talent. NIST should therefore focus its study on:

1. Better measuring productivity in the digital age, including with respect to artificial intelligence and digital goods and services;
2. Developing better frameworks to understand the impact of AI on labor; and
3. The potential for immigration reform to ensure U.S. firms can attract and retain the best global tech talent.

Issue Discussion

The NIST study focuses on "public and private sector marketplace trends, supply chain risks, legislative, policy, and the future investment needs" of eight emerging technology areas."
This includes artificial intelligence—specifically, with a study focus on "the state of the artificial

intelligence industry and the impact of such industry on the United States economy."[1] AI is already changing the nature of work, the welfare benefits given to citizens through free digital goods and services, and the future of the economy itself. To identify key areas for investment as well as legislative and policy solutions, it is essential to recognize the challenges in measuring tech and AI productivity, develop better frameworks to understand the impact of AI on labor, and seize the potential for immigration reform to attract and retain top talent.

AI and other emerging technologies hold great promise for economic growth and innovation, though we shouldn't expect them to immediately produce massive changes in productivity. Oftentimes, emerging technologies first require more time and investment — following a "J-curve" of slow initial growth followed by sudden rapid growth, as firms learn how to better develop and deploy the technologies.[2] Even as the pandemic has accelerated remote work and other technology uses, AI is likely to follow a J-curve. In addition, there is a wide range of AI research constantly ongoing in government, industry, and the academy, only further contributing to the possibility of major productivity growth just over the horizon.

Not all of this is easily measured, because GDP is based on consumers paying for goods and services. Thus, it excludes the many free goods and services consumers use because of AI and other technologies — many of which create jobs, increase productivity, and contribute to economic growth.[3] My research with colleagues on GDP-B proposes a new framework for measuring the proliferation of new, free goods and services when assessing GDP.[4] These kinds of technology-inclusive measurements are essential in navigating public and private marketplace trends and identifying areas for future policy, legislation, and investment. Otherwise, we will fail to capture and understand exactly how AI and other emerging technologies are impacting productivity and the future economy.

There is also great potential for AI to boost productivity and accelerate economic growth. While this may not happen immediately, per the J-curve, the long-term trajectory of AI development holds great promise for American workers and America's standard of living. Yet ensuring this is the case — that the right investments are made, and the right policies and laws are implemented — requires better frameworks to understand the exact, unfolding impacts of AI on labor. Like virtually all advances in technology, AI also will require changes in business processes which could lead to temporary job displacement, changes in employee well-being or even the long-term elimination of entire roles. More comprehensive, higher-quality data and better measurement frameworks could help industry, policymakers, and academics understand those risks and the best ways to mitigate them.

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[1] U.S. National Institute of Standards and Technology. Notice. *Study To Advance a More Productive Tech Economy*. 86 FR 66287. https://www.federalregister.gov/documents/2021/11/22/2021-25428/study-to-advance-a-more-productive-tech-economy.

[2] Erik Brynjolfsson, Daniel Rock, and Chad Syverson. 2021. "The Productivity J-Curve: How Intangibles Complement General Purpose Technologies." *American Economic Journal: Macroeconomics*, 13 (1): 333-72. https://www.aeaweb.org/articles?id=10.1257/mac.20180386

[3] Erik Brynjolfsson and Avinash Collis, "How Should We Measure the Digital Economy?" *Harvard Business Review* (November-December 2019), https://hbr.org/2019/11/how-should-we-measure-the-digital-economy.

[4] Erik Brynjolfsson et al. *GDP-B: Accounting for the Value of New and Free Goods in the Digital Economy*. Cambridge: National Bureau of Economic Research, March 2019. https://www.nber.org/papers/w25695.

Investing in AI and other technologies alone is not sufficient to maximize their benefits and minimize their costs to jobs, productivity, and the economy. Human capital is also vital — and that includes talent that U.S. firms want to attract and retain from around the world. Immigrants have long played a pivotal role in driving technological innovation in the United States, from the internet to AI. Restrictive immigration policies, coupled with a lack of incentives programs, may therefore undermine access to that talent.[5] Immigration reform could greatly increase American firms' ability to attract and retain top AI and technological talent from around the world, particularly as other countries already expend more resources on trying to attract that talent for themselves.

Recommendations

We recommend that NIST, in response to its request for information on advancing a more productive tech economy, focus on ways to better measure productivity in the digital age and with respect to AI. Current measurements like GDP are insufficient when they only factor in goods and services for which consumers have paid money; these measurements must account for the many goods and services provided at no cost to consumers which still increase consumer welfare as well as create jobs and generate profit. Moreover, advancements in AI decision-making and prediction could generate new opportunities for economic growth that have never been previously realized. NIST should study possible frameworks to better measure productivity in the age of artificial intelligence.

We also recommend that NIST focus on developing better frameworks to understand the impact of AI on labor. AI developments are going to continue disrupting the economy — and will continue changing the work landscape. There is much speculation about the possible impacts of AI on workers, but much of this is done without sufficient data and comprehensive models. Government and industry will thus be better prepared to understand and mitigate AI's potential risks to workers if they have access to those more comprehensive and higher-quality models and data to measure and forecast trends.

Finally, we recommend that NIST study and stress the potential for immigration reform to ensure the U.S. can continue attracting and recruiting the best tech talent. Investments in technology alone are insufficient to generate significant job, productivity, and economic growth. Instead, investments in technology must be paired with investments in business processes, business skills, and other kinds of "intangible capital" before emerging technologies generate significant returns.[6] This is precisely why the likes of improving temporary visa options for skilled workers and expanding opportunities for permanent residency[7] can ensure continued U.S. tech development and leadership — and help maximize the long-term benefits for the economy.

Thank you for the opportunity to provide comment on this vital work.

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[5] Tina Huang and Zachary Arnold. *Immigration Policy and the Global Competition for AI Talent*. Washington, D.C.: Center for Security and Emerging Technology, June 2020. https://cset.georgetown.edu/publication/immigration-policy-and-the-global-competition-for-ai-talent/.
[6] Erik Brynjolfsson and Georgios Petropoulos, "The coming productivity boom," *MIT Technology Review*, June 10, 2021, https://www.technologyreview.com/2021/06/10/1026008/the-coming-productivity-boom/.
[7] See, e.g., Huang and Arnold, *Immigration Policy*, v.

Sincerely,

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