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Industrial Innovation Policy in the United States

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ABSTRACT

Despite longstanding opposition from mainstream economists to industrial policy, in the period of 2020–2021 the United States, confronted by advanced technology competition from China, the demands of climate change, and the need to respond to a global pandemic, adopted a series of major industrial policy programs. Although the U.S. Defense Department has long practiced industrial policy approaches, and the U.S. has followed industrial *economic* policies in its agriculture, transportation, electric power and healthcare sectors, the new programs focused on promoting technology innovation, so can be labled "industrial *innovation* policy." The large scale of these efforts amounted to a new step for the U.S. in non-defense sectors.

There is history behind this step. Contrasting Hamiltonian and Jacksonian economic views anticipated this industrial policy debate. While during World War II the U.S. entered into a highly connected set of industrial innovation policies, linking industry, universities and government for technologies like radar, electronics and nuclear energy, it departed from this approach in the immediate postwar. Vannevar Bush, the architect of postwar science organization, backed a linear model, combining federal support for basic research

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with a supposition that industry would manage the subsequent technology implementation. This position came under fire in the 1980s from critics like Donald Stokes as U.S. manufacturing declined with the rise of Japan's quality manufacturing model, which was backed by government industrial coordination and support. Gradually, the U.S. began retreating from a basic research-only approach in non-defense areas through a series of policies. These included, in the 1980s a response to Japan's quality manufacturing model, then starting in the 2000s a response to climate change through a reorganization of energy programs, and then after 2012 in response to China's manufacturing advances the adoption of advanced manufacturing policies.

Although the definition of industrial policy is debated, with some arguing it should serve social needs versus specific technology advances, this study adopts a more straightforward definition. Industrial innovation policy involves governmental intervention in one or more of the post-research innovation stages, from development to prototyping to production, to further technology innovation. The study reviews in detail six major examples of new U.S. industrial innovation policies adopted between 2020 and 2022: Operation Warp Speed for coronavirus pandemic vaccines; the CHIPS Act to restore U.S. semiconductor leadership; the Infrastructure Act of 2021, with its major support for new energy technology development; the Inflation Reduction Act, with its impetus for implementation of new energy technologies; the Biden Administration's Assuring Domestic Supply Chains initiative, and the Endless Frontier/CHIPS and Science Act, with its support for applied development of critical technologies and regional innovation. All adopt an industrial innovation policy approach.

These take different approaches. Operation Warp Speed, for example was more "top down," with government selecting

then supporting a series of companies to develop four different vaccine platforms. Tesla was an example of a "bottom up" approach, with government creating a range of technology incentives which companies – in this case Tesla – could systematically apply to electric vehicle development. However, there remain major gaps in U.S. industrial innovation efforts in scale-up financing, advanced manufacturing support and cross-agency coordination. The scale of China's extensive industrial financing policies offers a useful comparison to U.S. scale up efforts. Overall, the study reviews in detail the need for the U.S. to adopt a new kind of infrastructure and accompanying operational mechanisms in order to make its new industrial innovation policies work. These include: rebuilding manufacturing foundations; testing and demonstration capability; mapping supply chains; technology certification; better integration between industries, universities and government; technology scale up support; application of government procurement; and use of flexible contracting mechanisms.

1

The Early Historical Context

Industrial policy has long been taboo in the United States outside its defense sector. Yet the federal government is now pursuing a series of new industrial policies at a level not tried before.[1] This effort has been driven politically, largely on a bipartisan basis, by concern over China's extensive industrial policy system, which has enabled it to surpass the United States as the world's leading industrial power. China is also starting to out-invest the United States, long the leader, in overall research and development (R&D) and in critical technologies, directly taking on a role that has been central to U.S. innovation and, therefore, economic growth and national security. Growing concern about climate change has also been a major driver for these new policies, as has the Covid-19 pandemic, particularly during 2020–2021.

This study first places these new policy approaches into an historical context both in the postwar and in a series of subsequent periods, particularly emphasizing industrial policy approaches to the innovation system. It then reviews the definitional and economic debates over industrial policy. It next catalogs and summarizes the current main thrusts of new U.S. industrial policy efforts, and describes the major

[1] This work is drawn from Bonvillian (2021b).

elements, as well as gaps in these approaches. In particular, it notes the critical gap in the U.S. for scale-up funding for moving new technologies into production, comparing this to China's system of industrial support. The study also notes varieties of industrial innovation policies, characterizing "top down" and "bottom up" approaches. Finally, it reviews the new mechanisms and supporting infrastructure needed to make industrial policy approaches operational.

Like many innovation topics, this one starts with Alexander Hamilton. The first American leader – as the first Treasury Secretary - to back a federal role in industrial policy,[2] in his report on manufacturing to Congress[3] and subsequent work[4] he advocated nurturing American industries through protectionist tariffs and direct support of industry. Later, he joined President George Washington in supporting government-owned industries through creation of military arsenals to produce weapons for the army.[5] Hamilton's tariff-based trade policies became a mainstay of federal government industrial policy for more than a century. The system of military arsenals was expanded a few years later to include government-owned shipyards that built the early American Navy. The arsenals and shipyards marked the federal use of a defense justification for industrial policy. The arsenals at Harpers Ferry, West Virginia and Springfield, Massachusetts subsequently developed the first system of interchangeable machine-made parts in making muskets; this system spread across early factories in the northeast in the 1840s and was a critical step in enabling American mass production.[6]

But Hamilton's plans were opposed by agriculture-oriented southerners led by Jefferson and Madison, and more direct support of civilian sector manufacturing was not taken up by the federal government. Instead, Hamilton launched this branch of his industrial policy approach not through federal but through state support to a corporation developing waterpower at the Passaic Falls in Patterson, New Jersey, which

[2] See generally, Bonvillian and Singer (2018).
[3] Hamilton (1791).
[4] Hamilton (1792). See generally, National Academies of Sciences (2019).
[5] Smith (1973, 1977).
[6] Summarized in Bonvillian and Singer (2018, pp. 18–21).

supported a network of factories built around that power source.[7] These patterns of federal support for industrial policy – support for trade policy and for military R&D and industrial facilities, but not for direct civilian sector industry involvement – proved long-lasting.

There are other historical currents, as well, for understanding American attitudes to industrial policy. Hamilton's Federalist party evolved into the Whig Party in the 1830s, and it backed an agenda of government support for "internal improvements" – canals, roads, railroads – at both the federal and state level, as well as a central bank to promote sound fiscal policy. To entice investment into these improvements, states often bestowed monopoly rights on the risk-takers; these tended to go to established figures from the monied classes. The Whigs were fought by President Andrew Jackson's Democrats who favored democratic egalitarian ideals, closed the central back as a hallmark of privilege, and sought to end government monopolies in favor of all-out, unfettered competition.[8] Corporations evolved by the mid-19th century, at first in part as a way for government to charter and manage infrastructure projects for public needs, such as steamship routes or railroad segments. But the corporate model took off, shaking off its connection to government limits in the second half of the 19th century, particularly with the rise of railroads. Federal subsidies for infrastructure grew with the transcontinental railroad acts at the same time that corporate power expanded. This initiated another generation of battles against unfettered corporate power through anti-monopoly and regulatory movements toward the end of the century. In this period the roles switched: corporations took up Jacksonian era views against government controls while populists shifted to support of them, including antitrust laws[9] Both Hamiltonian and Jacksonian attitudes survive today in attitudes to a governmental role in industrial policy.

The next noteworthy stage of federal industrial policies involved efforts by Herbert Hoover as Commerce Secretary in the 1920s who feared that unfettered competition limited companies' investment in

[7] See NJCDC (n.d.) and Wikipedia (n.d.).
[8] See, for example, Stiles (2009, pp. 91–136).
[9] Stiles (2009, pp. 438–473).

innovation. His policies included collaboration by industry in undertaking research and development and a major role by the Department of Commerce in supporting industry-wide technology standards.

During the Second World War, Vannevar Bush, as Franklin Roosevelt's science advisor, led the creation of a highly connected system for technology advance. His approach enabled the federally-funded research university to be initiated at scale, and these universities were closely linked to industry, the military, and government agencies. Federally funded R&D centers (later called FFRDCs) were created as well, and these elements led to critical wartime technology advances at the Rad Lab at MIT for radar and the Manhattan Project for nuclear weapons. It was an intense system of industrial policy designed by Bush and other technology leaders to win the war. Immediately following the war, Bush led the dismantling of much of this extremely successful "connected" system. The title of his policy tract, *Science, the Endless Frontier* was designed to appeal to the American sense that opportunity beckons at the frontier. In it, he recommended to President Truman a focus on basic research within a disconnected system.[10]

Why? With the war machine being dismantled in the expectation of world peace, Bush likely was trying to salvage some parts of the system. He saw the power of the federally funded research university and advocated federal support for basic research that could sustain that creation. Basic research is far cheaper than applied development, and he likely thought the government could still support that basic stage amid the postwar cutbacks. He also was concerned that science, like Icarus, was "moving too close to the sun"—science had become too tied to government, with all its intense political and military power, and he wanted to shield it, reclaim its independence. Bush, as discussed, advocated what was later called the "pipeline model" for innovation, with early-stage research as the federal input into the pipeline, with the later pipeline inputs relying on industry. The model disconnected the actors in that innovation system. Like with Humpty Dumpty, the United States has never fully managed to put the pieces together again.

[10] Bush (1945).

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