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Unraveling the Political Dynamics Shaping the U.S. Strategy for Technology Leadership

Constanza M. Vidal Bustamante
Douglass Vijay Calidas

HARVARD Kennedy School
BELFER CENTER
50 YEARS OF RESEARCH, POLICY, AND LEADERSHIP

WORKING PAPER
FEBRUARY 2024

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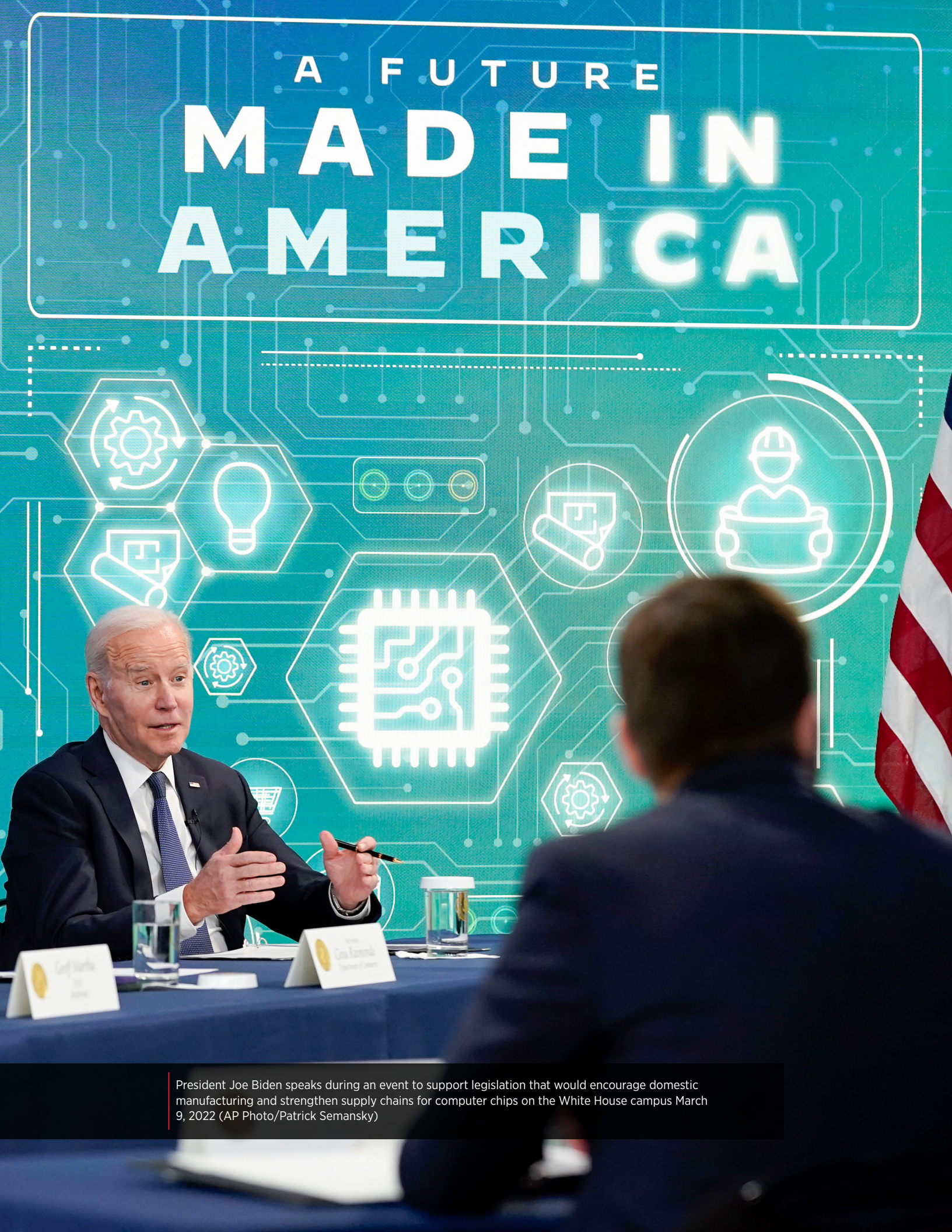


President Joe Biden speaks during an event to support legislation that would encourage domestic manufacturing and strengthen supply chains for computer chips on the White House campus March 9, 2022 (AP Photo/Patrick Semansky)

Introduction

> "While the battlefield has changed since the Cold War, leadership in science, technology, and innovation remains the most important weapon in the current competitive environment."[1]

Securing U.S. leadership in cutting-edge, dual-use technologies[2] is now an overarching policy priority shared by Republicans and Democrats. Leaders in both parties routinely tout U.S. competitiveness in semiconductors, AI, and other 'critical' technologies as necessary to address a series of global and domestic challenges—from China's steady rise as a geopolitical adversary, to climate change, to the hollowing out of manufacturing capacity in the heartland of the United States. Policies intended to protect and promote technology competitiveness have featured so prominently in the administrations of Presidents Trump and Biden that many observers claim we may be entering a new era of U.S. industrial policy in advanced technologies.[3]

Although there is broad agreement between the two major parties on the desirability of technology leadership, significant sources of tension—and confusion—persist. These include disagreements about whether to focus exclusively on national security objectives or to also address economic development and social policy goals; whether to invest heavily in strengthening domestic productive capacity or simply slow geopolitical rivals' progress; and whether to fund early-stage research and development or invest in more advanced stages of technology development such as scale-up manufacturing. These issues, which often block consensus both within and between the two major parties, are likely to influence the course and effectiveness of any federal technology leadership strategy for the foreseeable future.

By examining the political dynamics that led to the enactment of the *CHIPS and Science Act*, we probe these tensions and seek to assess their likely impact on the federal technology strategy in the coming years. We contend that safeguarding national security has been and will remain a core factor driving bipartisan consensus on expanding the federal government's role in developing technological capabilities at home and restricting the transfer of knowledge and resources overseas. However, this factor alone may not be sufficient to bridge unresolved ideological disagreements over the proper role of government in the economy, the economic merits of industrial policy, and the proper balance of geopolitical objectives and broader societal goals in shaping the national technology strategy.

Box 1: Major policy developments related to technology leadership in recent years

CHIPS and Science Act of 2022: This landmark bill was signed into law in August 2022 and has two main components:[4]

- **CHIPS Act funding:** Aimed at revitalizing the semiconductor industry in the United States, this component of the law appropriated $52 billion in subsidies, in addition to investment tax credits and loan guarantees, for semiconductor manufacturing facilities and research and development. Its purpose is to reduce U.S. reliance on foreign semiconductor production and strengthen domestic supply chains. First introduced by Senators John Cornyn (R-TX) and Mark Warner (D-VA), the original CHIPS Act[5] became law as part of the National Defense Authorization Act for Fiscal Year 2021, but the *CHIPS and Science Act* appropriated the funding.
- **"Science" component:** This component of the law authorized funding (without direct appropriations) for research agencies—primarily the National Science Foundation (NSF) and the Department of Energy (DOE)—to finance R&D in strategic technology areas including semiconductor materials, quantum computing, biotechnology, and artificial intelligence. This included both reauthorizations of the agencies' basic research activities as well as the creation of a permanent new NSF Directorate for Technology, Innovation, and Partnerships (TIP Directorate). The TIP Directorate will support the translation and transfer of basic research into practical and commercial applications, foster public-private partnerships that can accelerate technology development and deployment, and invest in education and training programs to prepare a skilled workforce in emerging technology sectors. The law authorized funding in the amount of $20 billion to create the new permanent directorate but left it to future Congresses to decide whether or not to appropriate the authorized funding. These components of the bill originated in the Senate as part of the Endless Frontier Act of 2020[6] introduced by Majority Leader Charles Schumer (D-NY) and Republican Todd Young (R-IN), and were blended with House-originated provisions to become the "Science" part of the *CHIPS and Science Act*.

Technology export and investment restrictions under Trump and Biden presidential administrations

- **US-China trade war under President Trump:** In June 2018, the Trump administration imposed tariffs on billions of dollars worth of Chinese goods, citing unfair trade practices and intellectual property theft.[7] This triggered a series of escalating tariffs and trade measures between the two countries that has continued into the Biden administration. Although the original targets included a wide range of products—from solar panels and washing machines to steel and aluminum—the dispute became increasingly centered around high technology products that posed national security concerns, especially products manufactured by Chinese tech companies like Huawei. In May 2019, the U.S. government raised concerns about the security of Huawei's products and their potential use for espionage by the Chinese government, leading to significant restrictions and sanctions.[8] The "US-China trade war" started under President Trump helped cement technological competition as a major aspect of the US-China rivalry.
- **Exports and investment controls under President Biden:** The Biden administration has continued and expanded upon the restrictions started under President Trump, implementing export and investment controls in advanced technologies to limit China's technological advancements in areas that may threaten U.S. national security. These measures include export controls on advanced computing semiconductors and semiconductor manufacturing equipment, first announced by the Commerce Department in October 2022.[9] In August 2023, President Biden issued an executive order further restricting U.S. investments in Chinese entities engaged in the design, fabrication, or packaging of advanced semiconductors, as well as quantum computing and AI systems used for military or intelligence end-uses.[10]

Science and Technology components of the *Inflation Reduction Act* of 2022: Passed at a time when the Democratic Party controlled both chambers of Congress and the White House, the *Inflation Reduction Act* (IRA) directed unprecedented levels of federal spending to mitigate climate change and bolster clean energy production in the United States. The law allocated nearly $400 billion, largely in consumer and industry incentives, for clean energy technologies and electric vehicles,[11] with the aim of reducing carbon emissions substantially over the next decade and positioning the U.S. as a leader in green technology.[12] Large-scale

climate technology efforts like the IRA currently rest on a highly partisan basis of support and depend on unified Democratic control of the White House, the Senate, and the House of Representatives.

President Biden's 2021 Executive Order to Secure Supply Chains: Executive Order 14017, issued in February 2021, called for an all-of-government approach to assess vulnerabilities and strengthen the resilience of the United States' critical supply chains across several sectors.[13] A first priority was conducting vulnerability assessments for four critical product categories: semiconductor manufacturing and advanced packaging, large capacity batteries, critical minerals and materials, and pharmaceuticals and active pharmaceutical ingredients. The results of these assessments informed several later efforts related to the U.S. technology strategy, including supporting domestic production of critical medicines, securing an end-to-end domestic supply chain for advanced batteries, investing in sustainable domestic and international production and processing of critical minerals, and partnering with industry, allies, and partners to address semiconductor shortages.[14] Considerations of supply chain vulnerabilities and potential solutions also influenced the various pieces of legislation that became law as part of the *CHIPS and Science Act* of 2022.

Wind turbines turn behind a solar farm in Rapshagen, Germany, Thursday, Oct. 28, 2021. (AP Photo/ Michael Sohn, File)

Technology leadership for what? Considerations of national security, economic prosperity, and societal wellbeing

The broad popularity of the *CHIPS and Science Act* notwithstanding, major disagreements remain regarding what the explicit goals of the U.S. technology strategy should be and how these goals should be prioritized.[15] Many Democrats and a significant number of Republican lawmakers are reevaluating the federal government's decades-long commitment to neoliberal economic policies and champion investments in technology and advanced manufacturing as an effective method for creating good new jobs and broad-based economic prosperity. At the same time, deeply ingrained free-market principles continue to inspire considerable opposition to classic industrial policy, which most American economists have long criticized for its perceived inefficiency and waste.[16] Additionally, some Democrats dislike framing the country's science and technology strategy solely in terms of geopolitical competition, advocating instead for a more comprehensive approach that incorporates broader societal challenges including environmental protection and social equity.

Disagreement over the relative importance of national security, economic security, and societal wellbeing sparked heated debates among—as well as within—both political parties and chambers of Congress throughout the legislative process that produced the *CHIPS and Science Act*. Aspects of this debate continued during the implementation of the semiconductor subsidies program,[17] and are likely to pose obstacles for future legislative efforts aimed at safeguarding U.S. technological leadership.

National Security

National security issues have revitalized the Cold War-era consensus on the importance of technology leadership and the role of the federal government in safeguarding it. Indeed, the United States' rising geopolitical competition with China was singled out by Members in both parties as the primary motivation for funding both large-scale investments in semiconductor manufacturing and high-technology research and development more generally.[18]

Leadership in technological innovation has historically been a critical component of the U.S. military's "offset strategies," where technological advances are leveraged to overcome an adversary's relative advantage (such as numerical superiority), helping ensure victory during conflict as well as deterring potential confrontations altogether.[19] Emerging dual-use technologies like AI are already powering increased automation and cyber warfare around the world, and are poised to continue revolutionizing military capabilities.[20] It is therefore no surprise that rising geopolitical tensions between the United States and China, paired with China's astounding progress in technological sophistication over the past few decades, have motivated policymakers to focus squarely on securing the United States' technological leadership.[21]

Its elite research universities and attractive innovation ecosystems nonwithstanding, there are ominous signs that the U.S. cannot continue to take its technological superiority for granted.[22] A telling example, cited frequently to build public support for the *CHIPS and Science Act*, is the stark decline in the United States' share of global semiconductor manufacturing, which plummeted from 37 percent in 1990 to 12 percent in 2022.[23] Meanwhile, China has made remarkable strides in science and technology over the past three decades, as the Chinese Communist Party (CCP) rolled out an aggressive and tightly coordinated series of initiatives to position

China as a global leader in dual-use technologies. Chinese R&D investments have surged exponentially since 1990 and are set to overtake U.S. levels in the next few years, while the number of STEM Ph.D. graduates produced by Chinese universities has consistently exceeded those produced by U.S. universities for the past several years.[24]

In addition to R&D investment and talent development, the CCP has aggressively deployed a series of far-reaching industrial policy tools, including heavy subsidies for domestic industries, systematic acquisition of international companies, strict technology transfer conditions on foreign investment, industrial espionage and cybertheft, and a "military-civil fusion" strategy that seeks to harness commercial technological developments for military advantage.[25]

American voters have long supported a strong role for the federal government in supporting certain sectors of the economy when such policies are justified by acute national security concerns. Indeed, the United States can be said to have been funding industrial policy in dual-use technologies for decades through its defense system,[26] and it is no accident that policymakers turn to national security first when building public support for technology leadership strategies.

Economic Prosperity

The importance of the United States' technology leadership strategy is further evidenced by the attention it now receives in debates regarding the country's economic strength and competitiveness, particularly at a time of rising discontent with entrenched neoliberal economic policies. Both Democrats and Republicans now routinely acknowledge that an overreliance on unfettered trade with countries like China contributed significantly to the erosion of America's industrial base, the offshoring of manufacturing jobs, and the creation of vulnerable "chokepoints" in the U.S. supply chain. Meanwhile, China's economy experienced decades of striking growth, though this trajectory has slowed substantially in recent years.[27]

Voters' discontent with neoliberal economics, simmering since the 2008 financial crisis, reached a tipping point during the 2016 presidential election. Then-candidates Donald Trump and Bernie Sanders loudly criticized the offshoring of U.S. manufacturing jobs to China and China's unfair trade practices and aggressive industrial policies, and their insurgent campaigns sparked a dizzying redrawing

of economic policy fault lines within the two major parties.[28] Trump won the Republican primary election—and ultimately the general election—in large part by running against the neoliberal establishment in both parties and capitalizing on working class Americans' resentments about international trade and manufacturing job losses. Similarly, Sanders overperformed in the Democratic primary and came close to winning the nomination by the promise of giving voice to working class voters (and young progressives) who had largely been neglected in favor of corporate interests since the Clinton Administration held power.

The public response to the Trump and Sanders campaigns led to bipartisan recognition of China as a geopolitical and economic competitor and prompted a reassessment of the role of the federal government in the economy.[29] A faction of populist Republicans has emerged, branding themselves as "pro-worker" and advocates of "common good capitalism."[30] Recognizing this shift in political sentiment, President Biden has also prioritized industrial policies related to advanced technologies in formulating his economic policy agenda.[31] By strengthening domestic technological capacity, political leaders can credibly claim to create new manufacturing jobs (which are popular with the electorate), realign supply chains to make them less reliant on other countries, and drive long-term economic growth, especially when policies focus on dual-use technologies with large commercial markets, such as semiconductors.

Such considerations of economic competitiveness were instrumental in building bipartisan support for the *CHIPS and Science Act*. In addition to its Republican co-leads, the bill became law with the support of seventeen other Republican senators, including prominent figures like Senate Minority Leader Mitch McConnell, Mitt Romney, and Lindsey Graham.[32] It also gained the support of 24 Republican House Members, primarily those hailing from states such as Ohio, Texas, and Michigan, whose voters expected to benefit from the opening of new manufacturing facilities.[33]

"Economic security" arguments have met resistance from a range of groups, spanning libertarians to some moderate Democrats, who argue that industrial policy runs counter to the United States' modern aversion to protectionist policies. In U.S. politics, letting the government "pick winners" has long been associated with market inefficiencies and the potential for corruption and political rent-seeking by corporate lobbyists and insiders.[34] Contrary to these conventional

beliefs, an emerging body of research using large historical datasets and modern statistical analysis now suggests that industrial policies have often led to beneficial economic outcomes in the long term, including job creation and enhanced productivity and export performance in the targeted industries.[35] Nevertheless, "kneejerk opposition" to industrial policy remains well-entrenched in mainstream economics, complicating efforts to direct continued public investment into specific commercial sectors such as semiconductors.[36]

In supporting and implementing a wave of industrial policies without precedent in the past fifty years, the Biden administration and congressional Democrats have chosen to straddle the line between national security and economic security goals, sometimes highlighting the overarching importance of national security considerations[37] and sometimes emphasizing the importance of job creation and economic security.[38] This ambiguity has only prolonged the debate over the proper role of the federal government in the economy, with experts in both parties convinced that the neoliberal consensus is dead but unsure what exactly will replace it.[39] Complicating the debate further is the widespread recognition that dual-use technologies are by definition important for military capabilities while also having a substantial commercial market, making it nearly impossible to separate considerations of "national security" from "economic security" in crafting a technology leadership strategy. This is especially difficult when the primary "country of concern" that these policies are aimed at does not recognize this distinction.[40]

Social Policies

Many progressive policymakers and advocacy groups have called for a technology leadership strategy that explicitly addresses societal wellbeing, arguing that issues related to climate, health, and social equity are themselves matters of national and economic security. In their view, explicitly prioritizing societal wellbeing is a necessary response to the decades-long failure of free-market economic policies to deliver equitable opportunities as a byproduct of promised economic growth. In a similar vein, the Biden Administration has defended the inclusion of "social policy" conditions attached to federal subsidies—including hiring union-eligible workers and providing on-site childcare—as necessary to attract and maintain the workforce required to expand manufacturing in the United States.[41]

Opponents of these ideas claim that incorporating social policy goals into the technology leadership strategy threatens to dilute the intensity of efforts to address urgent national security issues currently facing the United States. More pragmatically, centering these goals tends to weaken bipartisan support for major policy proposals, especially since decisions about which social policy goals to pursue can often appear subjective to opponents.[42] Industry leaders and many Republicans in Congress—including Senator John Cornyn, who introduced the CHIPS Act in the Senate—have opposed the inclusion of social policy considerations in the evaluation process for awarding semiconductor subsidies under the Act.[43] They argue that these considerations were not part of the original legislation and may prove counterproductive by discouraging companies from applying for subsidies due to the increased cost of compliance. In this view, prioritizing U.S. leadership in advanced semiconductor manufacturing should involve supporting leading-edge entities rather than trying to simultaneously address multiple broad and complex objectives like geographic diversity, equity and sustainability.

Efforts to integrate social policy goals into the U.S. technology strategy sparked substantial disagreements between Members of the Senate and the House (and between and within the two parties) during the drafting of the Science components of the *CHIPS and Science Act*. House Democrats, led by then-Chair of the Science Committee Eddie Bernice Johnson (D-TX), crafted their own version of the bill to expand government support for research that addressed grand societal challenges, such as climate change and social inequality. This approach contrasted sharply with the prioritization of a list of technologies critical for geopolitical competition found in the original Endless Frontier Act proposal led by Senators Schumer and Young.[44] Although a compromise was eventually reached to get the legislation passed,[45] the impact of these disagreements over societal versus national security approaches to science and technology policy is likely to be enduring. Republican opposition to using public funding to advance public policy goals related to societal wellbeing may have contributed to the lower-than-expected appropriations for the Science portions of the bill,[46] and are likely to continue to complicate efforts to pass future large-scale legislation for technology leadership.

Leadership through what means? Defensive and offensive strategies

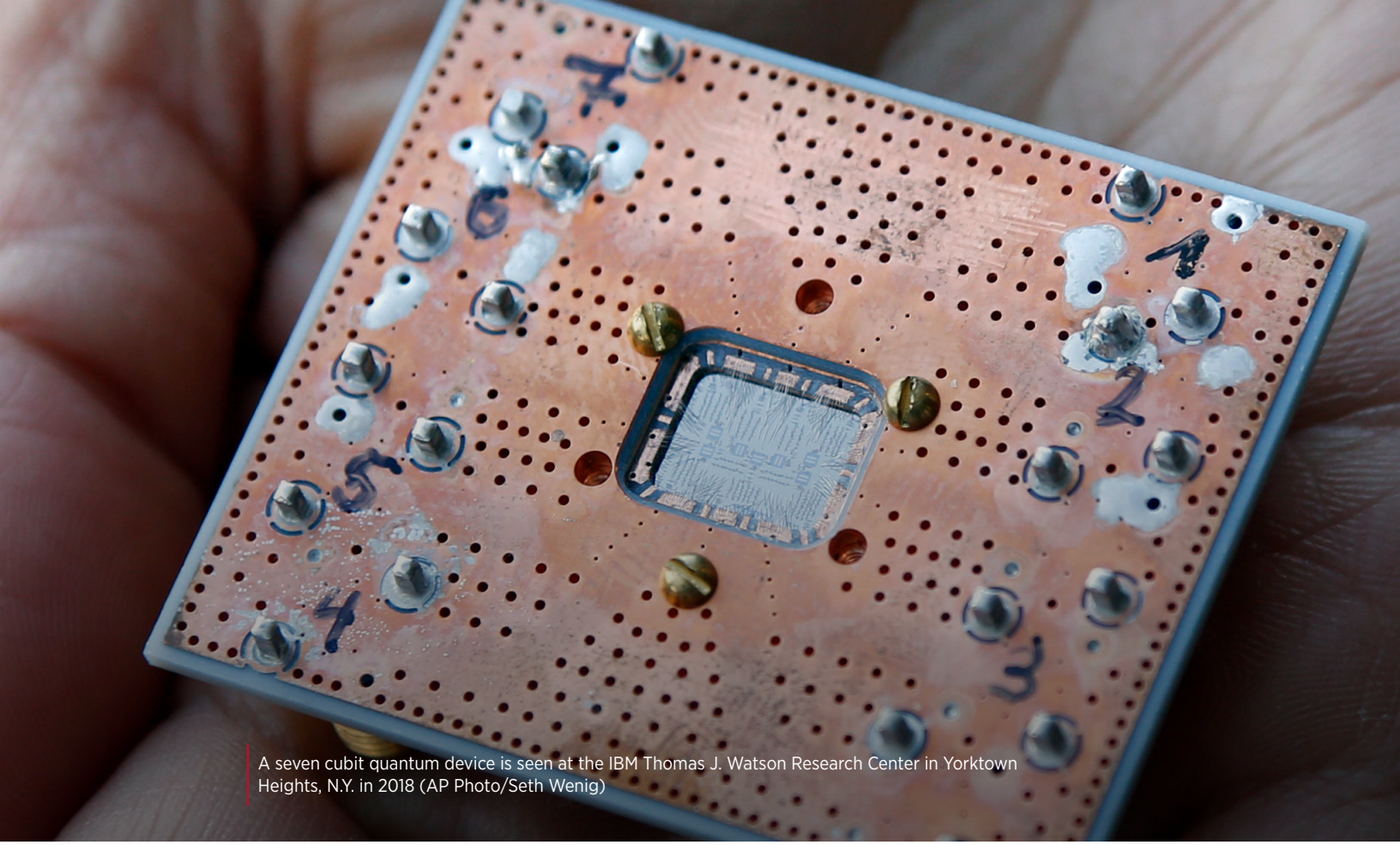
The *CHIPS and Science Act's* large-scale investments in domestic semiconductor manufacturing and high-tech R&D are one element within the broader national strategy for technology leadership. Both the Trump and Biden administrations have pressured Congress and pursued multiple initiatives through Executive branch agencies to secure the United States' technology lead (see Box 1 for an overview). These policies have been organized under two general approaches: protecting national interests from other rival nations, (a "defensive" approach), and promoting the development of domestic capacity (an "offensive" approach.)

The "defensive" pieces of the agenda were a major focus under President Trump's unequivocally hawkish stance against China, including banning Chinese entities from buying U.S. technology without special approval and effectively barring Huawei equipment from U.S. telecommunications networks.[47] The Trump administration's focus on the imposition of tariffs (a more straightforward policy tool)[48] and disinterest in building domestic capacity[49] reflected President Trump's sanction-favoring style that has been characterized as "all sticks and no carrots."[50] At the same time, the Trump Administration's actions radically changed bilateral relations between the U.S. and China and likely helped galvanize public support for a more vigorous federal role in preserving U.S. technology leadership.

Over the past three years, the Biden administration has presented a more balanced strategy for technology leadership that emphasizes both offensive and defensive components.[51] The "promote" agenda was a main strategic focus during the first two years of the Biden Administration, when Democrats controlled both the Senate and the House. President Biden leveraged this favorable political climate to consolidate domestic investments in strategically important sectors of the economy, from infrastructure and clean energy to science and technology innovation, leading a wave of industrial policies without precedent in the past fifty years. In addition to the *CHIPS and Science Act*, which President Biden lauded as an "inflection point" in the U.S. approach to industrial policy,[52] Congress passed both the *Infrastructure Investment and Jobs Act* and the *Inflation Reduction Act*, both of which stand as landmark examples of industrial policy legislation in nondefense sectors.[53]

After Congress approved nearly half a trillion dollars in federal spending during President Biden's first two years in office, Republicans won control of the House in the midterm elections of November 2022, effectively halting any significant new policy proposals from the Biden Administration or congressional Democrats. Since that time, the Biden administration's focus has shifted to implementing the recently enacted laws and doubling down on trade restrictions aimed at containing and countering China. Picking up the thread from Trump's presidency, the Biden administration has expanded export and outbound investment controls on advanced semiconductors for China in an attempt to prevent U.S. technology and funding from furthering Chinese military capabilities. The notion of "decoupling" critical supply chains, especially from China, arose early on in the Trump administration, but the COVID-19 pandemic's strain on critical supply chains helped accelerate and cement the notion among leaders in both parties that globally distributed supply chains are vulnerable to substantial "chokepoints" that can be exploited by the United States' geopolitical adversaries.[54]

Notwithstanding the Biden administration's demonstrated commitment to imposing strong protective measures against China, key administration officials have taken pains to emphasize that they still view China as a strategic partner over the long term and to assuage concerns about U.S. isolationism.[55] Administration officials generally avoid using the term "decoupling" and prefer the terms "de-risking and diversifying" favored by European allies and anchored on national security objectives. Likewise, the administration has insisted that their export controls on advanced semiconductors represent a "high fence, small yard" approach, whereby comprehensive protective measures are limited to a "narrow slice" of advanced technologies that, if incorporated into geopolitical rivals' military capability, would represent a critical threat to the United States' national security.[56]



A seven cubit quantum device is seen at the IBM Thomas J. Watson Research Center in Yorktown Heights, N.Y. in 2018 (AP Photo/Seth Wenig)

What stages of the technology development pipeline should the government fund, and through what financial mechanisms? From R&D to scale-up manufacturing

Another source of tension in defining the U.S. technology leadership strategy pertains to whether the government should support all stages of technology development or focus on only some. While the federal government has long been a primary funder of basic research, the *CHIPS and Science Act* (as well as the *Inflation Reduction Act* and the *Infrastructure Investment and Jobs Act*) broke the mold by supporting all technology development stages—from applied R&D to scale-up manufacturing—leading to substantial disagreement among policymakers, academic researchers, and other stakeholders.

Since the postwar period—when the United States' science and technology policy underwent a substantial and enduring reorganization—federal science investments in the civilian sector have been largely limited to basic research and early-stage development.[57] This approach has been buttressed by the mainstream neoliberal tradition, which considers basic research a form of market failure.[58] In this view, government involvement in later stages of technology development beyond basic research could potentially lead to market distortions, inefficiencies, and even the politicization of science and technology, so they should be left to the private sector and privately funded academic researchers.

Indeed, the *CHIPS and Science Act's* establishment of a new arm within the National Science Foundation focused on applied and translational R&D in specific "key technologies" raised concerns about a potential shift away from the agency's core mission of supporting basic research.[59] Critics, especially within the scientific community, feared that allocating significant resources to applied R&D might reduce the funds otherwise available for fundamental science and would ultimately lead to a top-down imposition of research priorities by the government. More practically, negotiations over the bill's proposal to expand the scope of the NSF also triggered concerns about potential overlap with the roles of other federal agencies, such as the Department of Energy and the Department of Defense. In contrast to these agencies, which also fund applied research and technology development, the NSF had only limited experience supporting technology development efforts beyond basic research.

While the legislation's ambitions for the new NSF Technology directorate got whittled down during the legislative process, the directorate itself was preserved in the final version of the bill that became law. Supporters pitched this new NSF arm as an elegant institutional solution to the proverbial "valley of death"—a term that refers to the fate faced by the multitude of breakthroughs in fundamental research that never make it into technology implementation.[60] Inconsistent government support during the high-risk stages of research translation has been repeatedly held responsible for this problem, and by focusing directly on use-inspired and translational research, the new Directorate aims to bridge this gap and "[advance] U.S. competitiveness through investments that accelerate the development of key technologies and address pressing societal and economic challenges."[61]

Government involvement in manufacturing stages of technology development elicits even greater controversy. Investments in domestic semiconductor manufacturing capacity is arguably a more time-sensitive use of government funds compared to early-stage research and development, and has the additional benefits of helping create jobs, spur additional investments in these sectors, and ultimately foster economic growth.[62] Yet, as discussed earlier, reservations about industrial policy and the inefficiencies of government interventions in the economy remain entrenched, and the once job-heavy manufacturing sector is viewed as particularly ripe for political favoritism. Notably, although the federal government has been funding all stages of technological development in the defense sector—including development, prototyping, testing, demonstration, and oftentimes serving as the initial market—in the civilian sector the definition of innovation (and its associated market failures) has not included advanced manufacturing processes, but rather remained limited to the earliest stages of technology development.[63]

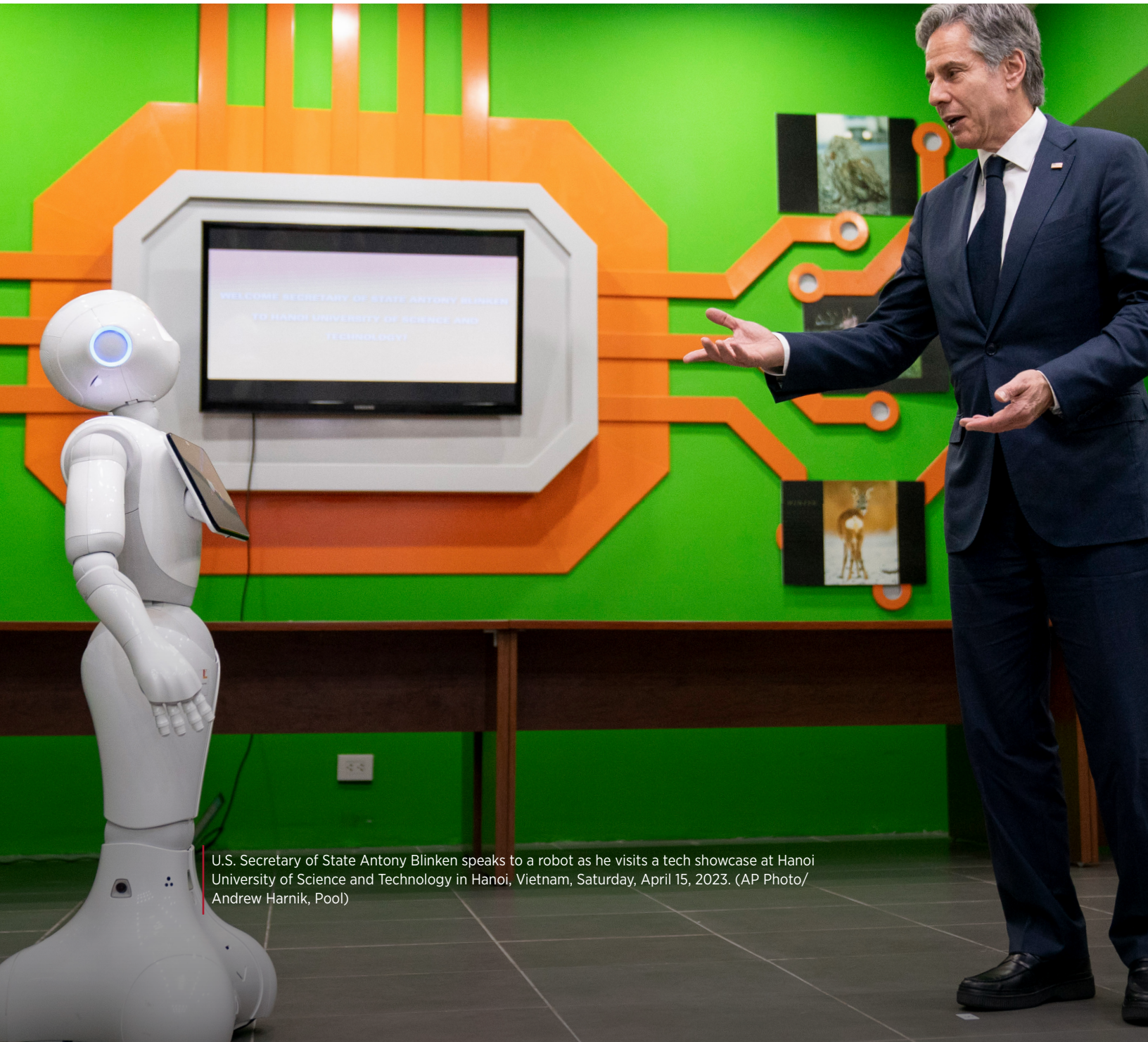
Even among those who supported the *CHIPS and Science Act's* substantial government investments in the economy, disagreements remain over whether this scale of funding should remain rare or serve as a gateway into a new era of enhanced federal spending on advanced technology R&D and manufacturing. For those that support limited government involvement, the government should pass the baton to the private sector; in this view, the hundreds of billions of dollars in domestic and foreign private investments that are already being "crowded in" for semiconductor manufacturing as a consequence of the *CHIPS and Science Act*[64] should be able to sustain the industry moving forward. Skepticism about the wisdom and practicality of financing any fresh efforts in industrial policy are further reinforced by the substantial and growing budget deficits faced by the federal government in recent years.[65]

Meanwhile, others argue that this should be but the first of a series of bills investing in domestic production capacity in semiconductors as well as other critical technologies, especially since American voters in both parties support such investments.[66] They point out that the *CHIPS and Science Act* investments, while substantial, are dwarfed by the much larger and repeated subsidies provided by governments like China, South Korea, and Singapore to their respective domestic industries.[67] Moreover, with the funding appropriated by the "Science" components of the bill falling substantially short of its authorizations,[68] there are increasing calls for additional funding that matches the original scope of the legislation's technology R&D ambitions.[69]

If this Congress or a future Congress decides to fund manufacturing efforts to spur technological leadership in strategic technologies, there are a variety of financial mechanisms to do so, as outlined in a recent piece by David Adler and William Bonvillian:[70]

- *Direct subsidies and grants* from the government to fund new advanced production facilities for critical technologies, like the semiconductor manufacturing subsidies offered by the *CHIPS and Science Act*.
- *Tax credits and incentives*, as used in the *Inflation Reduction Act* as well as the *CHIPS and Science Act* to encourage private investments and adoption of advanced manufacturing processes and production in priority technology sectors.
- *Guaranteed contracts* from the government to reduce risks for companies and assure production, as the government did with COVID-19 vaccine makers via the successful Operation Warp Speed.[71]
- *Expanding lending authority of existing federal institutions*, like the Department of Energy Loan Programs Office, which has provided financing for scale-up of new energy technologies since 2005, including a $465 million loan to Tesla in 2009. The *Inflation Reduction Act* authorized close to $12 billion for this office to expand its loan authority by approximately $100 billion, as well as $5 billion to create a new program of up to $250 billion for upgrading energy infrastructure.[72] Moreover, in response to the supply chain risk assessments conducted as part of President Biden's executive order on Securing Supply Chains (see Box 1), the administration proposed repurposing an established federal bank, the Export-Import Bank, to provide manufacturing scale-up support alongside its long-standing export financing role.[73]
- *Establishing new financing institutions*, such as Senator Chris Coons' (D-DE) proposal to create an industrial finance corporation to provide scale-up financing for innovative manufacturing. Similarly, in 2022 the DOD created a new "Office of Strategic Capital" for technology scale-up, though likely limited to technology with direct military applications.[74]

Since political actors typically have different levels of comfort with direct subsidies, loans, and tax credits, proposals that utilize a variety of financing mechanisms are more likely to remain in play across a broader range of political climates. Many advocates who favor public investment to secure technology leadership recommend that policymakers provide substantial and reliable funding through established institutional mechanisms, viewing this as a more efficient and stable approach to supporting technological innovation and development when compared with discrete, time-limited legislative efforts as large and politically complex as the *CHIPS and Science Act*.



U.S. Secretary of State Antony Blinken speaks to a robot as he visits a tech showcase at Hanoi University of Science and Technology in Hanoi, Vietnam, Saturday, April 15, 2023. (AP Photo/ Andrew Harnik, Pool)

Ongoing challenges and the future of the U.S. tech leadership strategy

The *CHIPS and Science Act* was an unprecedented effort to boost the United States' lead in cutting-edge, dual-use technologies. Despite the bill's bipartisan support and strong popularity with the American public,[75] prospects for similar legislative efforts in the near term are uncertain. Substantial disagreements persist both between and among Democratic and Republican lawmakers, including disagreements about whether the U.S. technology strategy should be framed around geopolitical competition, economic competitiveness, or societal wellbeing; whether the U.S. should focus on building domestic capacity or preventing adversaries from accessing American technologies; and the extent and avenues of federal intervention in different stages of technological development, from research and development to scale-up manufacturing.

Core to these tensions is many policymakers' continued ambivalence over the role of government in the economy, especially in spurring technological innovation and development in a climate of heightened geopolitical competition. Industrial policy efforts are especially politicized, not only because they undermine longstanding economic orthodoxy, but additionally because they create tangible outcomes—such as the opening of new facilities and employment opportunities—that political leaders often highlight as accomplishments in re-election campaigns.[76]

In the coming years, much will depend on the outcome of the 2024 elections, especially the presidential election. If President Biden wins re-election, he will likely attempt to recreate the coalitions that proved so successful in coordinating passage of the landmark industrial policy laws enacted during his first two years in office, though he will have a difficult time convincing congressional Republicans to support his efforts—especially if Republicans control either chamber of Congress. If leading Republican candidate Donald Trump returns to power, he may find industrial policy to be one area of policy that is ripe for bipartisan cooperation—if he is willing to propose measures that are closely targeted to national security and economic growth and do not require Democrats to abandon core principles, such as longstanding commitments to labor and the environment.

President Biden has already demonstrated his willingness to build upon President Trump's defensive trade and financial policy vis-a-vis China. Both candidates can be expected to continue this defensive approach if they were to be inaugurated in January 2025, though former President Trump's stated plans for countering China in a second term are even more radical than the policies he proposed and implemented during his time in office.[77]

Regardless of who holds power, policymakers face an array of challenges in crafting and implementing a successful strategy to maintain the United States' technology leadership. In addition to the political tensions outlined in this article, cross-cutting policy challenges include developing a skilled workforce, coordinating policy efforts across dozens of government agencies as well as with industry and academia, and ensuring sustained international alignment with allies and trusted partners. Ultimately, any successful vision for technology leadership will have to contend with a wide range of complicated and interrelated national security, economic, and societal issues while consolidating the nascent support that exists among voters in both parties for a more assertive federal role on this issue. The stakes are high, and the challenges are not likely to recede.

Endnotes

1 National Academies of Sciences, Engineering, and Medicine, "Protecting U.S. Technological Advantage" (2022), https://nap.nationalacademies.org/catalog/26647/protecting-us-technological-advantage

2 Broadly, dual-use technologies refer to those that have both military and civilian applications. For a discussion of the term and its usage, see Jordi Molas-Gallart, *Which way to go? Defence technology and the diversity of 'dual-use' technology transfer*, Research Policy 26(3) (1997): 367-385, https://doi.org/10.1016/S0048-7333(97)00023-1

3 *See, e.g.*, Willy C. Shih, *The New Era of Industrial Policy is Here*, Harvard Business Review (Sept. – Oct. 2023), https://hbr.org/2023/09/the-new-era-of-industrial-policy-is-here. William Bonvillian has termed these policy efforts "industrial *innovation* policy." William B. Bonvillian, *Industrial Innovation Policy in the United States*, Annals of Science and Technology Policy, v. 6, n. 4: 318-352, 373-392 (Nov. 2022), https://www.researchgate.net/publication/365741066_Industrial_Innovation_Policy_in_the_United_States

4 The White House, "FACT SHEET: *CHIPS and Science Act* Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China" (Aug. 9, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs-create-jobs-strengthen-supply-chains-and-counter-china

5 Press Release, Senator Mark Warner, "Bipartisan, Bicameral Bill Will Help Bring Production of Semiconductors, Critical to National Security, Back to U.S." (July 10, 2020), https://www.warner.senate.gov/public/index.cfm/2020/6/bipartisan-bicameral-bill-will-help-bring-production-of-semiconductors-critical-to-national-security-back-to-u-s

6 Press Release, Senator Todd Young, "Young, Schumer Unveil Endless Frontier Act to Bolster U.S. Tech Leadership and Combat China" (May 27, 2020), https://www.young.senate.gov/newsroom/press-releases/young-schumer-unveil-endless-frontier-act-to-bolster-us-tech-leadership-and-combat-china

7 Press Release, Office of the United States Trade Representative, "USTR Issues Tariffs on Chinese Products in Response to Unfair Trade Practices" (June 15, 2018), https://ustr.gov/about-us/policy-offices/press-office/press-releases/2018/june/ustr-issues-tariffs-chinese-products

8 David Lawder & Susan Heavey, *U.S. blacklists China's Huawei as trade dispute clouds global outlook*, Reuters (May 15, 2019), https://www.reuters.com/article/us-usa-trade-china-idUSKCN1SL2DI/

9 Press Release, U.S. Department of Commerce, Bureau of Industry and Security, "Commerce Implements New Export Controls on Advanced Computing and Semiconductor Manufacturing Items to the People's Republic of China (PRC)" (Oct. 9, 2022), https://www.bis.doc.gov/index.php/documents/about-bis/newsroom/press-releases/3158-2022-10-07-bis-press-release-advanced-computing-and-semiconductor-manufacturing-controls-final/file. These controls were later tightened and expanded to additional countries to mitigate the risk of trade merely diverting through other nations to China. See Press Release, U.S. Department of Commerce, Bureau of Industry and Security, "Commerce Strengthens Restrictions on Advanced Computing Semiconductors, Semiconductor Manufacturing Equipment, and Supercomputing Items to Countries of Concern" (Oct. 17, 2023), https://www.bis.doc.gov/index.php/documents/about-bis/newsroom/press-releases/3355-2023-10-17-bis-press-release-acs-and-sme-rules-final-js/file

10 The White House, Exec. Order No. 14105, "Addressing United States Investments in Certain National Security Technologies and Products in Countries of Concern," 88 Fed. Reg. 54867 (Aug. 9, 2023), https://www.whitehouse.gov/briefing-room/presidential-actions/2023/08/09/executive-order-on-addressing-united-states-investments-in-certain-national-security-technologies-and-products-in-countries-of-concern

11 McKinsey & Co., "The Inflation Reduction Act: Here's what's in it" (Oct. 24, 2022), https://www.mckinsey.com/industries/public-sector/our-insights/the-inflation-reduction-act-heres-whats-in-it. The *Bipartisan Infrastructure Law of 2021* also included $20 billion in funding for energy technology demonstration programs and research hubs. U.S. Department of Energy, "DOE Fact Sheet: The Bipartisan Infrastructure Deal Will Deliver For American Workers, Families and Usher in the Clean Energy Future" (Nov. 9, 2021), https://www.energy.gov/articles/doe-fact-sheet-bipartisan-infrastructure-deal-will-deliver-american-workers-families-and-0

12 To offset this expenditure and reduce the federal deficit, the law also included measures to generate revenue, including increases in corporate tax rates and improved enforcement of tax collection by the IRS. It also featured a range of provisions pertaining to health care and pharmaceutical drugs, some of which were expected to raise revenue due to their impact on existing federal spending obligations.

13 The White House, Exec. Order No. 14017, "Executive Order on America's Supply Chains," (Feb. 24, 2021), https://www.whitehouse.gov/briefing-room/presidential-actions/2021/02/24/executive-order-on-americas-supply-chains

14 The White House, "FACT SHEET: Biden-Harris Administration Announces Supply Chain Disruptions Task Force to Address Short-Term Supply Chain Discontinuities" (June 8, 2021), https://www.whitehouse.gov/briefing-room/statements-releases/2021/06/08/fact-sheet-biden-harris-administration-announces-supply-chain-disruptions-task-force-to-address-short-term-supply-chain-discontinuities

15 Julius Krein, *What Should Be the Goal of U.S. Industrial Strategy?*, The Liberal Patriot (Nov. 13, 2023), https://www.liberalpatriot.com/p/what-should-be-the-goal-of-us-industrial; Robert Atkinson, *Industrial Policy May Have Finally Arrived: But For What?*, American Compass (Nov. 16, 2020), https://americancompass.org/industrial-policy-may-have-finally-arrived-but-for-what/

16 While industrial policy has many definitions, we use the most common definition – "government support for industries that are deemed strategically important." *See* Anshu Siripurapu & Noah Berman, "Is Industrial Policy Making a Comeback?," Council on Foreign Relations (Sept. 18, 2023), https://www.cfr.org/backgrounder/industrial-policy-making-comeback

17 Sabrina Siddiqui and Yuka Yahashi, *No 'Social Policy' in Chips Act Rules, Commerce Secretary Gina Raimondo Says*, Wall Street Journal (Mar. 28, 2023) https://www.wsj.com/articles/no-social-policy-in-chips-act-rules-commerce-secretary-gina-raimondo-says-616f156e

18 This includes both the CHIPS for America Act of 2020 and the Endless Frontier Act of 2020, the bipartisan precursors of the measures that would ultimately become law as the joint *CHIPS and Science Act of 2022* (see Box 1 for more details). Andrea Peterson, "Lawmakers Propose Multibillion Dollar Semiconductor R&D Push," American Institute of Physics (June 24, 2020), https://ww2.aip.org/fyi/2020/lawmakers-propose-multibillion-dollar-semiconductor-rd-push; Press Release, Senator Todd Young, "Young, Schumer Unveil Endless Frontier Act to Bolster U.S. Tech Leadership and Combat China" (May 27, 2020) https://www.young.senate.gov/newsroom/press-releases/young-schumer-unveil-endless-frontier-act-to-bolster-us-tech-leadership-and-combat-china

19 Gian Gentile et al., "A History of the Third Offset, 2014–2018," The RAND Corporation (2021), https://www.rand.org/pubs/research_reports/RRA454-1.html

20 Kelley Sayler, "Emerging Military Technologies: Background and Issues for Congress," Congressional Research Service (Nov. 1, 2022), https://crsreports.congress.gov/product/pdf/R/R46458; Ryan Fedasiu et al., "Harnessed Lightning: How the Chinese Military is Adopting Artificial Intelligence," Center for Security and Emerging Technology (Oct. 2021), https://cset.georgetown.edu/publication/harnessed-lightning; Jacob Stokes et al., "U.S.-China Competition and Military AI: How Washington Can Manage Strategic Risks amid Rivalry with Beijing," Center for a New American Security (July 25, 2023), https://www.cnas.org/publications/reports/u-s-china-competition-and-military-ai; Ulrike Franke, "Not smart enough: The poverty of European military thinking on artificial intelligence," European Council on Foreign Relations (Dec. 18, 2019), https://ecfr.eu/publication/not_smart_enough_poverty_european_military_thinking_artificial_intelligence

21 Indeed, advanced science and technology have taken center stage in the US-China rivalry, with many experts in both Beijing and Washington referring to leadership in emerging technologies as the most critical battleground. Peter Engelke & Emily Weinstein, "Assessing China's approach to technological competition with the United States," The Atlantic Council (Apr. 24, 2023), https://www.atlanticcouncil.org/content-series/strategic-insights-memos/assessing-chinas-approach-to-technological-competition-with-the-united-states; Graham Allison et al., "The Great Tech Rivalry: China vs. the U.S.," Belfer Center for Science and International Affairs, Harvard Kennedy School (2021), https://www.belfercenter.org/sites/default/files/GreatTechRivalry_ChinavsUS_211207.pdf

22 National Academies of Science, Engineering, and Medicine, "Protecting U.S. Technological Advantage" (2022), https://nap.nationalacademies.org/catalog/26647/protecting-us-technological-advantage

23 Semiconductor Industry Association, 2022 SIA Factbook, https://www.semiconductors.org/wp-content/uploads/2022/05/SIA-2022-Factbook_May-2022.pdf

24 American Academy of Arts & Sciences, "The perils of complacency: America at a tipping point in science and engineering" (2020), https://www.amacad.org/sites/default/files/publication/downloads/Perils-of-Complacency_Report-Brief_4.pdf; Remco Zweetsloot et al., "China is Fast Outpacing U.S. STEM PhD Growth," Center for Security and Emerging Technology (Aug. 2021), https://cset.georgetown.edu/publication/china-is-fast-outpacing-u-s-stem-phd-growth; National Academies of Sciences, Engineering, and Medicine, "Protecting U.S. Technological Advantage" (2022), https://nap.nationalacademies.org/catalog/26647/protecting-us-technological-advantage

25 James McGregor, "China's Drive for 'Indigenous Innovation': A Web of Industrial Policies," U.S. Chamber of Commerce (2010), https://www.uschamber.com/assets/archived/images/documents/files/100728chinareport_0_0.pdf; Jeroen Groenewegen-Lau & Michael Laha, "Controlling the Innovation Chain: China's strategy to become a science & technology superpower," Mercator Institute for China Studies (Feb. 2, 2023), https://merics.org/sites/default/files/2023-02/merics-report-controlling-the-innovation-chain.pdf; Karen Sutter, "'Made in China 2025' Industrial Policies: Issues for Congress," Congressional Research Service (Mar. 10, 2023), https://sgp.fas.org/crs/row/IF10964.pdf

26 William B. Bonvillian, *Industrial Innovation Policy in the United States*, Annals of Science and Technology Policy, v. 6, n. 4: 318-352, 373-392 (Nov. 2022), https://www.researchgate.net/publication/365741066_Industrial_Innovation_Policy_in_the_United_States;

27 Testimony of Logan Wright, Partner and Director of China Markets Research, Rhodium Group, US-China Economic Security and Review Commission, Hearing on China's Financial and Economic Challenges (Aug. 21, 2023), https://www.uscc.gov/sites/default/files/2023-08/Logan_Wright_Testimony.pdf

28 See Michael Lind, How to Transform US Politics—and How Not To, Compact Magazine (Mar. 14, 2023), https://www.compactmag.com/article/how-to-transform-us-politics-and-how-not-to; Julius Krein, *America after neoliberalism*, The New Statesman (Dec. 23, 2023), https://www.newstatesman.com/the-weekend-essay/2023/12/america-after-neoliberalism

29 The Obama Administration paid close attention to China – particularly during President Obama's second term – and treated China as a worthy competitor whose actions would shape U.S. policy for the next generation. However, this assessment primarily impacted the strategies of the Defense and State Departments (rather than economic policies) and, with some notable exceptions, did not form a core part of President Obama's public communications strategy.

30 Eliana Johnson, *A Big Policy Fight Is Brewing on the Right. And It's Not All About Trump.*, Politico (Aug. 5, 2021), https://www.politico.com/news/magazine/2021/08/05/republican-economic-populism-502412

31 Greg Ip, *Bidenomics and Its Contradictions*, Wall Street Journal (June 8, 2023), https://www.wsj.com/articles/bidenomics-and-its-contradictions-4d76ee7d; Remarks by National Security Advisor Jake Sullivan at the Brookings Institution, "The Biden administration's international economic agenda: A conversation with National Security Advisor Jake Sullivan" (Apr. 27, 2023), https://www.brookings.edu/events/the-biden-administrations-international-economic-agenda-a-conversation-with-national-security-advisor-jake-sullivan; Office of the United States Trade Representative, "Ambassador Katherine Tai›s Remarks at the National Press Club on Supply Chain Resilience" (June 15, 2023), https://ustr.gov/about-us/policy-offices/press-office/speeches-and-remarks/2023/june/ambassador-katherine-tais-remarks-national-press-club-supply-chain-resilience; The White House, "Remarks by Heather Boushey on How President Biden's Invest in America Agenda has Laid the Foundation for Decades of Strong, Stable, and Sustained, Equitable Growth" (May 31, 2023), https://www.whitehouse.gov/briefing-room/speeches-remarks/2023/05/31/remarks-by-heather-boushey-on-how-president-bidens-invest-in-america-agenda-has-laid-the-foundation-for-decades-of-strong-stable-and-sustained-equitable-growth

32 U.S. Senate, Roll Call Vote 271, 117th Congress, Second Session (July 27, 2022), https://www.senate.gov/legislative/LIS/roll_call_votes/vote1172/vote_117_2_00271.htm

33 Office of the Clerk, U.S. House of Representatives, Roll Call Vote 404, 117th Congress, Second Session (July 28, 2022), https://clerk.house.gov/Votes/2022404. Securing twenty-four Republican votes for the *CHIPS and Science Act* was no small accomplishment given the timing of the vote, which took place the day after Senate Majority Leader Charles Schumer and Senator Joe Manchin (D-WV) announced a separate agreement on a proposal that would become the Inflation Reduction Act, shocking Republicans who believed that a Democratic-only clean-energy bill was no longer on the table. See Mychael Schnell & Emily Brooks, *Whip-lash: House GOP moves to oppose CHIPS-Plus bill in rebuke to Manchin deal*, The Hill (July 27, 2022), https://thehill.com/homenews/house/3577342-whip-lash-house-gop-moves-to-oppose-chips-plus-bill-in-rebuke-to-manchin-deal

34 Adam Posen, *America's Zero-Sum Economics Doesn't Add Up*, Foreign Policy (Mar. 24, 2023), https://foreignpolicy.com/2023/03/24/economy-trade-united-states-china-industry-manufacturing-supply-chains-biden; Greg Ip, *This Part of Bidenomics Needs More Economics*, Wall Street Journal (July 12, 2023), https://www.wsj.com/articles/this-part-of-bidenomics-needs-more-economics-2cea1641; John Abbott, "US CHIPS Act is only a small step toward a very big problem," S&P Global Market Intelligence (Aug. 22, 2022), https://www.spglobal.com/marketintelligence/en/news-insights/blog/us-chips-act-is-only-a-small-step-toward-a-very-big-problem; Erika York, "Careful What You Wish For: CHIPS Subsidies Require 'Excess Profits' Sharing," Tax Foundation (Mar. 2, 2023), https://taxfoundation.org/blog/biden-semiconductor-chips-act-subsidies

35 Réka Juhász, Nathan Lane & Dani Rodrik, "The New Economics of Industrial Policy," HKS Working Paper (Aug. 2023), https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4542861

36 *See id.* ("There are few economic policies that generate more kneejerk opposition from economists than

industrial policy.").

37 Commerce Secretary Gina Raimondo, whose agency was tasked with disbursing the CHIPS Act funds, has consistently cited national security concerns as the reason for these investments, arguing that "this is not the first in a 'wave' of industrial policies. Trade with China is good and must continue, but we must also protect the security of the United States." Remarks by Secretary Gina Raimondo, "A Conversation with US Commerce Secretary Gina M. Raimondo and Sen. Todd Young (R-IN) on the Future of US Semiconductor Policy," American Enterprise Institute (July 26, 2023), https://www.aei.org/events/a-conversation-with-us-commerce-secretary-gina-m-raimondo-on-the-future-of-us-semiconductor-policy

38 See, e.g., The White House, "Statement from National Economic Advisor Lael Brainard on Today's CHIPS & Science Act Announcement" (Jan. 4, 2024), https://www.whitehouse.gov/briefing-room/statements-releases/2024/01/04/statement-from-national-economic-advisor-lael-brainard-on-todays-chips-science-act-announcement (noting how CHIPS Act investments are "creating good jobs"); House Democratic Leader Hakeem Jeffries (D-NY), Floor Remarks in support of the Inflation Reduction Act (Aug. 22, 2022), https://www.govinfo.gov/content/pkg/CREC-2022-08-12/pdf/CREC-2022-08-12.pdf ("We passed the *CHIPS and Science Act* that will bring back domestic manufacturing jobs to the United States of America.").

39 *See, e.g.*, Dani Rodrik, *Washington's New Narrative for the Global Economy*, Project Syndicate (May 9, 2023) https://www.project-syndicate.org/commentary/biden-administration-international-economic-agenda-must-not-undermine-global-economy-by-dani-rodrik-2023-05; Julius Krein, *What Should Be the Goal of U.S. Industrial Strategy?*, The Liberal Patriot (Nov. 13, 2023), https://www.liberalpatriot.com/p/what-should-be-the-goal-of-us-industrial; (U.S. Senator) Chris Murphy, *The Wreckage of Neoliberalism*, The Atlantic (Oct. 25, 2022), https://www.theatlantic.com/ideas/archive/2022/10/democrats-should-reject-neoliberalism/671850

40 Both the legislative text of the *CHIPS and Science Act* and the Commerce Department's implementation documents refer euphemistically to "countries of concern" – a group of geopolitical adversaries that includes Russia, Iran, and North Korea – even though many of the restrictions are aimed at countering China in particular. *See, e.g.*, Press Release, U.S. Department of Commerce, "Commerce Department Outlines Proposed National Security Guardrails for CHIPS for America Incentives Program," (Mar. 21, 2023), https://www.commerce.gov/news/press-releases/2023/03/commerce-department-outlines-proposed-national-security-guardrails. According to Senator Chris Coons (D-DE), "The commercial and military distinction is eroded in China's case." David E. Sanger et al., *Senate Poised to Pass Huge Industrial Policy Bill to Counter China*, New York Times (June 7, 2021) (quoting Senator Coons), https://www.nytimes.com/2021/06/07/us/politics/senate-china-semiconductors.html

41 Sabrina Siddiqui & Yuka Yahashi, *No 'Social Policy' in Chips Act Rules, Commerce Secretary Gina Raimondo Says*, Wall Street Journal (Mar. 28, 2023), https://www.wsj.com/articles/no-social-policy-in-chips-act-rules-commerce-secretary-gina-raimondo-says-616f156e (discussing the requirements that U.S. companies must meet in order to be eligible for subsidies under the *CHIPS and Science Act*)

42 Suzanne Berger, *Back Down to Earth*, Boston Review (Sept. 15, 2021), https://www.bostonreview.net/forum_response/back-down-to-earth

43 Press Release, Senator John Cornyn, "Cornyn Warns Against Partisan CHIPS Implementation" (Mar. 16, 2023), https://www.cornyn.senate.gov/news/cornyn-warns-against-partisan-chips-implementation

44 According to several congressional staffers, difficulties in harmonizing House Democrats' insistence that social policy provisions be included with Senate Republicans' insistence that they be excluded nearly led to the entire "Science" component of the bill being eliminated in order to salvage the component funding the CHIPS Act.

45 The final version of the Science parts of the bill included the establishment of a new NSF Directorate for Technology, Innovation and Partnerships focused on ten critical technologies and five "national, societal, and economic goals." Tim Clancy, "*CHIPS and Science Act* Enshrines Policy for New NSF Technology Directorate," American Institute of Physics (Nov. 23, 2022), https://ww2.aip.org/fyi/2022/chips-and-science-act-enshrines-policy-new-nsf-technology-directorate

46 Matt Hourihan et al., "The bold vision of the *CHIPS and Science Act* isn't getting the funding it needs," Brookings Institution (May 17, 2023), https://www.brookings.edu/articles/the-bold-vision-of-the-chips-and-science-act-isnt-getting-the-funding-it-needs/; Madeleine Ngo, CHIPS Act Funding for Science and Research Falls Short, New York Times (May 30, 2023), https://www.nytimes.com/2023/05/30/us/politics/chips-act-science-funding.html

47 David Shepardson & Karen Freifeld, *Trump administration hits China's Huawei with one-two punch*, Reuters (May 16, 2019), https://www.reuters.com/article/idUSKCN1SL2QX

48 As President Trump stated in a famous 2018 tweet, "trade wars are good, and easy to win." President Donald J. Trump [@realDonaldTrump], March 2, 2018, https://twitter.com/realDonaldTrump/status/969525362580484098

49 Many Republican leaders framed the *Tax Cuts and Jobs Act of 2017,* which led to substantial reductions in corporate taxes, as a policy tool to support business development and innovation for global competitiveness. However, the "global competitiveness" argument was aimed at a range of European and East Asian competitors; aggressive geopolitical competition with China would not come into focus until later in the Trump presidency. Meanwhile, the Trump Administration's frequent invocation of "Infrastructure Week" attracted frequent criticism because the Administration's messaging on the importance of improving the nation's infrastructure was never coupled with a sustained attempt to enact major legislation on the issue. *See* Katie Rogers, *How 'Infrastructure Week' Became a Long-Running Joke,* New York Times (May 22, 2019), https://www.nytimes.com/2019/05/22/us/politics/trump-infrastructure-week.html

50 Gardiner Harris, *Trump Has Only Sticks, No Carrots*, New York Times (Nov. 9, 2018) https://www.nytimes.com/2018/11/09/sunday-review/trump-sanctions-iran-foreign-policy.html

51 Alexandra Alper, *Explainer: Biden combines billions in chipmaking grants with China curbs to keep US ahead*, Reuters (Oct. 17, 2023), https://www.reuters.com/technology/bidens-latest-china-curbs-are-part-plan-shift-chip-production-stateside-2023-10-17; Gavin Bade, *'A sea change': Biden reverses decades of Chinese trade policy,* Politico (Dec. 26, 2022), https://www.politico.com/news/2022/12/26/china-trade-tech-00072232;

52 The White House, "Remarks by President Biden at Signing of H.R. 4346, 'The *CHIPS and Science Act* of 2022,'" (Aug. 9, 2022), https://www.whitehouse.gov/briefing-room/speeches-remarks/2022/08/09/remarks-by-president-biden-at-signing-of-h-r-4346-the-chips-and-science-act-of-2022

53 The *Infrastructure Investment and Jobs Act* (IIJA) remains better known by its informal title, the Bipartisan Infrastructure Law. Insofar as transportation infrastructure and utilities are classic "public goods" that governments are expected to fund or subsidize, major components of the IIJA are not considered industrial policy, strictly speaking. Other components of the IIJA – such as its expansive investments in clean energy demonstration projects and subsidies for affordable broadband internet access, blur the line between infrastructure and industrial policy. More importantly, the political realignment that made space for a reinvigorated federal role in laying the groundwork for economic activity was the necessary condition for making all three of these laws possible.

54 United States Trade Representative, "Ambassador Katherine Tai's Remarks at the National Press Club on Supply Chain Resilience" (June 15, 2023), https://ustr.gov/about-us/policy-offices/press-office/speeches-and-remarks/2023/june/ambassador-katherine-tais-remarks-national-press-club-supply-chain-resilience

55 Press Release, Department of the Treasury, "Remarks by Secretary of the Treasury Janet L. Yellen on the U.S. - China Economic Relationship at Johns Hopkins School of Advanced International Studies" (Apr. 20, 2023), https://home.treasury.gov/news/press-releases/jy1425; David Shepardson, *Raimondo: crucial US, China have stable economic relationship*, Reuters (Aug. 28, 2023) https://www.reuters.com/markets/raimondo-crucial-us-china-have-stable-economic-relationship-2023-08-28; Remarks by National Security Advisor Jake Sullivan at the Brookings Institution, "The Biden administration's international economic agenda: A conversation with National Security Advisor Jake Sullivan" (Apr. 27, 2023), https://www.brookings.edu/events/the-biden-administrations-international-economic-agenda-a-conversation-with-national-security-advisor-jake-sullivan

56 Many observers view the Administration's preferred rhetoric as an exercise in semantics, insofar as the protective trade measures implemented by the Administration are hawkish in substance while the nuanced distinctions between terms used to describe the U.S.-China relationship are primarily symbolic. Nevertheless, the Biden administration generally avoids antagonizing China through rhetoric alone, in contrast to President Trump, who often lambasted China in colorful terms while often praising Chinese President Xi Jinping for his strength of leadership.

57 The establishment of a science and technology policy strategy centered on basic research (and not further stages of technology development) has been credited to Vannevar Bush, Science Advisor to President Roosevelt. In his famous 1945 report titled *Science, The Endless Frontier,* Bush laid out a model of innovation that followed a linear trajectory whereby the government funds basic research and the results are taken up by industry and further developed into technology products that may eventually reach the market. Bush's report inspired the title of Senators Schumer and Young's Endless Frontier Act that served as the foundation for the "Science" component of the *CHIPS and Science Act*. Vannevar Bush, "Science, the Endless Frontier: A Report to the President by Vannevar Bush, Director of the Office of Scientific Research and Development" (1945), https://www.nsf.gov/about/history/EndlessFrontier_w.pdf; William Bonvillian, *Encompassing the Innovation Panoply*, Issues in Science and Technology v. 38, n. 2: 37-43 (Winter 2022), https://issues.org/us-industrial-policy-innovation-bonvillian

58 The private sector systematically under-invests in curiosity-driven research due to long timelines, high costs, uncertain outcomes, and difficulty in capturing benefits. Public investments are justified by these private underinvestments and the large positive externalities created by scientific research.

59 Mitch Ambrose, "NSF Doubles Budget of Its New Technology Directorate," American Physical Society News (May 11, 2023), https://www.aps.org/publications/apsnews/202306/nsf-budget.cfm

60 Philip E. Auerswald & Lewis M. Branscomb, *Valleys of death and Darwinian seas: Financing the invention to innovation transition in the United States*, The Journal of Technology Transfer, v. 28: 227-239 (2003); Donald E. Stokes, Pasteur's Quadrant: Basic Science and Technological Innovation, Brookings Institution Press (2011).

61 Note that this mission statement includes references to national security, economic competitiveness, and societal missions, reflecting a political compromise regarding the diverse goals attached to technology leadership, as discussed earlier; U.S. National Science Foundation, "Technology, Innovation and Partnerships: A new directorate at the U.S. National Science Foundation," https://new.nsf.gov/tip/latest (accessed January 24, 2024).

62 Justin Badlam et al., "The *CHIPS and Science Act*: Here's what's in it," McKinsey & Co. (Oct. 4, 2022), https://www.mckinsey.com/industries/public-sector/our-insights/the-chips-and-science-act-heres-whats-in-it; https://www.spglobal.com/marketintelligence/en/news-insights/blog/us-chips-act-is-only-a-small-step-toward-a-very-big-problem

63 William B. Bonvillian, *Industrial Innovation Policy in the United States*, Annals of Science and Technology Policy, v. 6, n. 4: 318-352, 373-392 (Nov. 2022), https://www.researchgate.net/publication/365741066_Industrial_Innovation_Policy_in_the_United_States; David Adler and William B. Bonvillian, *America's Advanced Manufacturing Problem—and How to Fix It*, American Affairs, v. 7, n. 3 (Fall 2023), https://americanaffairsjournal.org/issue/fall-2023

64 Robert Casanova, "The CHIPS Act Has Already Sparked $200 Billion in Private Investments for U.S. Semiconductor Production," Semiconductor Industry Association (Dec. 14, 2022), https://www.semiconductors.org/the-chips-act-has-already-sparked-200-billion-in-private-investments-for-u-s-semiconductor-production

65 U.S. Department of the Treasury, FiscalData, "What is the national deficit?" (accessed January 10, 2024), https://fiscaldata.treasury.gov/americas-finance-guide/national-deficit

66 *See* John Halpin, "What's the Point? Americans Support the *CHIPS and Science Act*," Center for American Progress Action Fund (Aug. 19, 2022), https://www.americanprogressaction.org/article/whats-the-point-americans-support-the-chips-and-science-act ("Hopefully, this legislation can become a model for bipartisan federal efforts to improve America's economy and create good jobs for workers and their families."); Congressman Ro Khanna, who led the Endless Frontier Act in the House, has proposed: "Let's have a CHIPS act for aluminum, for steel, for paper, for microelectronics, for advanced auto parts and for climate technologies." Press Release, Office of Congressman Ro Khanna (D-CA), "Khanna delivers remarks on rebalancing China with a new economic patriotism" (Apr. 24, 2023), https://khanna.house.gov/media/press-releases/khanna-delivers-remarks-rebalancing-china-new-economic-patriotism

67 Gerard DiPippo et al., "Red Ink: Estimating Chinese Industrial Policy Spending in Comparative Perspective," Center for Strategic and International Studies (May 23, 2022), https://www.csis.org/analysis/red-ink-estimating-chinese-industrial-policy-spending-comparative-perspective

68 Matt Hourihan, "CHIPS and Science: FY24 Research Appropriations Short by Over $7 Billion," Federation of American Scientists (Oct. 3, 2023), https://fas.org/publication/fy24-chips-short-7-billion/

69 *See*, e.g., Laura Colton, President, The Science Coalition, Commentary, *To Win in the 21st Century, the 118th Congress Must Act on Science*, The Well News (Mar. 21, 2023), https://www.thewellnews.com/opinions/to-win-in-the-21st-century-the-118th-congress-must-act-on-science ("Leaders in both the House and Senate must work together this year to finalize an appropriations package that allocates new federal money to keep American science at the forefront. The next century of discovery depends on it."); Science & Technology Action Committee, "STAC's Statement on the One Year Anniversary of the *CHIPS and Science Act*," (Aug. 9, 2023) ("Now, both sides of the aisle must continue that great collaboration to unleash the full potential of the law they so diligently worked on to pass."), https://sciencetechaction.org/news-item/stacs-statement-on-the-one-year-anniversary-of-the-chips-and-science-act/

70 David Adler & William B. Bonvillian, *America's Advanced Manufacturing Problem—and How to Fix It*, American Affairs, v. 7, n. 3 (Fall 2023), https://americanaffairsjournal.org/issue/fall-2023

71 David Adler, *Inside Operation Warp Speed: A New Model for Industrial Policy*, American Affairs v. 5, n. 2 (Summer 2021), https://americanaffairsjournal.org/2021/05/inside-operation-warp-speed-a-new-model-for-industrial-policy/

72 Department of Energy, Loan Programs Office, "Inflation Reduction Act of 2022," https://www.energy.gov/lpo/inflation-reduction-act-2022

73 Press Release, The White House, "The Biden-Harris Plan to Revitalize American Manufacturing and Secure Critical Supply Chains in 2022" (Feb. 24, 2022), https://www.whitehouse.gov/briefing-room/statements-releases/2022/02/24/the-biden-harris-plan-to-revitalize-american-manufacturing-and-secure-critical-supply-chains-in-2022

74 C. Todd Lopez, *New Defense Office Connects Next-Gen Tech Developers With Much-Needed Capital*, U.S. Department of Defense, DOD News (Dec. 1, 2022), https://www.defense.gov/News/News-Stories/Article/Article/3233894/new-defense-office-connects-next-gen-tech-developers-with-much-needed-capital/

75 Chris Teale, *Regardless of Political Leaning, at Least 3 in 5 Voters Back Government Help for U.S. Chipmaking*, Morning Consult (Mar. 20, 2022), https://pro.morningconsult.com/instant-intel/domestic-chipmaking-subsidies-survey; Research!America, "Survey Shows Strong Bipartisan Support for Investing in Research" (Feb. 2, 2023), https://www.researchamerica.org/press-releases-statements/survey-shows-strong-bipartisan-support-for-investing-in-research/

76 As a result, many lawmakers are likely to support industrial policy efforts only when their party holds power. This is especially the case for congressional Republicans, many of whom are loath to provide votes for any additional investments in domestic production capacity that President Biden can claim as accomplishments in his re-election campaign.

77 Yuka Hayashi, *Trump Is Primed for a Trade War in a Second Term, Calling for 'Eye-for-Eye' Tariffs*, Wall Street Journal(Dec. 26, 2023), https://www.wsj.com/politics/elections/trump-is-primed-for-a-trade-war-in-a-second-term-calling-for-eye-for-eye-tariffs-aff5bec5?mod=hp_lead_pos6; Rintaro Tobita, Trump will raise China tariffs if he wins White House: ex-USTR, Nikkei Asia (Aug. 6, 2023), https://asia.nikkei.com/Politics/International-relations/US-China-tensions/Trump-will-raise-China-tariffs-if-he-wins-White-House-ex-USTR; Donald J. Trump for President 2024, "President Trump Will Stop China From Owning America," https://www.donaldjtrump.com/agenda47/president-trump-will-stop-china-from-owning-america

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