GLOBAL CHINA
ASSESSING CHINA'S GROWING ROLE IN THE WORLD

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SUCCEEDING IN THE AI COMPETITION WITH CHINA

A STRATEGY FOR ACTION

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Executive Summary

Technology is at the center of the emerging competition between the United States and China, with far-reaching consequences for democratic societies. At stake in this competition are the prestige and reach of liberal values, as well as the economic competitiveness and national security of the United States and its allies and partners. Fortunately, there are steps that the United States government, working with the private sector and other democratic governments, can take to sharpen America's edge across four dimensions of the technology competition: talent; norms and standards; research and development; and trade, investment, and industrial policy.

Introduction

Technology is perhaps the most intense realm of competition between the United States and China today, and artificial intelligence (AI) is central to that contest. By developing state-of-the-art capabilities in AI, China seeks to achieve a strategic advantage over the United States and its allies. It also aims to leverage new forms of AI-enabled surveillance and repression in ways that strengthen its illiberal model of governance – both within China and around the world. Democratic countries have started to push back, with rising calls for the development of robust AI norms, and the United States and EU each passing major semiconductor bills. Nonetheless, China still threatens to outpace the United States and its allies in AI research and standards-setting.

Ultimately, the United States' and China's competition over AI and emerging technology will create ripple effects that go far beyond the digital domain. The values that underpin free and open societies are at stake, and the countries and coalitions that gain a sustainable advantage will be rewarded with economic benefits and a national security edge. Luckily, there are steps that the United States can take, working with democratic allies and partners, to protect democracy and liberal values in an age of AI.

Talent

The United States has long focused on developing new policies for research and development (R&D) and market access. Yet, there is only incipient analysis and policy development about how to apply a similar national security focus to U.S. education and workforce policy. This is because of several factors, including:

1. the federal government rarely makes direct interventions in the workforce or educational system, outside of worker retraining in industries negatively affected by trade agreements;

2. the federal government, through the Department of Education and other federal agencies, has limited direct influence over the curriculum or priorities of schools or universities at the state level. Moreover, there is not enough continuous coordination between the federal and state levels on specific educational priorities; and

3. education is not traditionally perceived as a domain of national security competition. As a general policy matter, the health of the U.S. education system and workforce is managed by the domestic policy council and its constituent departments, such as the Department of Labor and Department of Education.

To achieve leadership in the technologies of the future, the United States will need a deep talent pool that can regularly migrate between industry and government. Therefore, just as the U.S. government is mobilizing federal resources to develop policies and tools to ensure a robust industrial base, it must also extend that effort to developing a human talent base in the United States. At an aggregate level, this calls for the creation of an industrial talent base and would allow policymakers to hone in on specific sectors, depending on the nature of the challenge.

Developing an industrial talent base should include, at a minimum:

- **Developing dedicated tools to monitor the availability of talent.** The Departments of Labor, Education, Commerce and the National Science Foundation (NSF), at a minimum should collect data on the available talent in specific disciplines of the technology workforce, as well as the supporting technical and vocational industries. Currently, the available data is not granular enough to assess whether the United States is strong or weak in specific technology domains, nor does it provide any indication of future strengths or weaknesses.

- **Aligning talent projections with industry-specific market forecasts.** The Department of Commerce needs to modernize its ability to collect data on the labor market for fields related to AI and machine learning and their growth trends. These data can be paired with new data on the education pipeline as proposed above to allow policymakers and industry executives to understand where investments will need to be made in order to be competitive into the future.

- **Monitoring and coordinating federal financial, technical, regulatory and policy resources for education and the workforce.** The U.S. government has several tools to monitor, support, stimulate, and invest in education and workforce policy. To date, however, these tools are executed independently across the federal government, with little to no coordination. While there are initial efforts to apply federal resources more coherently, policymakers must first understand what tools are available, align them against (in this case) technology competitiveness goals, and execute them at scale.

- **Monitoring and coordinating with state-level education and workforce policies.** Education and workforce policies in the United States are largely developed and executed at the state and local levels. While the federal government has a set of tools, national policy priorities will only be effective if they are paired with state and local efforts. Therefore, the Departments of Education, Labor, Commerce, and other policy arms across the government should develop an equally mature

understanding of what can be done by state and local officials, the private sector, or non-government stakeholders to bolster the talent pipeline. Officials should make deliberate efforts to coordinate in an enduring way to achieve national goals.

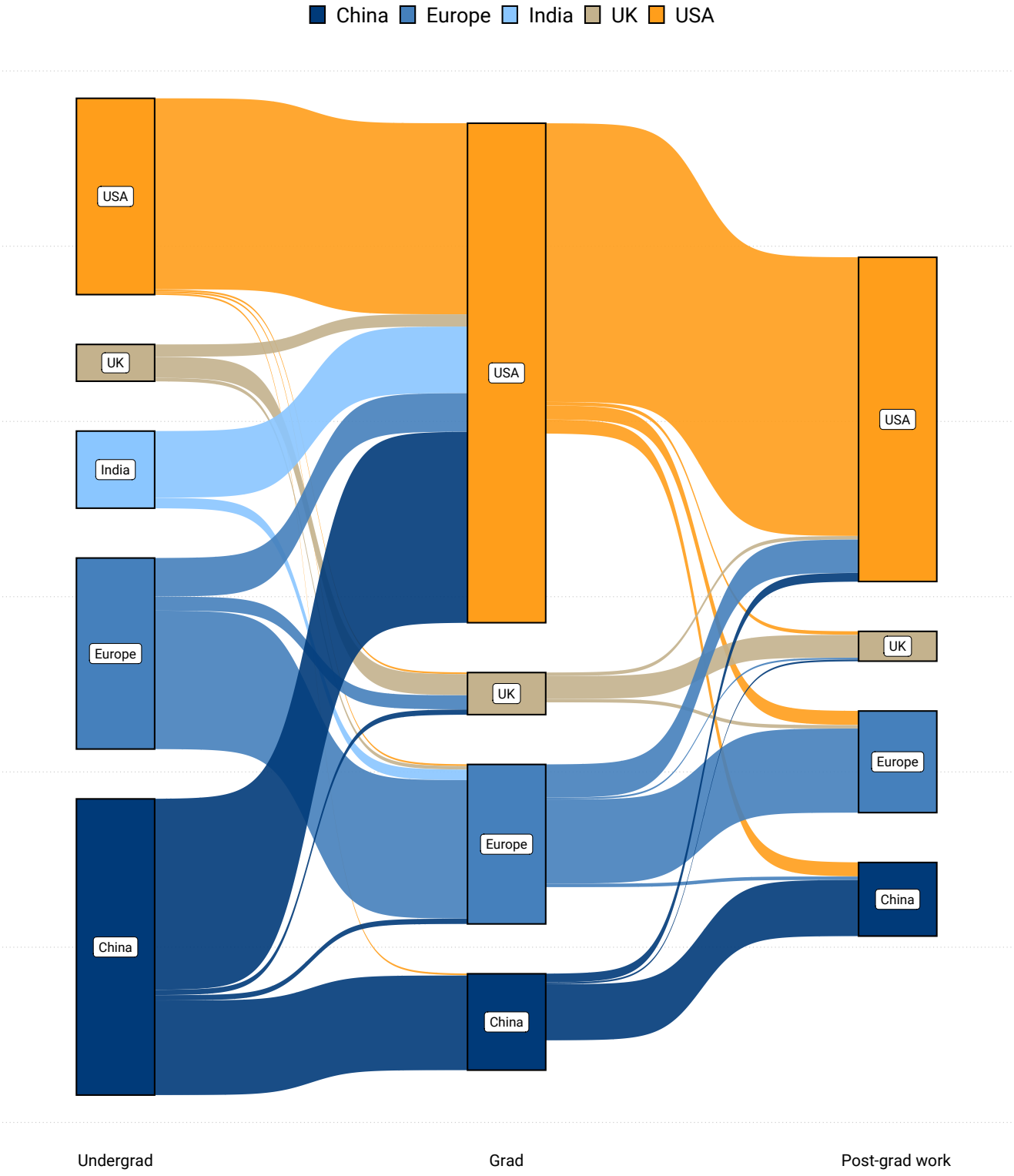
- **Investing in technical and vocational education.** In addition to focusing on STEM education, an equally important priority for the United States is to invest in teaching technical and vocational skills. From machine operators, toolists, welders, electricians, and metallurgists, the industries of the future will require people with the ability to translate sophisticated R&D into prototypes and products at scale. Currently the United States has a shortage of technically trained workers who are capable of translating intellectual property to reality.

- **Establishing whether there are enough H1-B immigrant visas.** There is an energetic debate, particularly amongst technology companies, on the availability of H1-B visas. Some critics argue that technology companies prefer employing H1-B visa holders because they are prepared to work for lower salaries and are less likely to leave the company, since the H1-B sponsorship is tied to their employer.[1] The U.S. government, particularly the Departments of Commerce, State, and Labor should conduct rigorous analysis on the current supply and demand of H1-B visas. This would establish whether there is a shortfall, whether the policy of tying H1-B sponsorship to an employer is the right design, and whether there is a shortfall of domestic talent that can fill the gap. Based on this review, policymakers should work with Congress to propose solutions to improve the H1-B policies, while also increasing investments in domestic education and workforce programs to create a healthy pipeline of domestic talent.

FIGURE 1

Global AI talent flow

Country residence of NeurIPS authors at different stages in their careers. Data based on a sample of papers accepted at NeurIPS 2019.

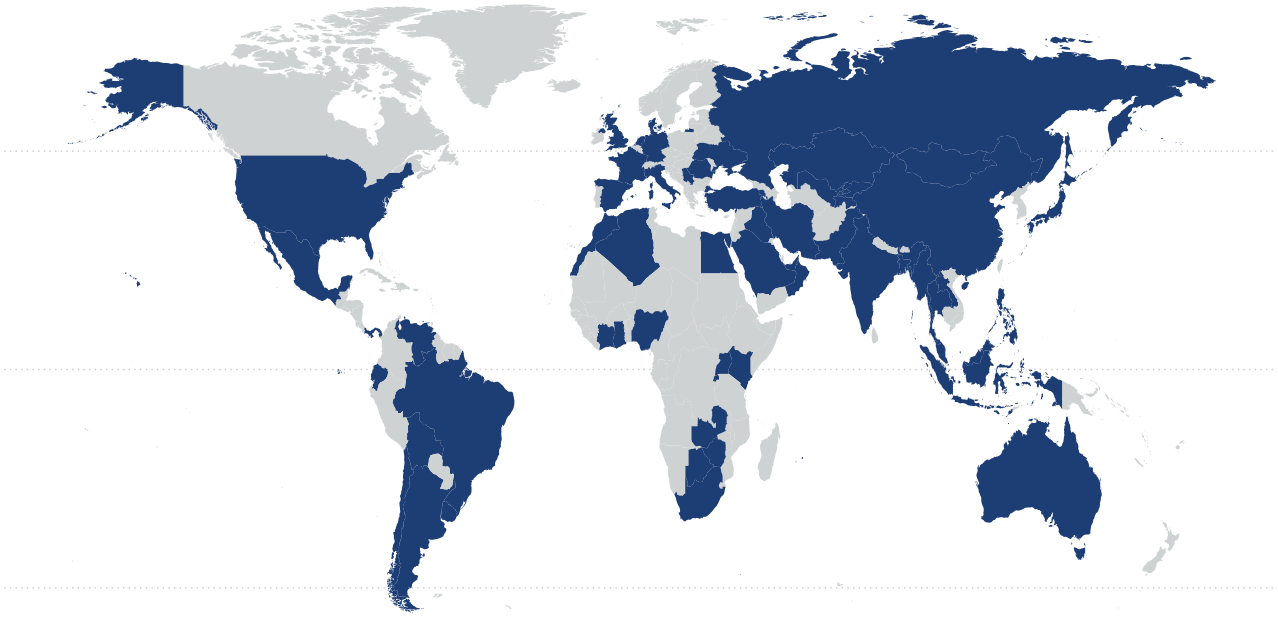


Source: Macro Polo Global AI Talent Tracker.

FIGURE 2

The expansion of Chinese surveillance technology around the world

Countries in blue have purchased AI surveillance equipment from Chinese suppliers.



Source: Carnegie Endowment for International Peace AI Global Surveillance (AIGS) Index (2019).

Norms and standards

International standards-setting organizations – which establish policies that shape how emerging technologies are designed and deployed – have become a fierce battleground in the geopolitical contest underway in the technology domain. Beijing is bringing focused attention to its engagement in these bodies, working to increase its competitiveness, expand its influence over what forms of technology become widely adopted, and shape norms around how those technologies are used.[2] Its approach, as in other areas of the technology competition, has largely been driven from the top down.

This is in sharp contrast to the U.S. approach to standards setting, which is primarily driven from the bottom up by a vibrant private sector. For years, U.S. dominance in the technology domain meant there was little downside to that way of doing business. But China's advances may be shifting that dynamic. By establishing product specifications for characteristics such as explainability[3](the capacity of its outputs to be comprehended and trusted by a human), robustness, and fail-safe design, among others, AI standards-setting processes can steer the development and deployment of AI systems toward best practices. And by establishing process standards, they can also help shape the context in which AI is researched and developed, to mitigate risks and enhance competitiveness.[4] The United States should work strategically to advance these goals without turning standards-setting bodies – which are intended to be technical, expert-driven organizations – into a locus of outright geopolitical competition.

With that in mind, there are steps policymakers across sectors can take to ensure that the United States is well-positioned to shape norms and standards around AI. These include:

- **Upgrading U.S. capacity to engage in AI standards-setting processes.** As the State Department's new Bureau of Cyberspace and

Digital Policy begins its work, Congress, the White House, and State Department leaders should ensure that it is equipped to engage in international AI standards-setting processes. This should include designating participation in AI standards-setting processes as part of its mission and hiring and empowering appropriate personnel.

- **Building synergies across norm-building efforts.** The administration should work to build synergies across norm-building efforts within existing international groups, such as the Framework for G7 Collaboration on Digital Technical Standards, the new Indo-Pacific Economic Framework (IPEF) initiative launched by U.S. President Joe Biden, and the Quad. Recognizing valuable work underway in the EU on AI rights,[5] the administration should aim to reinforce that progress through the U.S.-EU Trade and Technology Council (TTC) and the IPEF.

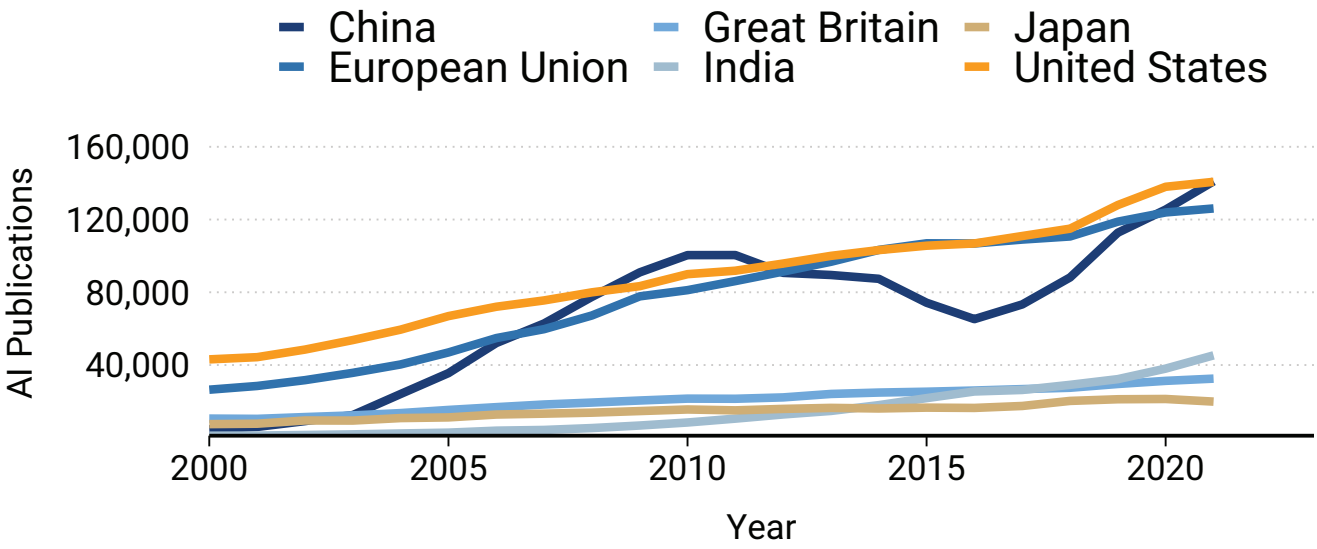
- **Developing voluntary standards.** Civil society leaders – including legal and technical experts within academia and the private sector – should develop a set of voluntary standards for certifying AI companies that support democratic values. The priority should be companies producing AI that could be repurposed as a surveillance tool, as well as other high-risk applications.

- **Designing robust testing and evaluation systems and processes for high-risk applications of AI.** The administration should work jointly with multilateral partners around AI-enabled military applications and their use, ensuring that test, evaluation, verification, and validation (TEVV) systems are in place for AI-enabled weapons.

- **Promoting dialogue with Chinese counterparts.** Both within and outside of government, policymakers should look for opportunities to convene more frequent expert dialogues with Chinese counterparts for safety conversations about high-risk applications of AI. Both countries are navigating near the frontier of innovation and making parallel advances. It is in the United States' interests to ensure that their Chinese counterparts are considering specific risks and addressing them in ways that limit, rather than expand, potential for misuse.

FIGURE 3

Global AI research publications



Source: OECD.AI (2022).

R&D

Long-term competition over strategic technology often hinges on research and development – and the U.S. competition with China over AI is no exception. Discovering and developing the next-generation technologies capable of powering the future of AI is not just an academic exercise, but a strategic concern. With Beijing investing tens of billions in China's growing AI ecosystem – and pledging to invest far more – the United States must pursue a robust research and development strategy of its own.

Fortunately, the United States has a strong research foundation on which to build. The algorithms underlying modern AI were first developed in the United States decades ago,[6] and the U.S. private sector – including both venture capital startups and established companies – has repeatedly shown that it has the resources, time-horizons, and infrastructure needed to develop and commercialize breakthrough technologies at scale. Likewise, the recent CHIPS and Science Act showed once again the United States has the political will to maintain those advantages as well.[7]

Yet to outpace China, the United States will need to be strategic about how and where it invests in AI research and development. Key among its priorities should be:

- **Taking the lead on privacy-preserving AI.** As the technology has proliferated, so too have concerns about its impact on data privacy. One way to ensure that AI strengthens rather than undermines democratic norms of privacy is to bake in privacy by default. The United States and its allies have taken early steps to fund privacy-enhancing AI, but those efforts should be scaled out in the coming years. Homomorphic encryption, which makes it possible to carry out operations on data while it is still encrypted, is particularly ripe for greater fundamental research and development, since it is still nascent and will require new breakthroughs to be computationally efficient enough to be deployed at scale.

- **Invest in neuromorphic and optical computing.** Conventional processor designs are approaching fundamental constraints in bandwidth and energy consumption that will limit the speed at which they can train or run an AI model. Two alternate

approaches are neuromorphic computing,[8] which seeks to loosely emulate the neural structures of the brain directly within a chip's architecture, and optical computing, which uses photons rather than electrons to perform computations.[9] Both technologies have the potential to generate improvements in training and inference for AI and should be able to continue scaling well into the future. This is especially true for optical computing, which has the potential to be orders of magnitude faster than conventional electronics. The National Science Foundation, whose budget is set to double from $9 billion this year to over $19 billion in 2027, should invest its new funding accordingly.[10]

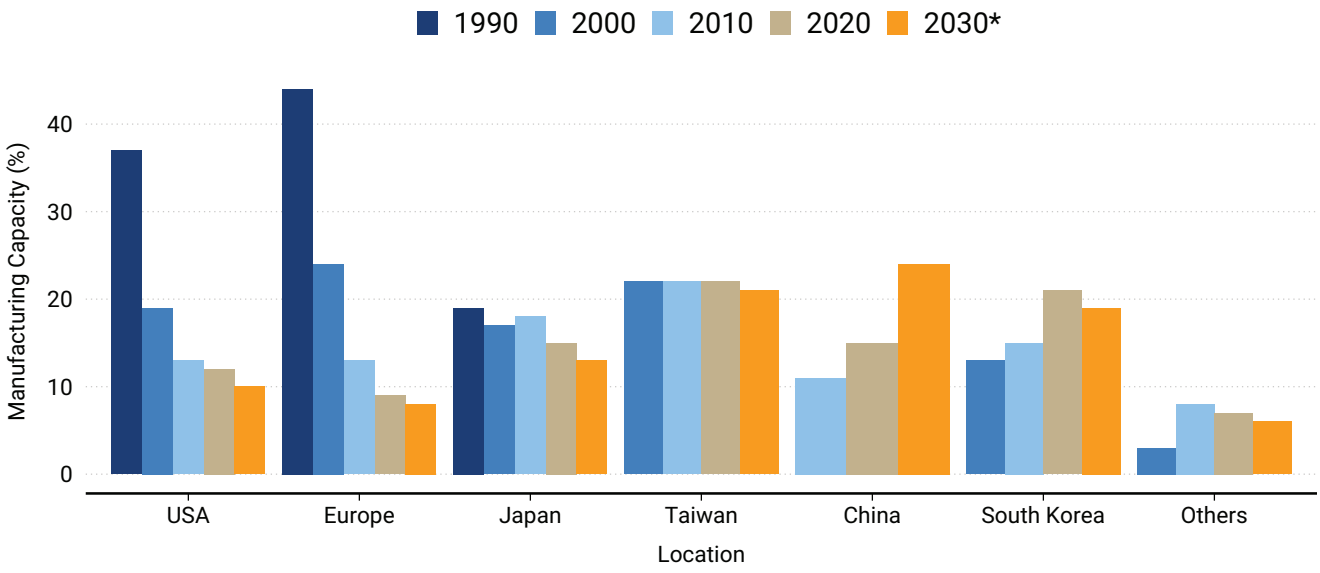
- **Fund new efforts on quantum machine learning.** Quantum computing, which leverages the unique properties of quantum mechanics to carry out massively complex computations, also has the potential to scale well past the bounds of conventional chip architectures. However, quantum computing also represents a radically different computing paradigm whose underlying physics will require new machine learning algorithms as well. Although the CHIPS Act will push forward research into quantum sensing, communications, and cryptography, the funding earmarked for quantum research should also seek to meaningfully advance the nascent field of quantum machine learning. Since a breakthrough in quantum machine learning may enable China to leapfrog the United States in advanced AI capabilities, the two biggest recipients of quantum funding – the NSF and Department of Energy – should also invest heavily into research on quantum machine learning too.[11]

- **Foster greater research globally on AI safety.** The United States should encourage the creation of collaborative, multinational research efforts into technical approaches to AI safety. Despite the clear importance of developing technical approaches to AI safety for high-risk applications, funding for new technical approaches to AI safety is comparatively scarce, and often dependent on private philanthropy. The United States should invest more in foundational research on AI safety through the NSF, while also leveraging the new tech envoy in the State Department to promote the importance of AI safety research globally. Critically, these efforts should also seek to engage with Chinese researchers and academic institutions, and encourage U.S.-funded labs and research centers to take part in exchanges on AI safety between U.S. and Chinese researchers.

- **Coordinate with allies on R&D funding.** As the United States and its democratic allies and partners invest in the next generation of AI capabilities, there is no shortage of potential breakthroughs to pursue. If each country invests independently in research and development, some approaches may end up being comparatively overfunded while others are underfunded. The White House and State Department should work with their partners abroad, including through the TTC, Quad, IPEF, and other frameworks, to coordinate research and development in foundational AI technologies.

FIGURE 4

Global semiconductor manufacturing by location



Source: Boston Consulting Group and Semiconductor Industry Association, "Government Incentives and US Competitiveness in Semiconductor Manufacturing," September 2020. (*) shows forecasted capacity for 2030.

Trade, investment, and industrial policy

The U.S. response to China's advances in information technologies has largely been to play defense in trade, investment, and industrial policy. It has imposed sanctions, restricted academic and professional exchanges with Chinese nationals, and broadened and deepened restrictions on U.S. exports to and investments in Chinese companies. Recent legislative action in the form of the CHIPS Act has begun to move the United States in the direction of playing defense and offense at the same time.

The risk of exclusively playing defense is two-fold. One is that American tech industries miss potential growth opportunities. Sanctions and tariffs have triggered reciprocal moves that harm American companies seeking to export to China, and wide-ranging export controls similarly limit these companies – and their European counterparts – from exporting a broad range of emerging technologies with dual-use potential, such as sensing technology, data analytics, logistics, 3D printing, and robotics in ways that would improve their profitability. Reshoring American chip manufacturing may not necessarily improve the efficiency or viability of these U.S. firms. The second risk is that reciprocal tariffs and sanctions increase the cost of goods for consumers.

While continuation of sanctions and export controls tailored to advanced military technologies is sensible, the United States also can take proactive steps to promote its own competitiveness. These measures could include:

- **Moving the department of defense out of the technology development business and into the technology acquisition and adoption business instead.** The U.S. federal government now funds roughly 20% to industry's 70% of total national R&D activity,[12] and commercial industries are demonstrably better than the Department of Defense at converting those R&D dollars into

functional products. The Defense Advanced Research Projects Agency (DARPA) can continue to manage the most sensitive military projects, while the remainder of the department should focus on defining functional needs, interfacing productively with industry, and creating processes to support rapid adoption and use. The department has money to spend: doing so effectively will spur innovation and growth in the domestic information technology ecosystem.

- **Not overreacting with on-shoring and supply chain security.** Much has been made of the fact that semiconductor manufacturing today occurs primarily in East Asia. While it is reasonable to geographically diversify this particular portfolio, the imperative should not be applied more broadly to the high-tech industry overall. The goal of subsidies, tax breaks, and loan guarantee programs should be to incentivize greater supply chain resilience in sectors that are vital for the provision of necessary public goods; it should not be to strengthen the balance sheet of domestic firms or increase domestic production of high-tech goods and services per se. Fully extracting Chinese firms from Department of Defense supply chains, including those that produce rare earth minerals for example, would likely be infeasible, and may discourage innovation by imposing costs that would likely be insurmountable for start-up companies. However, the government should track outbound investment into Chinese start-ups in domains with national security salience to maintain situational awareness about possible threats.

- **Collaborating with high-tech allies to increase joint gains from production and decrease supply chain fragility.** The United States, working with high-tech allies through mechanisms including, but not limited to the IPEF, should increase collaborations that make the United States a technology trade partner of choice and that decrease supply chain vulnerabilities. Policy initiatives should include creating incentives for firms to diversify the location of manufacturing plants in critical technologies that are currently overly concentrated in one place – Taiwan's current 92% share in fabricating the most sophisticated microchips is now emblematic of such an imbalance. Retaining a three-month strategic reserve of chips from either these plants abroad, or Taiwanese or South Korean-run plants in the United States, would provide a further hedge against future national security-impacting supply chain shocks. So too should the United States and its partners seek to encourage international venture capital investment in start-up companies in key sectors, for example in biotechnology, cybersecurity, and climate.

Competition between the United States and China within the technology domain is at the core of their broader geopolitical rivalry. Ultimately, the outcome of the technology competition will be driven by the performance of policymakers and technologists within each country, as well as their allies and partners. If adopted in whole or part, the proposed recommendations will significantly strengthen the competitiveness and security of the United States and its partners – and ensure that democratic societies remain at the forefront of AI and technology development for years to come.

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