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POLICY STRATEGIES FOR HARNESSING THE PRODUCTIVITY POTENTIAL OF AI IN THE U.S.

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DESPITE THE EMERGENCE OF NEW MACHINE LEARNING TECHNOLOGIES capable of diagnosing diseases, understanding speech, or recognizing images, the enormous economic potential of many digital goods and services remains largely untapped. Expectations about rapid rates of improvement in the efficiency of each worker over the past two decades have consistently given way to disappointment. A common way to measure this rate of improvement is via the change in output produced per hour work, in other words productivity growth. Measurements show that it has slowed from an average of 2.8 percent per year in the decade ending in 2005 down to 1.3 percent per year between 2006-2019. If U.S. productivity had grown at the same rate from 2005–2019 as it did from 1995–2004, overall GDP would have been about $4.2 trillion higher at the end of 2019 than what the official statistics measured it to be.

A recent paper of ours "Understanding and Addressing the Modern Productivity Paradox," took stock of the latest research. Economists failing to properly measure the output of the digital economy and large technology companies' tendency to take advantage of the monopolies they have created both undeniably play some role in the slowdown. However, in our view the most important factor is that

KEY TAKEAWAYS

- The pace of measured productivity growth in the United States has slowed over the past two decades, resulting in a massive gulf of potential GDP lost. We estimate that this is equivalent to $4.2 trillion lost for the year 2019.
- Failing to properly measure the output of the digital economy and monopolistic behavior by some companies play some role in the slowdown, but the most important factor may be the considerable amount of time and effort required for complementary innovations to keep pace with fundamental technologies like AI.
- Policymakers can boost productivity by increasing investments in research and development, expanding immigration of high-skilled labor and reinforcing our education system, and removing many of the legal and regulatory bottlenecks that currently exist to business innovation and entrepreneurship.

transformative technologies like AI take time to be implemented throughout the economy. Just as earlier innovations like electricity required entirely rethinking the nation's paradigm about factory organization, infrastructure and public utilities, these twenty-first century advances cannot simply be implemented without complementary investments. They must be accompanied by appropriate adjustments, workforce re-skilling and business process innovations in order to ensure that they translate into sustained improvements in productivity.

We propose here a set of policy recommendations that fall into three broad categories that might reverse the recent stagnation in productivity growth, make the United States more competitive, and reduce overall income inequality. First, increasing investments in research and development through direct grants and tax credits. Second, expanding the human capital available to the economy by boosting the nation's education system and expanding immigration of high-skilled labor. Third, removing many of the legal and regulatory bottlenecks that currently exist to entrepreneurship and business innovation. We are optimistic that if policymakers implement the plan for shared prosperity that we outline in this brief, the coming decade will be one of higher productivity growth and one where the United States returns to its historical role as the most dynamic economy in the world.

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INTRODUCTION

As information flows and knowledge-based work increase in importance, the challenging task of accounting for digital goods and services has become an increasingly critical piece of the economic puzzle. While traditional growth accounting handles the case of twentieth century economic activity like manufacturing relatively well, instances of unmeasured inputs and outputs that stem from what are known as intangible or hidden assets—assets like corporate culture or business processes that are not kept as inventory in a warehouse and not easily transferable between firms—have upended the mechanics of economic theory. Among the four explanations analysts have offered for slower than expected productivity growth, one argument posits that the hype around technology is overblown and that the

increasingly difficult path for researchers to arrive at the frontiers of their discipline means we have reached the end of the line in terms of technological innovation. We do not find this argument particularly compelling. The documented improvements of AI calls this into question. Instead we look towards issues with properly measuring economic activity and with creating the optimal environment for advanced technologies to explain how public and private sector leaders can chart the way forward.

A second explanation states that economists may be failing to properly measure new sources of economic activity and points to the rapidly changing way that consumers value platforms like search engines or social networks. Goods like maps and encyclopedias were also generally not free before they became digital goods, and improper or uncertain measurement in how individuals value their use is further complicated by the fact that prices might also be mismeasured.

A third hypothesis is that lucrative technologies are beneficial to the private companies that developed them, but they are not necessarily having positive effects on the economy generally. Economists deem this "rent-seeking" behavior, and it can extend from how a platform interacts with its user base to how companies secure beneficial concessions from the government. As corporations focus on developing technologies that are only marginally more efficient than workers, they are missing out on the opportunities provided by nascent technologies that could expand overall productivity while increasing wages.

The final—and to our mind most important—explanation behind the productivity slowdown is that transformative technologies like AI take time to reach their full economic potential because they require complementary investments. We find this argument convincing because of the intangible nature of general-purpose technologies (GPTs) like artificial intelligence that have the capacity to lead to complementary new advances. In the early stages of GPT-related productivity enhancement, it can appear that increased tangible costs like those traditionally reflected on a firm's balance sheet are required to achieve the same level of output as in the past. Eventually, unmeasured capital service flows and unmeasured costs to create that capital will accrue and start to balance each other out. The official statistics will show measured productivity growth falling below the historical trend line as real resources are devoted to investments in these innovations. This process can take years or even decades to play out as complementary innovations come online and are integrated into the economy in a meaningful way for fundamental advances such as AI.

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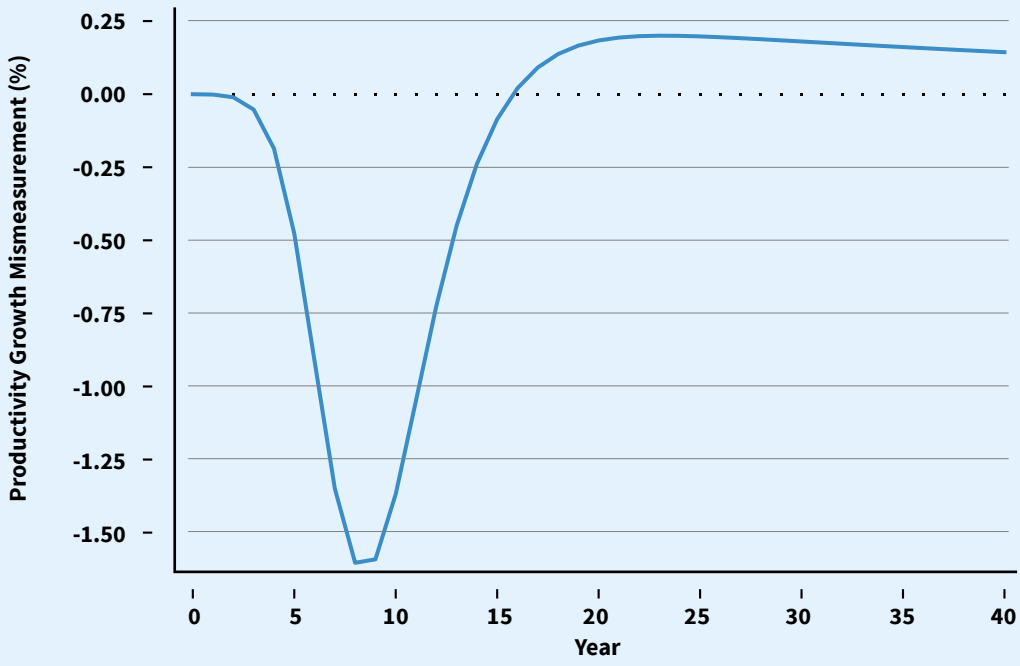
POLICY DISCUSSION

Each of the four arguments offered above are likely to contribute to the productivity slowdown. In order to help make the economic gains not only larger, but also more widely shared, we propose a set of policy recommendations.

These recommendations fall into three broad categories: first, in order to address inadequate research and development (R&D) activity, we propose to boost levels of spending in both public and private R&D by authorizing large, government-directed research projects, government grants through the National Science Foundation or the National Institutes of Health, and through tax credits for private businesses. This approach acknowledges that fundamental science is often best carried out by government, academia, or nonprofits and that marketable applications of that basic research are often optimally delivered through private development. The federal government should adopt a diversified approach in building this program in order to reduce overall risk and fund early stage or large-scale projects that the private sector either would not be able to pursue or would not want to pursue because the private returns might not be worth it, even if the social benefits would be large.

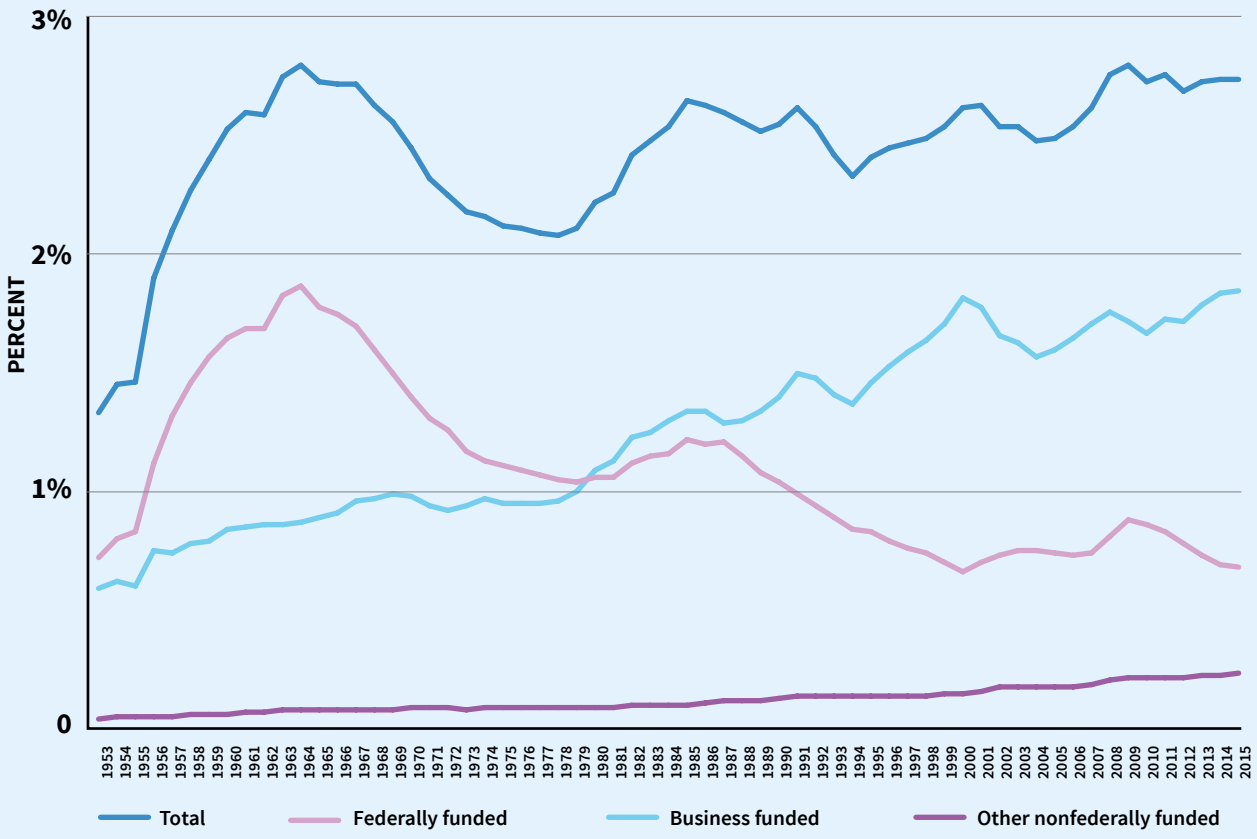
TOY ECONOMY: THE PRODUCTIVITY GROWTH MISMEASUREMENT J-CURVE CALCULATION OF CAPITAL AS SHARE AS 1-(WL/Y)

When the curve drops below zero, the effects of unmeasured output created using measured inputs dominate. Above zero, effects of measured output created using measured inputs are larger.



The second category of policy actions involve increasing the human capital of the country. We propose to accomplish this by reinforcing our education system and encouraging high-skilled immigration. Boosting the attractiveness of the United States to high-skilled immigrants is the simplest and most important action the country could take today to increase growth. Even immigrants and refugees who do not have university degrees may contribute to productivity growth by expanding market size and providing opportunities for entrepreneurs to serve specialized markets. Additionally, the United States should boost funding and support for universities (including potentially funding new universities) either

RATIO OF U.S. R&D TO GROSS DOMESTIC PRODUCT, BY ROLES OF FEDERAL, BUSINESS, AND OTHER NONFEDERAL FUNDING FOR R&D: 1953–2015



Notes: Some data for 2015 are preliminary and may later be revised. The federally funded data represent the federal government as a funder of R&D by all performers and similar for the business-funded data. The other nonfederal category includes R&D funded by all other sources—mainly, higher education, nonfederal government, and other nonprofit organizations. The gross domestic product data used reflect the U.S. Bureau of Economic Analysis's comprehensive revisions of the national income and product accounts of July 2017.
Sources: National Science Foundation, National Center for Science and Engineering Statistics, National Patterns of R&D Resources (annual series).

through updating the land-grant process used to create institutions like the University of California system or by allocating appropriately sized endowments to be administered by the states. In order to better prepare children and adolescents for college, the United States should do more to improve the quality of primary- and secondary-school instruction through better accountability for teachers, extending the length of school days and the school year, offering optional weekend classes, and providing one-on-one math tutoring. The goal here has to be not only producing more STEM PhDs in the U.S., but promoting the training of scientists abroad as well, since R&D conducted abroad is likely to affect the U.S. in a positive way.

The United States should correct the subsidy that it currently provides to capital-intensive automation over the invention of new tasks for labor.

Finally, our third category of policy interventions is designed to eliminate bottlenecks to innovation in the legal, regulatory, and tax spheres. In order to reduce adjustment costs and the lag time between developing a technology and reaping the rewards, policymakers should pursue legislation to eliminate or weaken the non-compete clauses that prevent too many skilled engineers and other workers from bringing their talents to competitors. They should further enact intellectual property reforms that push more technologies and artistic concepts into the public domain. Rather than focusing on breaking up digital platforms—which might destroy productivity-enhancing network effects—the federal government should promote standards that enable easier market entry and interoperability among competitors. Where this is impossible, regulators should focus on tax policy, regulation, and collective bargaining tools to ensure the benefits from these platforms are more widely distributed. Furthermore, decoupling healthcare coverage from employment and reforming occupational licensing will help make it easier for people to start a new business and boost entrepreneurship. Finally, the United States should correct the subsidy it currently provides to capital-intensive automation over the invention of new tasks for labor. Lawmakers should collaborate with other countries on corporate tax reform in order to prevent a "race to the bottom" with respect to corporate tax havens in the international contest to attract capital.

Pursuing these policies will reward firms for creating new jobs rather than destroying them and will ensure that the innovation provided by GPTs accelerates productivity growth across the entire economy. Supercharging productivity growth will in turn help expand wages, reduce income inequality and ensure that more equitable growth is enjoyed across the country. Addressing the productivity paradox will not only contribute to scalable machine intelligence being integrated into the global economy as quickly as possible, it will do so in a way that reflects our fundamental values about the dignity of human work and ensure that the power of AI is used to improve the human condition, not diminish it.

The original articles, ***"Understanding and Addressing the Modern Productivity Paradox"*** and ***"Artificial Intelligence and the Modern Productivity Paradox: A Clash of Expectations and Statistics"*** can be accessed at: https://workofthefuture.mit.edu/wp-content/uploads/2020/11/2020-Research-Brief-Brynjolfsson-Benzell-Rock.pdf and https://www.nber.org/papers/w24001 respectively.

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